Annual Review of Cybertherapy and Telemedicine

Volume 7 Year 2009 ISSN: 1554-8716

Advanced Technologies in the Behavioral Social and Neurosciences

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Interactive Media Institute

Annual Review of Cybertherapy and Telemedicine

Advanced Technologies in the Behavioral Social and Neurosciences

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Volume 7

Interactive Media Institute

Annual Review of CyberTherapy and Telemedicine

 Interactive Media Institute
6155 Cornerstone Court East
San Diego, CA 92121, USA

ISBN: 1554-8716

Journal Web site: http://www.arctt.info
IMI Web site: http://www.interactivemediainstitute.com

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Annual Review of CyberTherapy and Telemedicine (ARCTT – ISSN: 1554-8716) is published annually (once per year) by the Interactive Media Institute (IMI), a 501c3 non profit organization, dedicated to incorporating interdisciplinary researchers from around the world to create, test, and develop clinical protocols for the medical and psychological community. IMI realizes that the mind and body work in concert to affect quality of life in individuals and works to develop technology that can be effectively used to improve the standards and reduce the cost of healthcare delivery.

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

Cybertherapy - the provision of healthcare services using advanced technologies - can help improve the lives of many of us, both patients and health professionals, while tackling the challenges to healthcare systems.

Despite the potential of cybertherapy, its benefits and the technical maturity of the applications, the use of cybertherapy services is still limited, and the market remains highly fragmented. Although many countries – including USA, Europe, Korea and Japan - have expressed their commitment to wider deployment of cybertherapy, most cybertherapy initiatives are no more than one-off, small-scale projects that are not integrated into healthcare systems.

It is recognised that integrating these new types of services in healthcare systems is a challenging task. The aim of this volume is to support and encourage all the interested countries in this endeavour, by identifying and helping to address the main barriers hindering the wider use of cybertherapy and by providing evidence to build trust and acceptance.

Healthcare systems focus on meeting the needs of patients. Achieving cybertherapy's potential, therefore, depends on patients being convinced of its ability to satisfy their healthcare needs. Acceptance by patients depends crucially on acceptance by the health professionals treating them, given the high degree of trust the former place in the latter. An important factor for ensuring the confidence and acceptance of health professionals is enhanced dissemination of the evidence base regarding the effectiveness of cybertherapy services, their safety features and user-friendliness.

For the complexity of this goal, we have put a great deal of effort in the definition of the structure of the volume and in the sequence of the contributions, so that those in search of a specific reading path will be rewarded. To this end we have divided the different chapters in four main Sections:

1. **Critical Reviews**: They summarize and evaluate emerging cybertherapy topics, including Interreality, CyberAddiction and Telemedicine;
2. **Evaluation Studies**: They are generally undertaken to solve some specific practical problems and yield decisions about the value of cybertherapy interventions;
3. **Original Research**: They presents research studies addressing new cybertherapy methods or approaches;
4. **Clinical Observations**: They include case studies or research protocols with a long-term potential.

Each chapter begins with a brief abstract, helping the readers in identifying the relationships among its sections.

For both health professionals and patients, the selected contents will play an important

role in ensuring that the necessary skills and familiarity with the tools are present, as well as a fair understanding of the context of interaction in which they are operated.

Although some cybertherapy services have existed for a long time and most of the ICT has been in place for a while, the chapters underline different areas where technical and social and ethical issues need to be addressed.

Broadband access and the ability of providers to enable full connectivity is a prerequisite for the deployment of many cybertherapy and telemedicine applications.

Interoperability and standardisation are crucial to allow widespread use of the technologies, to enable them to benefit from the single market and to contribute to its completion. Use of existing standards and adoption of new standards and standardised approaches to achieve interoperability should be supported by standards development organisations, with the active participation of industry.

Trust and confidence in new and innovative technologies and ICT-based services within the health sector need to be built through rigorous testing, agreed standards and a widely accepted certification process. Unfortunately, this is a difficult process that requires time and money. In particular, as underlined by the fourth Section of the volume, there are many good ideas and protocols that still need further tuning and research. Promising research areas consist of treatment of addictions, depression, attention deficit disorder, stress management, and social skills training.

In conclusion, this volume underlines how cybertherapy has made initial progress in treating a variety of mental health disorders, but there is more work to be done in a number of areas including the development of easy to use and more affordable hardware and software, the development of objective measurement tools, the issue of side effects for some patients, and more controlled studies to evaluate the strength of cybertherapy in comparison to traditional therapies.

Wider dissemination of the technology will encourage the industry to develop tools in response to user needs. Web-based resources for cybertherapy practitioners are currently available and are in continuous development. Input on such topics as clinical protocols, equipment updates and purchases, ethical issues, and the newest research findings will be soon easily accessed using the Internet.

We are also grateful to Alessandra Gorini, Daniel Stevens, Federica Pallavicini and Tatiana Hulko for their work in collecting and coordinating chapters for this volume.

We sincerely hope that you will find this year's volume to be a fascinating and intellectually stimulating read. We continue to believe that together we can change the face of healthcare.

Brenda K. Wiederhold *Giuseppe Riva*

SECTION I

CRITICAL REVIEWS

In general, there are two reasons why cybertherapy is used: either because there is no alternative, or because it is in some sense better than traditional medicine.

In this sense telehealth has been used very successfully for optimizing health services delivery to people who are isolated due to social and physical boundaries and limitations.

Nevertheless, the benefits of cybertherapy, due to the variety of its applications and their uneven development, are not self-evident.

However, the emergence of cybertherapy is supporting the cost-effectiveness of certain applications, such as assessment, rehabilitation and therapy in clinical psychology and neuroscience.

Wiederhold & Riva, 2004

Interreality: A New Paradigm for E-health

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Abstract. "Interreality" is a personalized immersive e-therapy whose main novelty is a hybrid, closed-loop empowering experience bridging physical and virtual worlds. The main feature of interreality is a twofold link between the virtual and the real world: (a) behavior in the physical world influences the experience in the virtual one; (b) behavior in the virtual world influences the experience in the real one. This is achieved through: (1) 3D Shared Virtual Worlds: role-playing experiences in which one or more users interact with one another within a 3D world; (2) Bio and Activity Sensors (From the Real to the Virtual World): They are used to track the emotional/health/activity status of the user and to influence his/her experience in the virtual world (aspect, activity and access); (3) Mobile Internet Appliances (From the Virtual to the Real One): In interreality, the social and individual user activity in the virtual world has a direct link with the users' life through a mobile phone/digital assistant. The different technologies that are involved in the interreality vision and its clinical rationale are addressed and discussed.

Keywords: Interreality, Virtual Reality, Biosensors, Mobile Internet Appliances

Introduction

The aim of the present paper is to introduce and discuss "***interreality***" [1, 2], a personalized immersive e-therapy whose main novelty is the creation of a hybrid, closed-loop, empowering experience bridging both the physical and virtual worlds. The main feature of interreality is a twofold link between the virtual and the real world:

- *Behavior in the physical world influences the experience in the virtual world.* For example:
  - If my emotional regulation during the day was poor, some new experiences in the virtual world will be unlocked to address this issue.
  - If my emotional regulation was okay, the virtual experience will focus on a different issue.
- *Behavior in the virtual world influences the experience in the real world*. For example:
  - If I participate in the virtual support group I can SMS during the day with the other participants.
  - If my coping skills in the virtual world were poor, the decision support system will increase the chance of possible warnings in real life and will provide additional homework assignments.

In the next pages, we will present the different technologies that are involved in the interreality vision and will justify its clinical rationale.

1. The Technology

The bridge between the real and the virtual world is achieved using the following technologies (see Figure 1):

- **3D Individual and/or Shared Virtual Worlds (3DWs)**: immersive (in the health care center) or non-immersive (at home) role-playing experiences in which one or more users interact with one another within a 3D world. A 3DW enables its users to interact with each other through motional avatars, providing an advanced level of a social network service combined with general aspects of fully immersive 3D virtual spaces. Residents can explore, meet other users, socialize, and participate in individual and group activities.

Figure 1: The technology used in the Interreality approach

- **Personal Biomonitoring System (From the Real World to the Virtual World)**: typically 3DWs are closed worlds and do not reflect in any way the real activity and status of the users. In Interreality, instead, bio and activity sensors (Personal Biomonitoring System – PBS) are used to track the emotional/health status of the user and to influence his/her experience in the virtual world (aspect, activity and access). The link between the real and virtual worlds will be both in real-time - allowing the development of advanced dynamic biofeedback settings - or not, to ensure health tracking also in situations where an Internet connection is not immediately available.
- **Mobile Internet Appliances (From the Virtual to the Real One):** In interreality, the social and individual user activity in the virtual world has a direct link with the users' life through a mobile phone/digital assistant [3].
    - *Follow-up (warnings and/or feedbacks)*: it is possible to assess/improve the outcome of the virtual experience through the PDA/Phone, eventually also using the info coming from the bio and activity sensors.
    - *Training/Homework*: thanks to the advanced graphic/communication capabilities now available on PDAs/Smarthphone, they can be used as training/simulation devices to facilitate the real-world transfer of the knowledge acquired in the virtual world.
    - *Community*: the social links created in the virtual world can be continued in the real world even without revealing the real identity of the user.

2. The clinical use of interreality

2.1. The limits of Cognitive Behavioral Therapy

Cognitive Behavioral Therapy (CBT) is a psychotherapeutic approach that aims to influence dysfunctional emotions, behaviors, and cognitions through a goal-oriented, systematic procedure [4].

CBT has been proven to cure or significantly improve several psychological disorders such as depression, anxiety, and eating disorders [4]. CBT is significantly more effective, on average, than without treatment or other psychological therapies, and is at least as effective as medication. The American Psychiatric Association (APA) recommends CBT programs as the treatment of choice for several mental disorders, including anxiety disorders, major depression, and eating disorders, among others [5-7].

However, despite these promising findings, there are still limitations on the availability of these treatments, and not all the individuals who suffer from a mental disorder get to benefit from such programs.

Some mental health practitioners find it difficult to apply empirically validated programs, an important set of patients find it difficult or refuse seeking such help, or there are high non-acceptance rates of CBT and some therapeutic strategies are difficult to automate in these programs.

Some researchers think that it is the patient's relationship with the counselor and their motivation that determines the chances of success as much as the therapy itself. Professor Mick Cooper, an expert in counseling at the University of Strathclyde, said it was "scientifically irresponsible" to imply that CBT was more effective than other therapies [8]. Forms of treatment such as person centered and psychodynamic therapy

could be equally effective and were backed by small but substantial bodies of evidence. CBT may be like putting a sticking plaster on a problem rather than getting to the root of the problem, he said. So, although the efficacy of CBT has been widely demonstrated, there is still room for improvement.

2.2. The advantages offered by Interreality

CBT has undergone a very large number of trials in research contexts. However it has been less efficacious in clinical contexts and it has become obvious that CBT has some failings when applied in general practice. For this reason, the Interreality approach tries to improve three critical limitation of CBT:

- *the therapist is less relevant than the specific protocol used;*
- *the focus of the therapy is more on the top-down model of change than on the bottom-up;*
- *the protocol is not customized to the specific characteristics of the patient.*

By creating a bridge between virtual and real worlds, Interreality allows a full-time closed-loop approach actually missing in current traditional Cognitive Behavioral Therapy (CBT) regimens. In Interreality:

- *the assessment is conducted continuously throughout the virtual and real world experiences*: Interreality enables tracking of individuals' psycho-physiological status over time in the context of a realistic task challenge;
- *the information is continuously used to improve and update the overall treatment protocol both within and between sessions*: Interreality creates a conditioned association between effective performance state and task execution behaviors;
- *the patient is the center of the therapy*: Interreality uses bio and activity sensors and devices (e.g., PDAs, mobile phones) to track both the behavior and the health status of the user in real time and to provide targeted suggestions and guidelines.

Finally the sense of "presence" [9] allowed by this approach affords the opportunity to deliver behavioral, emotional and physiological self-regulation training in an entertaining and motivating fashion [10]: in Interreality the patients do not receive abstract guidelines but live meaningful experiences in which they can start to explore and act without actually feeling threatened. Nothing the patient fears can "really" happen to them in virtual reality. With such assurance, they can freely explore, experiment, feel, live and experience feelings and/or thoughts. Experience shows us that this allows the patient to "push the envelope" and try harder knowing they have the safety net of the virtual world to "catch them". This empowerment speeds their progress and growth, and leads to their increased self-efficacy.

3. Conclusions

The clinical use of Interreality is based on a closed-loop concept that involves the use of technology for assessing, adjusting and/or modulating the emotional regulation of the patient, his/her coping skills and appraisal of the environment (both virtual, under the control of a clinicians, and real, facing actual stimuli) based upon a comparison of

that patient's behavioral and physiological responses with a baseline or performance criterion:

- the assessment is conducted continuously throughout the virtual and real experiences;
- the information is constantly used to improve both the appraisal and the coping skills of the patient;

The advantages offered by this approach to traditional e-therapy are the following:

- *an extended sense of presence*: Interreality uses hybrid social interaction and dynamics of group sessions to provide each users with targeted – but also anonymous, if required - social support in both physical and virtual world.
- *a real-time feedback between physical and virtual worlds*: Interreality uses bio and activity sensors and devices (PDAs, Mobile Phones, etc) both to track in real time the behavior and the health status of the user and to provide targeted suggestions and guidelines.

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Eating Disorders on the Web: Risks and Resources

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Abstract. Our work is aimed at exploring the recent literature data on web sites, forums, and blogs, which promote eating disorders as normal life styles and their implication in the changes of the psychopatology of such disorders. We also want to understand whether new technologies have an impact in the course of the disorders or, on the other hand, whether they can also represent an instrument for searching help or information about them. The search strategy included a search of PsycINFO, Medline, and Ovid databases to identify research reports about pro-ana sites and their implication on the course of anorexia using the following key words: pro-ana, thinspiration, anorexia-web, online help eating disorders, anorexia nation.

Keywords. Eating disorders, Internet, pro-ana web sites.

Introduction

Among the risk factors for eating disorders the role of cultural influences coming from mass media has been widely described [1,4]. The links between eating disorders and new technologies show the cultural influences and the changes of the psychopathology of these disorders, which are accompanied by changes of individual and collective perception about the inner representation of food, body image, and individual wishes.

Western society is characterized by the cultural pressure towards the values of performing and being efficacious. Body image and the current ideal of pursued thinness as a value has progressively become an important mediator of one's own identity and is often promoted by media. The perception and the acceptance of the ideal female body type have changed throughout history [2]; twenty-five years ago the average fashion model was 8% thinner than the average woman. Today that number has risen to 23% [3]. In western countries' television, advertisements and the Internet describe models as being thin and "perfect," which are difficult to reach [4]. In a study carried out by Becker and colleagues, it has been shown that there was an increase in the incidence of eating disorders after the introduction of the television into the Fijians population [5].

Today it seems important to evaluate the role played in eating disorders by the Internet, starting from the observation of the diffusion of "*pro-ana*" web sites. Recently, blogs promoting anorexic and bulimic behaviors as a healthy and a sharable lifestyle have been spreading. Moreover, there are many web sites and forums in existence that promote the awareness and support a call for help [6]. The pro-anorexia movement promotes anorexic behaviors as normal and an acceptable ideology of life [7,8]. The

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Internet could perhaps represent the most powerful media or influence, due to its peculiar ability to virtually connect people to each other by means of chat, blogs, and social network; these create virtual spaces to share culture, interests, and emotions. In some circumstances the Internet can, on the other hand, ease the risk to create closed and selfish communities in which deviant behaviors can be promoted and incentivized. It has been showed that the Internet can influence and promote dysfunctional behaviors such as drug seeking, smoking, self-injury, and suicide- especially among adolescents [15]. Some authors have argued that *pro-ana* web sites can have an impact on the incidence and on the course of eating disorders [1, 6, 7, 8, 9, 10, 15, 16, 20, 21, 22, 23, 25].

1. Method

The purpose of this review is to evaluate recent literature data concerning the studies, which explore the impact of the web sites promoting eating disorder-related behaviors. It also reviews the impact of the websites, which offer information and help about eating disorders in order to evaluate the link between new technologies and eating disorders psychopathology. We conducted an electronic research using the most popular search sites such as PsycINFO, Medline, and Ovid databases, using the following key words: pro-ana, thinspiration, anorexia-web, online help eating disorders, anorexic nation.

2. Results

According to Abbate Daga and colleagues (2006), there are at least 300,000 websites promoting anorexic behaviors (257.000 “pro-anorexia”, 18.600 “pro-ana”, 14.200 “thinspiration”, 577 “anorexic-nation”) [6]. Almost all the webmasters are female; often adolescents and someone who has reported a previous history of depression or self-harm attempts [9]. Websites promoting recovery from eating disorders are less numerous [10]. The latter usually includes posts about personal experiences, links to professional sites, forums, and pages concerning eating disorders, but often the quality of information is less than excellent. As well as *pro-ana* users, pro-recovery visitors are characterized by a similar need of sharing and understanding; they often feel the virtual forum is more supportive than traditional therapy. The value of professional help in recovery is conditioned by the sufferer of an eating disorder’s own willingness to change [11]. While pro-recovery sites support the initial phases of recovery, they may impede the process at later stages [12].

The philosophy of *pro-ana* websites does not use the medical model of anorexia as a pathological condition or within the claim of an anorexic identity, which expresses values of power, success, and beauty. Despite the fact that the *pro-ana* philosophy is based on the refusal of the conceptualization of anorexia as a mental disease, several sites present themselves as supporting means for individuals affected by eating disorders, while only few of them clearly state that anorexia is a sharable lifestyle choice [9]. Ana represents the personification of the ideal of beauty and control, users refer to Ana calling it “she” and almost all sites are full of “letters from Ana.” *Pro-ana* members are invited to establish a blood pact “with her”. In comparison with pro-recovery sites, pro-anorexic ones are characterized by a rationalization of the

pathological eating behaviors and by an idealized perception of thinness and of the practices to lose weight. From a linguistic perspective, *pro-ana* sites display more positive emotions, lower anxiety, and lower worries concerning school and the severe consequences of fasting such as death; the use of verbal tense, shows that they are more focused on the present than on the past or the future, more worried about weight gain and, obviously, less aware of the disorder, as evidenced by a limited use of cognitive mechanism words, specifically insight words [13]. Focusing on the body, on the food, and on extreme physical exercise prevents subjects affected by eating disorders from facing the deep, depressive experiences, which are not easily managed and controlled. The chance to share internal experiences and behaviors makes the community a special place where the individual is sure to be understood and comforted. All this, once again, determines a strong underestimation of the true risks of the anorexic behaviors, which are, on the contrary, normalized and justified [14].

Pro-ana sites share some features in common [9, 14]. The section called *thinspirations* usually shows motivational quotes and the images of thin and emaciated women, especially celebrities (often modified by graphic editing programs) in order to support the adherence to *pro-ana* ideal and to motivate further weight loss [15, 16]. A thematic analysis of *pro-ana* (n=12) websites identified several prevalent themes including control, strength, and perfection. Weight loss is conceived as the only way to achieve success and control, while thinness represents the ideal of perfection. Religious metaphors are also very common, as it is described by the Ana Psalm entitled *Commandments and Creed*, as well as the use of words such as "sacrifice," "transformation," and "ideal" [9]. The ideal of *thinspiration* can become a compensatory function towards an inner experience of inadequacy in order to face the several requests of the post-modern society. *Thinspiration* expresses ideals of self-sufficiency omnipotent control of hunger. The exercise of controlling the body with eating and the interpersonal relationships, allow the subject to experience oneself as being autonomous, skilled, and worthy so they can compensate their internal experiences of inadequacy and of low self-esteem [8].

Newsletters, posts, and chats are the ways in which *pro-ana* groups provide social support to their members; they can keep constantly in touch with each other, the users describe themselves as isolated and stigmatised by others, and websites allow them to be supported and appreciated in their pathological behaviors. As Giles underlines, frequent attacks on websites in the media and by occasional hostile site visitors, often force the community into a defensive attitude which strengths its sense of identity [17]. An analysis of the content of *pro-ana* posts, in fact, indicate that pro-anorexic identities are normalized and strengthened by the normalization of participants' *pro-ana* thoughts and behaviors as well as by the group bonds created through the sharing of a secret identity [18,19].

"Tips and tricks" are maybe the most dangerous features of these sites because they promote fasting and the use of laxatives, complimentary, and alternative medicines [9, 20]. As observed by a systematic review of this section, the most frequent tips concern "dieting and calories restriction", use of "distraction" to reduce the eating impulse, and tricks for "deceiving" family members and clinicians about anorexic behaviors. Fasting, purging, and vomiting advice is also displayed. "Tips and tricks" induce distorted practices of weight loss, encourage dangerous behaviors for health, and can decrease the effectiveness of diagnosis and treatment of anorexia nervosa [20]. Finally, several sites sell Ana accessories such as the "ana bracelet," which is a symbol to remind the practice of anorexic behaviors and allows the wearer

the ability to identify and recognize other people who adhere to the philosophy; this obviously reinforces the sense of community.

The impact of *pro-ana* sites on the onset and to the course of eating disorders is still controversial [21]. Some studies analyzed the relationship between users of such sites and several measures of positive and negative affects, body images, self-esteem, and self-efficacy in the healthy population. While some have identified an increase of negative affects and a decrease of self-esteem and self-efficacy as potential risk factors for eating disorders in *pro-ana* users [21,23], others suggested that only a good self-efficacy could support the viewers in maintaining their strict eating practice [14]. As reported by two researchers comparing large samples of healthy women viewers with non-viewers of pro-ana sites (n=235, n=1575), the use of *pro-ana* sites is associated with a higher body dissatisfaction and worry of weight gain [23,24]. In the first study, even a single view of those sites has been linked with the expectation of dieting and exercise in the near future [23]. In the second study, visiting *pro-ana* sites predicted higher levels of eating disorders as well as restrictive and bulimic symptoms [24]. Interestingly, in this research, conducted among undergraduate students, the authors did not find significant differences in terms of abnormal eating behaviors between people who visited *pro-ana* sites and those who visited professional eating disorders sites [24]. Further research should better examine this issue, perhaps using larger samples. A study on the impact of *pro-ana* sites of 13-17 year-old students (n=711), reports that people who visited *pro-ana* sites more frequently have a more positive attitude towards *pro-ana* philosophy and have higher scores on several predicting factors of eating disorder such as the drive for thinness and perfectionism. This last association remains, even if the data is controlled for BMI and attitudes toward *pro-ana* philosophy [25]. Only a few studies investigate the relationship between anorexic behavior and *pro-ana* sites in young people suffering from an eating disorder. Wilson and colleagues have carried out a study on a sample of adolescents affected by eating disorders. 40.8% of the patients reported visiting pro-recovery sites and the 35.5% stated that they visited pro-eating disorders sites. Pro-eating disorders site use was correlated with longer disease duration and with less time spent on school-related activities. There was a higher level of hospitalization in adolescents using both *pro-ana* and pro-recovery sites. Most *pro-ana* users reported to have acknowledged new purging techniques and methods to lose weight [15].

3. Conclusion

The diffusion of blogs, web sites, and forums dedicated to anorexic practices can play a role in the course of eating disorders that promote abnormal attitudes towards dieting and restriction techniques while strengthening the identification with movements, which promote anorexia as an acceptable way of life. Clinicians in this field should consider the possible influences of new technologies on the prognosis and on the course of these disorders [15].

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'I' and 'Other' in Online Interactions: Intersubjectivity as a Social Bridge

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Abstract. The aim of this work is to propose Intersubjectivity as a key concept in a social interpretation of online dynamics while studying CyberPsychology and its applications. Dialogue is the inner soul of the Self, considered as "a dynamic multiplicity of voiced positions." The link between the Self and the Others must be considered too. Through dialogue, interlocutors negotiate both ideas and their self-images. Starting from 'single' intentions (a representation of what each participant wants to present outside), interactions support a co-construction of shared and linked images of interlocutors, called Subjectivities. These two or more Subjectivities are the basis of the Intersubjective dimension of an interaction.

Keywords. Intersubjectivity, Self, CMC, Dialogism

Introduction

Every interaction blossoms from the Self, but does not always change it or is totally coherent with it. This is particularly true for mediated interactions: people without the body create new ways to present themselves through language, avatars, icons and so on. A stream of research blossomed around this matter: the goal is to understand how people present themselves, in term of goals, strategies, and tools. Most of these scholars stress negative effects in terms of fragmentation of identity [1]; a question arises: the Self's stability is guaranteed only by the body?

Inner stability is guaranteed by the Dialogical Self [2] which is not a unique, fixed concept, but it's the result of an endless dialogue between different I-positions. Thanks to this dialogue, the individual can reach *a sense of coherence within different situations and roles (positions)*. Outside, each I-position has to discuss also with the Other's I- positions in order to negotiate roles, images or positions in a social context.

1. Subjectivity and Intersubjectivity

In order to understand the role of the external environment (interlocutors, context, etc.) in the evolution of the Self, we propose the concept of Subjectivity [3] and Intersubjectivity. Subjectivity is a fluid and narrowed image proposed to the outside world, a portion of what we are, based on our Self. During each interaction, we

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elaborate an intention based on our I-positions, our beliefs about our Self. This intention is strategically presented considering the interlocutor (in terms of his relevance, past interactions and what it is known about him) and the environment (artifacts and social elements). Its goal is to be understood by the Other and so it changes according to responses given during interactions and on tools offered by the context. The body is one of these tools but in Cyberplace we have cybertools, such as avatars or emoticons. Adaptation is a need in all kind of interactions, because Subjectivity must be understood to be effective. So, the two, or more, Subjectivities are strictly related one to the other, because each of them needs to be understood by the other and was created thanks to the feedbacks of others'. Every social interaction is characterized by a unique combination of subjectivities created in that context at a specific moment, we call this combination Intersubjectivity. The Intersubjective dimension is the real bridge from internal Self and the other; it does not belong to one interlocutor, it belongs to the interaction and it cannot be repeated, because it becomes the starting point for a new negotiation and a new shared meaning during the next meeting [4].

2. Method

In order to understand how Self, Subjectivity, and the Other are related when we consider an Intersubjective dimension, we try to analyze the correlation among three profiles (Self – Subjectivity – Subjectivity as seen by the Other) using a Semantic Differential [5]. This is a first attempt to understand how these elements are related. 61 participants were asked to carry out a task in couples, communicating via an Instant Messaging Service (MSN). At the end of this task, they filled three versions of a semantic differential, describing their Self, their Subjectivity during the experiment and the subjectivity of the interlocutor. From each profile three indexes ('Energy', 'Affectivity' and 'Stability') were calculated. Data was analyzed to verify a possible correlation between indexes.

Our Hypothesis are:

- H1: Subjectivity is significantly correlated to Self
- H2: Subjectivity is significantly correlated to Subjectivity as seen by the other.
- H3: Self and Subjectivity as seen by the other are not significantly correlated

3. Results

Results show that there is a correlation between 'Self' and 'Subjectivity' indexes and between 'Subjectivity' and 'Subjectivity/Other-Version' indexes confirming our Hypothesis.

Correlations between 'Subjectivity' and 'Subjectivity/Other-Version' show a stronger correlation than 'Subjectivity/Subject-Version' and 'Self'. As we supposed, the Self and what we present outside are related, but not too strongly, due to the strategical modeling of the original intention. So the analysis shows significant correlation, even though it never has a value higher than .621. It is not possible to predict how strictly Self and subjectivity may be related, because this link depends

Table 1. Correlation between the three versions of Semantic Differential

	Energy_subjectivity	Affectivity_subjectivity	Stability_subjectivity
Energy_self	0.376**		0.299*
Affectivity_self	0.256*		0.262*
Stability_self		0.611**	0.621**
Energy_other			
Affectivity_other		0.306*	0.613**
Energy_other		0.300*	0.453**

always on external feedbacks. The total absence of any correlation between 'Self and 'Subjectivity/Other-Version' confirms our third Hypothesis; a person can be recognized by the interlocutor even presenting an apparently distorted image through the mediation of subjectivity.

4. Discussion

This work is a first attempt to confirm our theoretical proposal and results confirm that Subjectivity works as a bridge between inner Self and what it is perceived by interlocutors. As for the Dialogical Self, outside fluidity and adaptivity are the keys to coherence and stability. Outside people avoid the risk of fragmentation not because the body always reminds us that we are one, but because only a little part of the Self is exposed to be understood. The possibility to co-construct an effective Intersubjectivity in which subjectivities can be shared and negotiated, as all the other meanings, is more important than the static presentation of a fixed image that fits only with the person's idea of himself. In order to better understand how the negotiation works and the connectivistic nature of Intersubjectivity it would be useful to carry out a conversational analysis, a qualitative method to study conversational mechanisms. These considerations may be a starting point for a development of a new and more complex model about Self.

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An ontology for Cognitive Behavioral Therapy. Application to Obesity

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Abstract. In the last few years the use of medical and biomedical ontologies has increased considerably. It is very common to find applications and semantic webs using this kind of ontologies and a large number of papers have been written explaining why ontologies are useful in these fields. In this paper the use of ontologies for psychology and its benefits is discussed and a first ontology for obesity treatment is presented.

Keywords. Obesity, intelligent e-therapy, ontology, cognitive behavioral therapy

Introduction

Ontologies have become the knowledge representation medium chosen in recent years for a range of science areas including medicine [1], bio-medicine [2], bio-informatics [3], semantic web [4], agents [5], etc. However, until the moment the design of ontologies for psychology is not very common.

The term "ontology" was first defined by T. R. Gruber in 1992 as a "formal specification of a conceptualization," [6] which is "the objects, concepts, and other entities that are presumed to exist in some area of interest and the relationships that hold among them."

It could be very interesting for psychological treatments to use a common vocabulary and to share what other people is doing in different parts of the world. Ontologies provide important advantages such as reusing and sharing knowledge.

The idea is to develop a modular and re-usable *Therapy Knowledge Base (TKB)* that lets the therapists around the world apply Cognitive Behavioral treatments on different patients and with different disorders. For this reason a first ontology on CBT (Cognitive Behavioral Therapy) has been designed. Different ontologies can extend this first design to completion for a concrete therapy; for example, the ontology for obesity has previously been designed.

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1. Methods

The process of designing an ontology is costly enough and, since it needs a previous phase of knowledge extraction, it is an iterative process in which the knowledge of the professionals in the domain (in this case doctors and therapists) is acquired up to coming to a useful, functional, and as specific as possible solution.

A CBT (Cognitive Behavioural Therapy) ontology has already been designed. It is a generic ontology that contains all the concepts and properties included in any cognitive behavioral therapy, which can be extended for any other disorder, adding specific concepts for this disorder.

From this CBT ontology, a new ontology needed to collect all the information related to the obesity system (physiological variables, contextual variables, cognitive variables, etc.) has been designed and developed. In our obesity ontology we can find four main entities:

Agent: Any user of the system is considered as an agent. Each agent has a name, a surname, a login, and a password. We can distinguish three different kinds of agents: patient, relative, or professional. There are also two types of professionals: doctor or psychologist.

A patient is an obesity user that is going to be treated. For each patient lot of data is stored such as: profile, diagnosis, treatment, evaluation, relative, doctor, etc.

Evaluation: This concept represents all the variables under control and measurements obtained from the patient. We have different type of measurements: psychological, obtained from the tests done by the psychologist; physiological, obtained by the doctor; or by a device, connected to the patient and contextually related to the environment of the patient (activity done by the patient, position, etc.).

Treatment: This concept represents the planning done by the psychologist to treat the patient. It also includes the general objectives of the treatment and the monitoring of the patient. A treatment is defined as a set of modules After analyzing the psychological information obtained from the tests initially done to the patient, the psychologist decided the appropriate modules for this patient (not all the patients need all the modules, sometimes is useful to focus only in some specific modules).

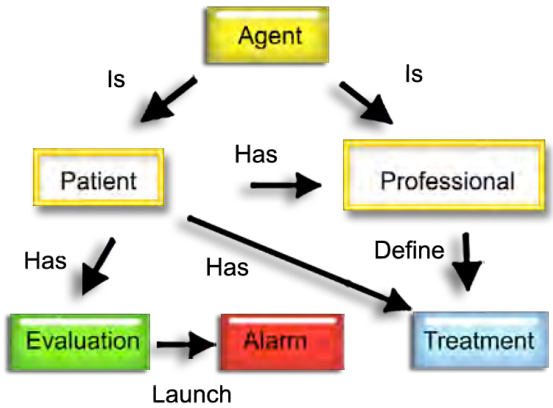

Figure 1. Main entities of obesity ontology

A number of sessions have to be specified for each selected module and for each session specific objectives are defined. A session also has information concerning what is going to be done during this session. In each session, the psychologist defines some tasks that the patient should do during the week. The results of these tasks can be consulted by the psychologist at any moment.

Alarms: This concept represents warnings to the patient or the professional (doctor or psychologist) that a variable under control is out of the allowed range.

2. Conclusions and Discussion

During these last years, obesity problems have increased in an alarming way among the population of all the ages, up to the point of being considered as a new epidemic (the WHO declared obesity in 1998 as a global epidemic). For this reason, an obesity ontology integrated in an obesity intelligent e-therapy has been developed.

Ontologies are very useful to facilitate the automatic reasoning, that is to say, without human intervention. From a few rules of inference, an engine of reasoning can use the information of the ontologies to infer conclusions.

The objective of the obesity intelligent e-therapy is to improve the efficiency of the obesity treatment, since, until recently, the treatments that are being applied for this disorder are not producing adequate results.

Recently, a new concept of psychological therapy has appeared. This new intelligent e-therapy (e-it) adapts itself to the patient's lifestyle, offering a 24/7 monitoring to the patient. E-it can be applied to many disorders, and it is based in a knowledge base that includes all the knowledge related to the disorder and its treatment.

The benefits provided by the use of ontologies, has made ontologies the best design option for the knowledge base of intelligent e-therapy.

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Second Life, Bio-Sensors, and Exposure Therapy for Anxiety Disorders

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Abstract. We give an overview of the Second Life (SL) virtual world, explaining what objects can be manipulated to implement user-defined scenari in SL, and give an example of a work-in-progress scenario of exposure therapy for anxiety disorders, coupled with automatic processing of bio-sensed emotional signals. Both e-Health and emotion recognition researchers can benefit from such experiments.

Keywords. e-Health Interventions, Second Life, Bio-Sensors, Exposure Therapy, Anxiety

Introduction

Research has shown that virtual environments with the ability to digitally recreate the realism of the physical world on a video screen (e.g. on a PC) can play an important role in computer-based psychotherapy [1,2], in addition to their already established popularity as virtual games. The *Second Life virtual environment* [3] has proven to be a particularly promising scientific tool [4]. Second life (SL) is an online virtual world, and a massively multiplayer online game (MMORPG) with an active community of developers and players. SL combines social networking and online gaming, which has evolved in terms of its usage: it started as a platform dominated by teenagers and young adults who used it as a social networking platform, and it now includes a wide variety of uses – ranging from educational facilities that build virtual campuses to give remote lectures (e.g. Univ. Ohio), businesses that have virtual corporate headquarters where they advertise their products (e.g. IBM), and research institutions that explore new ways to experiment with therapeutic and sociological settings [4].

1. An Overview of Second Life

Users who wish to connect to SL need only to download a desktop client for either Mac or PC, called the *SL Viewer*. Once connected, the user chooses an avatar and the SL experience begins. From then on, the user controls the movements and interactions of its **avatar** in the virtual world with the keyboard and mouse. Communication with

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Figure 1. Avatars in classroom created in *Second Life*.

Fig. 2.a GSR2 skin conductance device

Fig. 2.b Pulse Plethysmograph.

other users (via their avatar) occurs either via text or voice. Instant messaging, text, or voice can be used for private chat between two or more SL residents. One of the most important aspects of the SL experience is a user's online identity, manifested in a person's avatar. SL provides both default avatars from which the player can build a specific identity by choosing the avatar's gender and appearance (e.g. body type, facial features). In addition, *templates* can be manipulated with high-end graphic editing programs to fine-tune aspects of the avatar (e.g. curls, irises, body-part textures, fabric). Examples of avatars in a classroom setting are shown in Figure 1. SL is filled with 3D objects, mimicking real world objects created by SL residents (e.g. buildings, houses, rooms, vehicles, animals). Because of its sophisticated graphics and game engine, SL makes it possible to create prototypes of virtual worlds and to design custom-made objects. Actions can be added to objects via scripts written in the SL programming language that can be used to write high-level AI scripts. As explained subsequently, Figure 2 shows the bio-sensors that we use to collect and automatically analyze physiological signals (GSR, HRV) elicited by emotionally loaded stimuli [5].

2. Exposure Therapy for Children with Anxiety Disorders

Exposure therapy is a psychotherapeutic intervention that exposes the patient to feared situations and objects, found to be effective in the reduction of phobic and anxious symptomatology (e.g. phobias, anxiety disorder, Post-Traumatic Stress Disorder (PTSD) [1,6]. The principle is to slowly increase the level of intensity of the feared stimuli over multiple sessions, with the goal to slowly desensitize the patient to the stimuli by developing strong expectations of successful outcomes in the recreated situation (e.g. the student delivers successful oral presentations). Until recently, clinical psychologists 'exposed' patients by either asking patients to recreate feared situations in their *imagination*, or by working *in vivo* with a real life situations. Although exposure has proven useful for a variety of mental disorders, it has limitations: patients greatly vary in their ability to generate mental imagery, and working in vivo remains

Table 1. Fear Hierarchy for Agoraphobia

Feared Situation	Fear
School cafeteria	7
Classroom	7
Movie theaters	6
Waiting in line at store	6
Public transportation (e.g. train)	5
Restaurants	5
Church or temple	4
Stores or malls	4

Table 2. Fear Hierarchy for Social Situations

Feared Situation	Fear
Oral reports/reading aloud	8
Asking the teacher a question	7
Asking the teacher for help	6
Working or playing with a group of kids	6
Starting or joining a conversation (w/ classmates)	6
Inviting a friend to get together	5
Writing on the chalkboard	5
Walking in the hallways	4

difficult to control and to reproduce. The appeal of using virtual environments to simulate specific situations crafted for a specific user is an attempt to approach these limitations. We used *fear hierarchies* that appear to reoccur in children with anxiety disorders, shown in Tables 1 and 2 [6]: the feared situation is associated with the level of fear intensity it can elicit (on a scale from 1-low to 8-high).

As shown in Figure 1, we designed a classroom populated with students and a standing teacher to address the 'oral report' feared situation in Table 2. Increasing levels of fear intensity will be manipulated in various ways and their effect measured simultaneously with bio-sensors for GSR and HRV. Bio-signals are starting to be mapped automatically to specific affective state characteristics [5], but one of the limitations faced by automatic recognition is the ability to capture reproducible emotional stimuli-response for algorithm development. Stimuli variations will include changing the SL child's view between first-person and third-person, the number and attitudinal body language of the students in the class, the teacher appearance, the classroom design itself, etc. Interdisciplinary experiments will be conducted to *both* (1) test and document the effect of SL exposure therapy, and (2) enable the concurrent reliable capture of physiological signals for automatic recognition of emotions.

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Features for Culturally Appropriate Avatars for Behavior-Change Promotion in At-Risk Populations

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Abstract. We explore how avatars can be used as *social orthotics* defined as therapeutic computer-based social companions aimed at promoting healthy behaviors. We review some of the health interventions deployed in helping at-risk populations along with some of the unique advantages that computer-based interventions can add to face-to-face interventions. We posit that artificial intelligence has rendered possible the creation of culturally appropriate dialog-agents for interventions and we identify specific features for social avatars that are important – if not necessary – when applied to the domain of social orthotic systems for health promotion.

Keywords. Cultural Avatars, Embodied Conversational Agents (ECAs), Computer-Assisted Health Interventions, At-Risk Populations.

Introduction

Embodied Conversational Agents (ECAs) or avatars have been proposed as a natural computer interface for humans because of their anthropomorphic form and their potential functionalities – from anthropomorphic expressive abilities to dialog possibilities [1-3] which necessitate little or no effort for humans to understand. One context in which ECAs might prove useful is in computer-based therapeutic interventions that assist the human therapists. In this domain which has been under-explored [4], avatars might offer a promising potential if their social realism is addressed appropriately along with their abilities to adapt to the specific needs of different patients. Indeed mental illness has been identified as the second leading cause of disability and premature mortality in the developed world. Yet the majority of people suffering from treatable mental health disorders do not have access to the required treatment. Similar statistical data can be found about at-risk people (e.g. substance abuse, HIV/AIDS). *Computer-assisted (mental) health interventions* and computerized interventions might be able to address this imbalance [4]. If designed properly and evaluated as efficient, *social orthotics* – defined as therapeutic computer-based social companions aimed at promoting healthy behaviors – could potentially complement regular therapeutic sessions. Patients could interact daily (or as needed) with their artificial agents which (or who) are personalized to their specific disorder(s), between the scheduled weekly sessions with their therapist.

1. Current Interventions for Motivating Behavior Change of At-Risk Individuals

One type of intervention documented for encouraging preventive behavior toward HIV/AIDS or substance use is referred as brief *motivational interviewing (MI)*. Unlike more traditional confrontation-of-denial counseling, motivational interventions are intended, through *support* and *persuasion*, to increase the likelihood that people will make changes in their behavior toward healthy habits. It typically involves a brief assessment followed by feedback about the assessment results [5]. Sexual risk reduction interventions have proven most beneficial if they can individually tailor behavior change messages.

Tailoring involves the use of the participant's name (*personalization*), characteristics of the user such as gender (*adaptiveness*), or self-identified needs of the user (*feedback-provision*). Tailoring can also be *dialog-based* by asking the user about their goals and by recommending choices about how to best achieve these goals. The key is that the personalized, adaptive, or feed-back based tailored messages are more effective in promoting attitude and behavior change than the generic 'one size fits all' content delivered by print or to groups [6]. Although additional studies are needed, a brief individualized computer-delivered sexual risk reduction intervention study [7] has documented the risk reduction potential of interventions via computers for adolescents.

In a similar manner than computer-based interventions can be designed to assist in motivating drug users to change some of their behavior (via web-based interventions with avatars) [8], computer-based interventions can be designed to educate at-risk population about AIDS/HIV. There is a need to teach at-risk individuals about the *motivation* to use protective means available, and about their own *self-efficacy* at negotiating risk reduction behaviors, once private information about specific current behaviors has been collected. When revealing sensitive *private* information, participants have been found to be more candid with automated data collection systems than when interacting with a human interviewer [9, 10].

2. Features for Embodied Conversational Agents as Social Therapeutic Helpers

Based on the observations above and the latest progress in artificial intelligence, we posit that because ECAs can be designed to (1) be personalized to a user with a user-model, (2) be highly adaptive in terms of characteristics (e.g. gender, race, culture, language), (3) gather and remember feedback voluntarily given by a user, (4) have deep knowledge of a domain with specific expert-systems, and (5) be able to engage in meaningful dialog, they might be ideal to assist in delivering tailored health information to at-risk populations. In addition, the possibility to run them on a variety of *communication technologies* (e.g. internet-based platforms, PCs) including mobile phones [11,12], so that their accessibility and availability becomes quasi limitless, augments considerably their potential impact for at-risk populations, in a "window of opportunity" situation (substance-related arrest) during which motivation to change may be especially malleable [13].

Next, we identify specific features of ECAs that are important – if not necessary – to include in the design of social orthotic systems or computer-based interventions for health promotion behavior.

User-Modeling which combines Artificial Intelligence pattern recognition with high-level interpretation of a user's habits and behaviors can be used to build a profile

of a specific patient [14]. This can include (a) the result of a personality test taken once by the patient to determine the major traits of its personality, (b) the preferred patient's avatar identified either directly by the patient or inferred by the system based on the patient's ethnicity, age, and/or personality, (c) the time and type of interaction preferred by the patient, e.g. short reminders, dialogue with avatar over the internet, dialog over a mobile phone, other multimedia delivery. The user-model can be remembered and reloaded when interacting with the corresponding patient, and used to guide the future interaction accordingly.

Dialog Abilities: A number of studies have pointed out that one of the limits of computers for psychotherapy lies in their partial ability to adequately interpret natural language inputs [10]. Whereas latest progress in natural language processing in general and in social dialog abilities of ECAs in particular [15] have been increasing ECAs dialog abilities steadily, full natural language understanding is still not within reach. However, given the domain-specific nature of our avatar-based health interventions which follow semi pre-determined scripts, meaningful interventions can be designed without full natural language processing abilities.

Believability and Engagement: The last few years have seen considerable progress in animating virtual characters via mark-up languages, making it more feasible to have text-to-speech scripted interventions [16, 17]. While issues of synchronization between text and speech as well as vocal expressiveness of the ECAs (usually very monotonic and not credible) still need to be addressed, some interventions involving partial scripted spoken interventions mixed with other modalities (screen shots, reminders) can be designed for substantial impact [8] in the domain of health promotion.

Empathy: Empathy is considered the most important core condition in terms of promoting positive outcomes in psychotherapeutic contexts [18, 19]. Specific communication skills used by physicians – including strategies for conducting patient-centered interviews and relationship development – have not only been associated with improved adherence to treatment [20, 21] but also to improved physiological outcomes. In particular, empathy is considered the most important core condition in terms of promoting positive outcomes in psychotherapeutic contexts [22]. Furthermore, [23] observe that virtually all major schools of counseling note the importance of empathy in the counseling process. Recent progress in ECA facial expression [24] and vocal intonation synthesis are making it possible to envision an ECA capable of displaying empathy, which in its simplest affective form simply involves displaying the same type of affect as someone (which can be assessed via direct prompting "How do you feel today?" or via emotion recognition algorithms). The more complex cognitive empathy which entails understanding the inner state of another would require more complex processes than mirroring affective expressions.

Ethnicity: Ethnicity was previously assessed as having meaning beyond arbitrary representation, in a study that established that the same words meant different things when coming from an ECA that had similar ethnicity as opposed to a different one. The results provided strong evidence for surprising similarities in the way people respond to ethnicity in ECAs and in humans. We have therefore created a template of avatars, (shown in Figure 1) representing different ethnic background [24].

Personality: Personality was also found to be of importance in establishing believability [25]. Personality dimensions could be added to the avatar model corresponding to long-term personality traits (stable or slow changing patterns) guiding attitudes and responses to events.

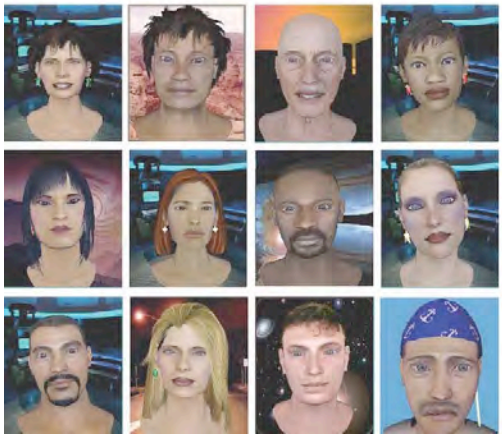

Figure 1. Multiethnic and Multilingual avatars

Figure 2. Mobile iPal

Hardware Platforms: New uses of mobile technologies are being studied [11, 12]. As shown in Figure 2, we envision an individualized ECA 'pal' companion available at all times on the portable device of patients that can provide them support if and when needed as a complement of counseling.

3. Conclusion

We have proposed a highly accessible type of computer-based therapeutic interventions for behavior change of at-risk populations which represents an interesting complement to what virtual reality has brought to the field of psychotherapy [26].

Acknowledgements

Part of this research was funded by a *Marie-Curie* grant from the European Commission.

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Cyberspace Psychopathology

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Abstract. The authors, after a initial description of the "Internet phenomenon" and more specifically concerning the psychological and psychopathological risks related to its use, propose a series of unpublished papers on this theme, developed during the last year.

Keywords. IRP, Internet Related Psychopathology, addiction, assessment.

Introduction

It was around 10 years ago when we studied the so-called Internet Addiction for the first time [1]. Since then, the "Queen of the Nets" spread at global level by becoming the best mean of communication among all the others. From one side, its spreading increased scientific knowledge related to the Net psychopathologic aspects and from the other this phenomenon made it possible to obtain any kind of information from it.

As conventionally agreed, we will use the expression "Internet Related Psychopathology" (IRP) in order to indicate a series of online disorders and behaviors (cybersex addiction, cyber relationship addiction, muds addiction and so on) [2].

1. Twenty-eight definitions for a disorder

The very first computer addiction cases appeared already in the 70's and 80's [3]. It is obvious that those kinds of problems were related to the PC use-abuse and not to Internet, since it did not exist at that time.

It was the American psychiatrist [4], the first scholar who assumed this "illness," who defined this phenomenon as *Internet Addiction Disorder*. He used the web to edit all relative diagnostic criteria with a provocative purpose. Since then, in order to describe this syndrome, several definitions were created in the scientific field. These definitions are as follows: *Internet Addiction* [5], *Internet Dependency*, [6], *Compulsive Internet Use* [7], *Compulsive Computer Use* [8] etc.

Similarly to the Chinese boxes, IRP can be intended as a smaller subset of a bigger problem that, on the basis of the specific addiction object (see the terminological table), can be split up into *Cybersexual Addiction, Cyber Relationship Addiction*, *Muds Addiction, Compulsive Online Gambling*, *Compulsive Online Shopping*, *Information Overload Addiction, EBay Addiction,* and *Trading Online Addiction* [5].

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Lavenia and Marcucci [9] perform a further distinction between *Cybersex Addiction* and *Cyberporn Addiction*, by assigning to the first type of addiction a sexual interactivity (man-machine-man system) that is completely absent in the second type of addiction (man- machine system).

In his cognitive-behavioral pattern, Davis [10] suggests to use the term *Specific Pathological Internet Use* (opposing to *Generalized Pathological Internet Use*) in order to identify any specific form of online addiction. As previously stated, the authors of this article proposed the acronym IRP, which stands for *Internet Related Psychopathology.*

We suggested a further definition in order to underline the "exhilarating" aspect of the Net. Indeed, with the word *Retomania,* we want to specify a kind of "almost-maniacal" exaltation, culminating into dissociative remarkable phenomena [11,12].

Carretti offers a good remark by explaining the Video Display Dissociative Trance, as provided by the DSM. He confirms that it is a disorder induced by technology and shows a clinical picture that can be related to an intense Internet intoxication [13,14].

2. Diagnostic criteria

Historically, IRP has been diagnosed by using differing assessment criteria. In 1996, Young was the first researcher who studied the disorder by proposing diagnostic criteria for *Internet Addiction Disorder* [5]. According to Young, it was possible to identify formal aspects of the addiction, such as tolerance, abstinence, and craving in all those people affected.

Afterwards, she thought to apply the same criteria to the pathologic gambling. This disorder is considered very close to IRP phenomenology, since it does not imply the assumption of chemical substances [15,16]. Some criteria for the pathologic gambling ("run-up" to the losses, committing illegal acts to finance the game, and finding money to relieve a financial situation caused by the gambling) were not considered applicable to IRP. Thus, a new specific criteria was created by scratch (spending more time online than predicted) by Johansson, Gotestam and Leung [17,18].

Shapira and his colleagues [19] proposed some interesting guidelines that highlight the emotional aspects connected to the loss of control. They also focus their attention on the intense anxieties and worries relevant to immoderate Net use.

Recently, the authors of this article proposed a set of criteria organized in *overt* (evident) and *covert* (hidden) symptoms. In order to diagnose the disorder, it is necessary to identify at least two *overt* symptoms and at least two *covert* symptoms, for a period of time no less than 6 months [20].

Up till now, IRP does not belong to any diagnostic system yet. People affected by the syndrome can be included in the category of the *Disorder of impulses control not differently specified*. Nonetheless, proposals to include this type of addiction into the next edition of the DSM (Diagnostic and Statistical Manual of Mental Disorder) become even more persistent. Last proposal came from the pages of the authoritative *American Journal of Psychiatry.* J. Block published an article, where he identifies IRP as a peculiar type of disorder referable to the compulsive- impulsive specter [21].

3. The effect of the disorder

The figures of IRP effects on the population vary in a substantial way. It depends on the methodology of the survey (surveys conducted in or out of the Net) and the type of instruments used (questionnaires based on several diagnostic criteria). Generally, online surveys indicate a rate of diffusion included between 3% and 11% [22, 23].

For instance, Greenfield's survey conducted on a sample of 17251 subjects with an age between 8 and 85 years shows a disorder effect rate equal to 5.7% [7].

More recently, a survey completed by some Korean researchers underlined a lower effect rate [24]: only 3.47% of participants in the survey became addicted to the Internet. Most likely these surveys prove that multiple factors influence the diffusion level differences. For instance, while Greenfield [7] focused his attention only on American users, Whang and his staff members studied exclusively Korean subjects. Moreover, Whang and his collaborators used the *Internet Addiction Test* proposed by Young, which is an instrument represented by a scale with 20 items called the *Likert* scale. The structure of this test is very different from the yes/no answers test used for Greenfield's survey.

Generally, studies completed on the net can better gather a big quantity of data in a relatively short period of time [25, 26]. Nonetheless, online supply can select subjects that frequently use the Internet or possibly have a problem with the Internet usage modality.

These surveys not conducted on the net on the basis of a random selection of subjects represent an important way to carry out researches on IRP. Up till now, only one survey has been published regarding this phenomenon among the general population that used a strategy of offline random sampling. This survey shows a very low diffusion rate varying from 0.3% to 0.7% [27].

4. Theoretical patterns

In this review, we will analyze only some of the patterns proposed by aiming to explain IRP phenomenon.

Young's ACE pattern [15] summarizes the main factors that make easy and/or induce the beginning of the disorders related to Internet:

- Accessibility: the easy and immediate accessibility to any online service allows an immediate gratification for the smallest need.
- Control: the very high control that can be performed on the online activity goes with an unreal perception of omnipotence.
- Excitement: the huge quantity of stimulus present on the Net allows reaching a high condition of psychological excitement.

In his pattern, Davis [10] uses a cognitive-behavioral approach, which bases itself on the *Pathological Internet Use* (PIU) of problematic cognitions linked to some behaviors that intensify or detain a non-adaptive response. This theory highlights cognitions and thoughts for the individual intended as the main source of the abnormal behavior. According to the author, the non-adaptive cognitions related to persons automatically starting with the Internet who could refer to himself/herself (by doubting about his/her personal esteem) or to the world (generalizations or thoughts about everything and nothing). The product of these cognitions is a PIU that can be specific or generalized. This specific PIU defines persons depending on an Internet specific

function (example: erotic material, gambling, auctions, etc.). These types of dependences are specific-content addictions and will exist, regardless of the presence of Internet. The generalized PIU, instead, includes a generalized and multidimensional overuse of Internet that can be comparable to the use of the Net.

Cantelmi and his colleagues suggested a pattern that shows a virtual path pushing the subjects to become real net addicted users in a progressive way. Initially, users experienced a toxiphilic *phase,* characterized by a constant and growing interest in checking email and a certain persistence in surfing the web. Afterwards, they experience the *toximaniac phase*, characterized by a hyper focalization on interactive applications as chat and mud, by building a multiple identity [2].

Grohol [28] believes that subjects suffering from this disorder are, more frequently, new users of the Net, who are not yet accustomed to the new technological environments and become "enchanted." However, even those who have been using the net for a longer period of time could develop the disorder, but only after discovering a novel, particularly attractive application. However, both new and old users will eventually reach stadium III, the stadium of balance.

According to Carretti, the Video Display Dissociative Trance (*Trance Dissociativa da Videoterminale*) [13] represents one of the possible consequences to the pathological computer addiction and its applications. This disorder implies an involuntary condition of trance with alteration of the awareness condition, depersonalization, and loss of the usual sense of personal identity that can cause a possible personal replacement of the original identity with an alternative one. From the psychodynamic point of view, we can distinguish three evolutionary levels: addiction, regression, and dissociation.

Addiction implies:

- A ritual hyper-involvement with the computer and its applications;
- An obsessive-compulsive relation with the virtual experiences and realities;
- A tendency to dream with open eyes prevailing over the action in the real relationships;
- An aware or unaware shame as peculiar detail of the weakness of the Ego;
- Phobic tendencies towards social life.

Regression implies:

- A tendency to imaginary relationships that compensate lacking real relationships;
- Autistic retreat;
- Autistic fantasy as defensive modality of the Ego.

Dissociation implies:

- Liability of the borders of the Ego;
- Dispersion of the Oneself;
- Depersonalization that is separation and alienation from themselves until the loss of the vital contact with the reality.

5. Predisposition

Nowadays, it is not easy to draw a profile of the psychological characteristics of Internet users. Moreover, it is not possible to state with certainty whether there are inducing factors explaining the abuse of such an instrument. It is obvious that the

psychological (family and relational problems) or psychiatric difficulties (personality disorders, social phobia, etc.) represent a strong risk factor [12].

Many studies could verify how varying the typology of Internet users can be and how different the reasons that push subjects to have recourse are to this new reality by becoming completely absorbed by it. Some subjects admit to using the web just because they look for a new and exiting identity. Others are just pushed by the stimulating perspective to remain anonymous. Even so, some use it simply to reduce the strain and the everyday stress. Finally, some use the Internet just because they want to meet new people in a comfortable and safe environment.

According to a survey conducted by Marcucci and Lavenia [9], IRP personalities would have a commonality to the schizoid side. Individuals with this characteristic tend to isolate and have difficulties in building durable social relationships. Their interests and hobbies usually increase their condition of isolation from people since they are more interested in things (objects, machines, etc.) than in people.

It has been suggested that male subjects could have a major tendency to develop Internet Addiction because of their excessive use of the Net. Male subjects would be more dedicated to activities with a very high "tossicologic gradient", such as videogames, virtual sex, and gambling [28]. This is what comes from many Internet surveys conducted with university students [6, 29, 30]. For example, a survey completed on a sample of students in Taiwan showed that a very high percentage of male subjects had already used online games in comparison to female subjects (81.8% against 36.4%) [31]. Moreover, this survey showed that male subjects had a higher score on a scale evaluating Internet Addiction (*Chen Internet Addiction Scale*) and that a higher amount of male subjects- compared to female subjects- spent more than 10 hours playing online [32].

According to Wallace [33], people with a higher "locus of internal control" would be more attracted to the Net because of the sensations of control it offers (the choice of websites, what to read, and what to download, etc..) On one hand, an important difference has been ascertained between subjects who use the Net and subjects who do not use the Net. On the other hand, concerning the rate of internality, it was not possible to verify the same difference among groups of users with a diverse level of involvement (use, abuse, addiction).

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Social Network and Addiction

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Abstract. In recent decades, the rapid development of innovative Internet-based communication technologies created a new field of academic study among scholars. Particularly, the attention of researchers is focusing on new ways to form relationship-thought social web. Social Network sites constitute a new form of web communities, where people meet and share interests and activities. Due to exponential growth of these sites, an increasing number of scholars are beginning to study the emergent phenomena in order to identify any psychopathological risk related to use of social web, such as addiction. This article examines the recent literature about this issue.

Keywords. Social Network, Addiction, Personality

Introduction

Social Network Sites (SNSs), such as MySpace, Facebook, YouTube and Flickr, are emergent social phenomena that are increasingly attracting the attention of academic research. SNSs are web-based services and are new way to communicate and share information. There are hundreds of SNSs that are regularly used by million of people around the world. A social network service is an online community where everyone can meet and interact with other people based on common interests, hobbies, job, political, religious, sexual views, and/or other activities [1].

SNSs allow individuals to construct a public profile, more or less visible according to default of site and user discretion, create a list of other users with who they interact and view list of contacts made by other users within the site [2].

On SNSs, each user can describe themselves, entering information about their background (e.g. high school), demographics (e.g. gender, age) and cultural tastes (e.g. favorite books, movies, television shows); users can choose photos and also write about themselves on their profiles, making self-promotion [3,4].

The increased use of SNSs has led scholars to study the psychological impact of social network services. Indeed, most users have integrated the use of social web into their daily practices, spending long time on Internet in order to create and/or maintain their social capital. Academic researches have begun to investigate the psychological and psychopathological aspects about use of SNSs, investigating their role in identity construction and expression, building and maintenance of social capital and concerns about privacy, focusing on the related risks.

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1. Method

In this review we evaluate the recent literature about the studies, exploring the impact of Social Network Sites on individuals and on their way to build social relationships. We begin to define the features of SNSs and to examine the link between use of these sites and traits of personality. Following this, we focus on psychological aspects relating to use of SNSs. In particular, we examine the recent articles that have investigated the risk of addictive behavior linked to use of SNSs.

We conducted a search on pubmed, psycinfo and google using the key words, such as Social Network, Addiction, Personality.

2. Results

Recently, Social Network Sites are proliferating and have attracted millions of users. The three most visited SNSs are Facebook, MySpace and Frindster. Until April 2007, the most popular SNSs was MySpace. At the moment, Facebook holds supremacy, but there are hundreds of social web daily visited by users [5].

The rise of SNSs could mean a shift in the organization and in the aim of online communities. Unlike web-communities, SNSs are organized around individual and are structured as personal network (ego-centric network). Each user is at the center of their community. Moreover, the main feature of SNSs is not to allow individuals to meet strangers, but to maintain pre-existing relationships, making visible the social network. On social web, meetings are often between users who share some offline, called "latent ties" [6].

These characteristics may be related to specific personality traits of the new generation. A recent research shows that students (Generation Y) are more narcissistic and self-absorbed than any previous generation. Technology allows the ability to express themselves quickly and easily and SNSs permit more self-promotion than traditional media [7].

More recent studies have investigated identity performance in less anonymous online settings, such as Facebook. The findings suggest that the Facebook selves appear to be highly socially desirable identities individuals aspire to have offline: Facebook users may exaggerate the part of their possible selves that are socially desirable but not emphasized in brief offline relationships, such as one's character, intelligence, and other important inner qualities. Concurrently, they may seek to hide the part of themselves they regard as socially undesirable, such as shyness, overweight, or stuttering [8].

Another research on two competing hypotheses from the literature shows that users more extroverted and with higher self-esteem support the "Social Enhancement" hypothesis, being more popular both offline and on Facebook, while users less popular offline support the "Social Compensation" hypotheses, because they are more introverted, have lower self-esteem and strive more to look popular on Facebook [9].

Furthermore, interesting researches examine the romantic communication over SNSs, focusing on several psychological variables. A study on MySpace users found that low self-esteem encourages young adults to engage in romantic communication while higher emotional intelligence discourages such activity. The study also suggested that those who have higher self-image, such as thinking themselves attractive and happy with their appearance, tend to engage in romantic communication [10].

One study examined same psychosocial variables in New MySpace.com users. Findings show that intending bloggers scored higher on psychological distress, self-blame, and venting and scored lower on social integration and satisfation with number of online and offline friends. Likely, intending bloggers may view this this activity as a potential mechanism for coping with distress in situations in wich they feel inadequately linked with social support [11].

Several studies inquired the modalities in which individuals create the profiles that reflect their identity. Researches reveal that females tend to turn to others for validation in contrast to males, who are more apt to maintain their individuality and whose relationships are more of an extension of their already-complete selves. In particular, Magnuson, in a recent study on MySpace profiles, found that the manifest identity formation consistent with traditional gender roles in which females are dependent on others for their sense of self [12-14].

Other research found further gender differences, examining the characteristics of users. On the one hand, women and men are equally likely to have accounts at a friend-networking site, on the other hand a sex difference occurs with the number of friends linked to the account, with men having significantly more friends linked to their accounts than women [15]. Moreover, men appear to have greater risk taking attitudes than women, e.g. men easily post information about themselves on the social network profiles, such as a phone number and instant messenger address. Instead, the women have greater privacy concerns and less identity information disclosure than men [16, 17].

Further, women are more likely to engage in online communication to maintain personal connections with family, friends and co-workers, while men use web sites for pursuing sexual interest and romance [18].

Another study shows that extraversion, one dimension of Big Five Personality Model, including energy, positive emotions, and the tendency to seek stimulation and the company of others, plays an important role in the formation of web-network ties [19].

Accordingly, the results of new research suggest that use of SNSs might provide greater benefits for users experiencing low self-esteem and low life satisfaction [20].
However, some scholars show concerns about potential abuse of social web: one speaks of “friendship addiction”, a new addictive process causing insecurity in users, particularly women [21].
Moreover, recent reports reveal that thirty per cent of teenagers spend long time on SNSs, neglecting school and family. It seems that young becoming addicted to social networking sites. Signs of possible social networking addiction included frequently visiting the site for long time, experiencing negative psychological or physical effects when the activity wasn't available, and scheduling other activities around online time. Studies show that typical addicts were more likely to be university students or people new to the workforce, people who had ready access to computers. According to scholars, addiction occurs when people go on web-site without a goal and it becomes part of their habit [22].

3. Conclusion

The exponential growth of Social Network Sites appears to respond to two opposing tendencies in modern society. On the one hand, social web meet the need of contact,

facilitating relationships and psychological wellbeing, on the other hand SNSs appear to accentuate individualism and self absorption, characteristics of modernity. Users self-centered, more vulnerable, particularly young people, could be absorbed by the web and develop addictive behaviors. To date, the question of potential risk related to use of social web remains largely underexploited. We believe that health care professionals, psychiatrists, psychologists, sociologists and communication professionals should focus their future researches on this issue, in order to identify signs of possible psychopathological behaviors related of abuse of SNSs.

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Designing Affective Video Games to Support the Social-Emotional Development of Teenagers with Autism Spectrum Disorders

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Abstract. Autism spectrum disorders (ASD) are a group of developmental neuropsychiatric disorders, comprised of three diagnostic entities – autistic disorder (AD), Asperger's disorder (AS), and Pervasive Developmental Disorder Not Otherwise Specified (including atypical autism) (PDD-NOS). A number of intervention techniques are currently used to reduce some of the associated challenges, with techniques ranging from behavioral therapy to dietary interventions and traditional counseling. This positional paper proposes the use of video games which leverage affective computing technologies as intervention in autism spectrum disorders in the context of the use of traditional play therapy with adolescents, who may feel uncomfortable engaging in traditional play with toys they may be too old for. It aims to explore the potential for greater 'social physics' made possible by affective computing technologies. This involves computationally 'recognizing' emotions in a user, often through the use of multimodal affective sensors, including facial expressions, postural shifts, and physiological signals such as heart rate, skin conductivity, and EEG signals. However, it is suggested that this should be augmented by researching the effect of social game design mechanisms on social-emotional development, particularly for those who experience difficulty with social interaction.

Keywords. Affective Computing, Autism, Video game applications

Introduction

Autism spectrum disorders (ASD) are a group of developmental neuropsychiatric disorders, comprised of three diagnostic entities – autistic disorder (AD), Asperger's disorder (AS), and Pervasive Developmental Disorder Not Otherwise Specified (including atypical autism) (PDD-NOS) [1]. The characteristics of autism vary from person to person, though each sharing the common elements of impairment in social interaction, social communication, and social imagination. Individuals diagnosed with autism may have difficulty making eye contact with others, find it difficult to make friends, may not understand other peoples' emotions, and have difficulty managing their own emotions. A number of intervention techniques are currently used to reduce some of the associated challenges, with techniques ranging from behavioral therapy to dietary interventions and traditional counseling.

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There has been some limited research into the use of non-directive play therapy in treating autistic children [2]. Traditional play therapy literature often cites the work of Huizinga [3] and the influential Homo Ludens, hailing the inherent benefits of play as well as the natural tendency for humans to engage in play-related behaviors at all stages in life. Gallo-Lopez and Schaefer [4] further observes that playing continues into adulthood, negating the idea that adolescent developmental tasks should preclude participation in play for therapeutic purposes. However, adolescents may feel uncomfortable engaging in traditional play with toys they may be too old for. Moreover, as it is the fastest growing developmental disorder, the cost of trained personnel will be increasingly expensive [1].

1. Aims

Thus this positional paper proposes the use of *affective video games* as an intervention in autism spectrum disorders. Games designed primarily for entertainment should be modified to leverage affective computing technologies in order to engage autistic teenagers on a social, emotional, and behavioral level. This is particularly relevant, given the close affinity autistic teenagers feel for technology and games [5]. Griffiths [6] reviews the literature in using video games in therapeutic settings, and argues that in the right context, video games can indeed have a positive therapeutic benefit to a large range of different subgroups, including children with particular emotional and behavioral problems (ADD, impulsivity, and autism).

The research also aims to explore the potential for greater 'social physics' made possible by affective computing technologies. This refers to computationally 'recognizing' emotions in a user, often through the use of multimodal affective sensors, including facial expressions, postural shifts, and physiological signals such as heart rate, skin conductivity, and EEG signals. Recently, such work has been applied to social-emotional computing applications to support high-functioning individuals with autism spectrum disorders [7] [8] [9]. However, it is suggested that this should be augmented by researching the effect of social game design mechanisms on social-emotional development, particularly for those who experience difficulty with social interaction. This addition of principles of video game theory extends current nascent research into affective technologies for autism, by providing a framework with a "variable and quantifiable outcome", one to which "the player feels attached" [10].

Additionally, such affective technologies need not be limited to traditional, 'sedentary' games; instead, game structures could effectively augment real-world social interactions. Such games are known as mixed reality, augmented reality, hybrid reality games, or even pervasive gaming, or ubiquitous gaming, though it can be defined broadly to games utilizing technologies that combine the real and virtual in any location-specific way, where both real and virtual information play significant roles [11]. Therefore, it is proposed that *affective* mixed reality games could be one form of affective game-based intervention for autism as described above.

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Scientific Evidence for the Effectiveness of Virtual Reality for Pain Reduction in Adults with Acute or Chronic Pain

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Abstract. The objective of this systematic review was to determine the level of scientific evidence for the effectiveness of VR for pain management in adults with pain. A comprehensive systematic search involving major health care databases was undertaken to identify randomized clinical trials (RCTs) and descriptive studies. Twenty-seven studies were identified that fulfilled the inclusion criteria. There was strong (Level 1a) evidence of a greater benefit from immersive VR and limited evidence (Level 2a) for the effectiveness of non-immersive VR in reducing acute pain. Moreover, there is limited evidence (Level 2a) of effectiveness of immersive VR compared to no VR for reducing chronic pain. There is currently no published study that has explored the effectiveness of non-immersive VR for chronic pain (level 5). It is concluded that VR can be recommended as a standard or adjunct clinical intervention for pain management at least in the management of acute pain.

Keywords. Virtual reality, pain, randomized controlled trials, systematic review.

Introduction

Pain is a prevalent problem in modern society and has a negative impact on psychological, physical, and social dimensions of quality of life. In the past, a major focus around pain management has centered on pharmacologic strategies, whereas the literature published during the last decade has increasingly focused on non-pharmacologic interventions. In recent years, VR has become popular in clinical research studies as an innovative distractor technique for pain reduction. Rizzo and Kim [1] defined VR as a non-invasive simulation technology that allows a user to interact with a computer- generated environment, in the three dimensions of width, height, and depth. In a series of preliminary studies, Hoffman [2-4] demonstrated that patients with severe burns using VR reported large reductions in worst pain, pain unpleasantness, and time spent thinking about pain and reported having more fun and less anxiety during various painful procedures. VR has also been used in

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different clinical settings to reduce dental pain [5], prostate thermo-surgery [6], cancer pain [7], cancer chemotherapy [8], and central post stroke chronic pain [9]. The objective of this systematic review was to determine the level of scientific evidence for the effectiveness of VR therapy on pain reduction in adults with acute (less than or equal to 6 weeks clinical pain or thermal procedural pain), or chronic (more than 12 weeks) pain stemming from various health conditions or the treatment thereof.

1. Methods

An extensive review of the scientific literature was performed by two of the investigators to identify published experimental studies focused on the effectiveness of VR therapy as an intervention for pain reduction in adults with acute or chronic pain. The following databases were searched: MEDLINE (PubMed) (1950- 2008), EMBASE (1980–2008), Cochrane Central Register of Controlled Clinical Trials and Cochrane Database of Systematic Review (2008), Database of Abstracts of Reviews of Effectiveness (DARE), PsycInfo (1966– 2008), CINAHL (1982 – 2008), Web of Science (1900 to 2008), Scopus (2008), and OT Seeker (1996- 2008). These databases were searched using the following key terms: virtual reality, virtual environment, virtual therapy, computer simulated environment, VR exposure, user-Computer Interface, pain, and analgesia. Randomized and quasi-randomized controlled trials, crossover studies, observational studies, pre-post studies, cohort studies, and case-control studies were included. We examined the methodological quality of RCTs using the Physiotherapy Evidence Database (PEDro) Scale. PEDro results were interpreted using Foley and colleague's quality assessment [10], where studies scoring 6-to-10 were considered methodologically "high," 4-5 were considered "fair" and ≤ 3 were considered "poor." The level of evidence of effectiveness was determined based on Sackett [11] but adapted to include PEDro ratings [12].

2. Results

One hundred and four studies were retrieved from the databases. Four additional studies were obtained from an examination of the reference lists of the retrieved studies. Forty-three studies were excluded because they were repeated in different databases. A further 23 studies were excluded because they did not fit the inclusion criteria, and 15 because they only focused on children. Thus 27 studies including 8 RCTs, 9 randomized crossover studies, 8 case studies, 1 study with uncontrolled clinical series of cases, and 1 randomized mixed factorial design were included. The studies were grouped according to the type of VR used for the intervention – immersive (18 studies) versus non-immersive (9 studies), and duration of pain- acute (25 studies) versus chronic (2 studies). Pain intensity, unpleasant pain, and time spent thinking about pain were the most outcomes measured. The visual analogue scale, graphic rating scale, and numerical rating scale were the most common measures used to assess pain. The most typical clinical populations included burn patients undergoing wound care and patients undergoing dental treatment. Most studies

used immersive VR in comparison to non VR distraction- control, or in comparison to other distraction therapies, such as movie distraction or hypnotic analgesia or audio distraction, or in comparison to combination of VR plus other techniques that included standard analgesic care plus immersive VR distraction or standard care plus TV. Only a small percentage of adults immersed in VR experienced side effects such as nausea and motion sickness; most studies did not report on adverse effects. There is strong (Level 1a) evidence suggesting immersive VR is an effective intervention for decreasing pain in adults experiencing acute pain. Limited evidence (Level 2a) indicates that immersive VR is also effective compared to no therapy for pain relief in adults with chronic pain. Further, there is limited (Level 2a) evidence suggesting that non-immersive VR compared to no VR- control or other distraction techniques has more benefits for reducing acute pain. Finally, there are no experimental studies that have investigated the effectiveness of non-immersive VR for adults with chronic pain (level 5).

3. Discussion

This systematic review is the first to evaluate the evidence of effectiveness of VR therapy for pain management. It was not restricted to type of pain (acute or chronic), type of VR (immersive or non immersive), gender differences, type of study, and specific language. In addition, data was collected in a systematic way within the framework of the Cochrane Collaboration that was expanded to include non-RCTs. Unfortunately, the number of studies investigating the impact of VR on chronic pain is limited. Based on the existing evidence, VR can be recommended as an effective intervention through which patients appear able to immerse themselves in a virtual environment world during procedural pain, decrease their attention to painful stimuli, reduce the need for analgesia, and improve their tolerance during painful procedures. These findings are encouraging given that VR equipment is now widely available and requires minimal technical knowledge for use.

4. Conclusions

Based on the existing evidence, it is concluded that VR can be recommended as a standard or adjunct clinical intervention for pain management at least in the management of acute pain. However, the current evidence of the effectiveness of non-immersive VR for chronic pain is limited and warrants further study.

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Affective Robot for Elderly Assistance

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Abstract. Recently, several robotic solutions for the elderly have been proposed. However, to date, the diffusion of these devices has been limited: available robots are too cumbersome, awkward, and expensive to become widely adopted. Another key issue which reduces the appeal of assistive robots is the lack of socio-emotional interaction: affective interchanges represent key requirements to create sustainable relationships between elderly and robots. In this paper, we propose a new approach to enhance the acceptability of robotic systems, based on the introduction of affective dimensions in human-robot interaction. This strategy is aimed at designing a new generation of relational and cognitive robots fusing information from embodied unobtrusive sensory interfaces. The final objective is to develop embodied interfaces, which are able to learn and adapt their affective responses to the user's behavior. User and robot will engage in natural interactions, involving verbal and non-verbal communication, improving empathic exchange of moods and feelings. Relevant independent living and quality of life related issues will be addressed: on-going monitoring of health parameters, assistance in everyday's activities, social support and cognitive/physical exercises. We expect that the proposed strategy will enhance the user's acceptance and adoption of the assistive robotic system.

Keywords. Elderly, independent living, affective interaction, relational robot, embodied sensory interfaces.

Introduction

The use of socially interactive robots for the elderly arises from two main trends, which portrays the current society. The first trend refers to social and health-related aspects, the second to technological ones.

The older population is growing at a considerably faster rate than that of the world's total population. This involves several issues to be considered, in particular the physical and psychological well being both of elderly and of caregivers.

Aging is a multidimensional process characterized by physical, psychological, and social change. However, many studies suggest that aging is not necessarily associated with negative evolution; actually, new abilities and skills can be developed, to compensate impairments caused by the physical decline. For example, reaction times

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become slower and more variable with age, while curiosity, creativity, and the wisdom gained from experience may expand. Research shows that even late in life potential exists for physical, mental, and social growth and development [1]. However, some clear impairments appear in perceptual, cognitive, and motor abilities.

The use of ITC and web-based communication work platforms is changing the society and is offering more and more solutions to everyday problems. Its integration in the new proposal addressing health and social activities is becoming less a suggestion and more a necessity.

As old populations continue to grow rapidly, the capacity of human caregivers is expected to be insufficient in the future. Nursing home care services do not represent a univocal solution, because of the social cost they involve: they are not only extremely expensive from an economic point of view, but also because they entail a forced relocation of elderly people.

A more supporting home environment has to be envisaged in order to reduce the individual and community burden.

The use of robotic systems, involving a physical proximity and an individualized service, provides a solution to main elderly and caregivers needs, related to everyday care and continuous monitoring.

1. Robotic solution for elderly assistance

Research on elderly emotional and social behaviors stresses that emotions and social relations play a key role for a healthy aging. When building social care and assistive robots, it is important to consider the desires, values, and needs of the elderly. Forlizzi et al. (2004) investigated the elderly expectations on assistive robotics. Seventeen elders aged 60 to 90 were interviewed. The authors of this study concluded that assistive robotics tools should support the elder's values of identity, dignity, and independence. The elders have the desire to maintain their personal standard within their home or community.

Dorfman (1994) [2] conducted an extensive ethnography of elderly people in an upscale residential retirement facility (Quaker community). She identified five main values: remaining autonomous; sustaining personal growth; helping others; maintaining social ties; experiencing pleasure.

Two main categories of robots can be found for elderly:

1. Assistive: focused on providing everyday life assistance, mainly addressing mild cognitive impaired persons or healthy elderly living by their-selves (showing at least some motor impairment).
2. Social: focused on emotional activation/stimulation and on therapeutic effects of communication patterns and social interactions in subjects with cognitive deficits.

While the first kind of robot belongs to the category of assistive technology, social robots involve pet therapy principles transfer to technological applications (pet robots). Many studies on Animal Assisted Therapy demonstrated positive effects arising from the interactions of humans with real animals; some of these beneficial effects for interaction were confirmed also with a robotic animal.

However, a very small amount of examples exist of social robots that combine the

function of being a companion with other functionalities.

2. Psychological issues in human-robot interaction

Robots have the ability to serve not only as good companions, but also to assist elderly in attaining their goals through exchange of instrumental, emotional, and informational resources.

Elderly acceptability of an autonomous robotic agent in their home is a relevant issue when dealing with human-robot interaction applications.

User acceptance does not depend only on the practical benefits they can provide, but on complex relationship between the cognitive, affective, and emotional components of people's image of robots.

Since now, only a small amount of studies have investigated the main aspects of these representations, surveying people at different stages of the lifespan and identifying their expectations and needs with respect to technology and in particular domestic robots.

The consideration of personal factors may help to clarify when robot can be perceived as mechanisms that facilitate regaining of independence, and when, on the contrary, they are seen as a threat to self-identity and autonomy.

Scopelliti, Giuliani and Fornari [3] interviewed several persons of different ages, aimed at identifying their actual representation of domestic robots, in particular how they should appear and work. The following results emerged:

1. People prefer direct speech to interact with the robot, usually through short and simple words ("as when speaking to my dog")
2. People indicated the use of both acoustic and visual modality with respect to how the robot should communicate.
3. Respondents described the potential interaction with the robot by referring to "social dynamics", typical of human beings. In particular this aspect involves: privacy regulation, unobtrusiveness, and equal relation instead of that between lord and slave
4. Finally, the robot should be small enough to be able to move everywhere inside the house.

When dealing with acceptance of robots, it is important to not only address acceptance in terms of the usefulness and ease of use of a system but also relational or social acceptance. This means that a user accepts the robot as a conversational partner, finds the robot's social skills credible, sees the robot as an autonomous social being, and is more likely to exhibit natural verbal and non-verbal conversational behavior as well as feeling comfortable in interacting with the robot.

In addition to these described features, we must also consider that usually the elderly are not familiar with using new technologies involving complex interaction styles. As a consequence, elderly people can be fearful at the prospect of having a robot at home by experiencing negative feelings and general anxiety.

3. Our proposal: An affective interfaces to improve user acceptance in robotic applications

We propose an interesting solution to user acceptability issue through the developing of an Affective Robot.

The interaction with affective robots is based on social communication between humans. As a result of human evolution, humans are experts in using and understanding social communication principles. Therefore, this interaction style is expected to be very suitable, intuitive, and straightforward.

Our project will target the arising paradigm related to ambient intelligence and the use of relational and cognitive robots fusing information from embodied unobtrusive sensory interfaces and capturing the dynamic behavioral profile of the user (gesture, gait, body dynamics) and the physiological response of the user to events (analysis of ECG, respiration, electro-dermal response).

User emotional state recognition and user-robot interaction will arise from a three step process:

1) Emotional expressions produce different changes in autonomic activity. In particular, some main biological processes modify themselves according to emotional states valence and arousal level. For examples, anger is associated with increased heart rate and skin temperature; fear with increased heart rate and decreased skin temperature; happiness with decreased heart rate and no change in skin temperature

Subjective physiological parameters will be recorded in a baseline condition, together with different emotional conditions (by presenting various stimuli, as images, videos and sounds), thanks to a new generation of biosensors [4].

In this first phase we will take into account only valence and arousal aspects. These measures will be useful in order to identify, in the next step, more complex emotional configurations.

2) Non-verbal and behavioral aspects (voice intonation, prosody and content, posture, gestures, movement, level and type of activities performed) are powerful indicators of different emotions experienced by subjects. In order to obtain a rich and coherent frame, both physiological and behavioral signals will be detected and interpreted as a whole.

Behavioral and speech parameters will help to identify the following states: Joy; Fear/Anger/Sadness/Apathy/Concern.

3) In addition to implicit emotional measures, some explicit measures will be considered, represented by self-evaluation questionnaires and semi-structured interviews. These will be identified and adjusted basing on some clinical tests. According to the previous implicit evaluations it will be possible to identify the presence of some main clinical disease: Depression/Anxiety/Stress.

According to the supposed emotional state detected, the robot will try to obtain more information by asking the user about his/her emotional state.

The robot action and speech will be adjusted to previous phase results and will be aimed at two main goals:

1) to build a natural and affective user-robot relationship
2) to prevent or reduce some negative emotional states and unsafe behaviors.

An embodied affective-based human-robot is at the core of our proposal, in order to establish a proactive and emotional interaction with the elderly, encouraging and motivating him and becoming his intermediary with the external world.

This social and affective robot will be used to:

- stimulate mental activity, to prevent memory problems and compensate for memory problems by intelligently reminding its users;
- facilitate communication with external world, by avoiding the risk of loneliness;
- support the elderly in his daily activities;
- monitor his health status and coach him for a healthier lifestyle;
- identify critical situations and to activate emergency calls.

4. A possible scenario

John is a 73 year-old man, still in very good shape, with only some slight memory and hearing deterioration problems. He bought the affective robot, naming it "Digy", and has the overall AI system in his home.

This day, the daily planner scheduled a medical visit at 2.00 P.M., to be performed by mean of the Digy video conferencing system.

John is quite upset about the doctor visit, since in the last visits some embarrassing situations occurred: when asked about his problems, he sometimes forgets to report some important things; it also happened that he was not able to remember the doctor's prescriptions and suggestions at the end of the visit.

Daily planner and user profile knowledge allows Digy to predict that John will be very anxious this day. When John wakes up, the biosensors monitoring system detect a physiological activation; during a short conversation, speech prosody, and content analysis module indicates a clear "concern" state; Digy puts some pre-defined questions (as "Do you feel self-confident?", "Do you feel nervous and restless?", "Do you have negative thoughts'") and, after having analyzed John answers, it classifies John state as "anxious". Digy behaves as an expert consultant: he reminds John about some strategies to deal with the visit. It suggests him to summarize and write down what it is important for the doctor to know, about his health status and last day's situation; John should also prepare a paper to record medical prescriptions. Digy also invites John to visit the "memory book", identified by a specific icon on the monitor, containing some multimedia information about memory functioning and strategies, together with some exercises to train memory abilities.

Then, he suggests a relaxing and pleasant activity to John to be performed just before the visit (for example, to cook a good lunch, to phone to his grandchild).

Digy will also record John and doctor's conversation, registering important information about healthy program and ongoing variations.

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Stress Inoculation Training Supported by Physiology-Driven Adaptive Virtual Reality Stimulation

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Abstract. Significant proportion of psychological problems related to combat stress in recent large peacekeeping operations underscores importance of effective methods for strengthening the stress resistance of military personnel. Adaptive control of virtual reality (VR) stimulation, based on estimation of the subject's emotional state from physiological signals, may enhance existing stress inoculation training (SIT). Physiology-driven adaptive VR stimulation can tailor the progress of stressful stimuli delivery to the physiological characteristics of each individual, which is indicated for improvement in stress resistance. Therefore, following an overview of SIT and its applications in the military setting, generic concept of physiology-driven adaptive VR stimulation is presented in the paper. Toward the end of the paper, closed-loop adaptive control strategy applicable to SIT is outlined.

Keywords. Physiology-driven adaptive virtual reality stimulation, stress inoculation training, adaptive control, physiological measurements

Introduction

Large peacekeeping operations, and assessment that 10–50% of operational injuries are psychological [1], emphasize importance of mental care for military personnel. Mental readiness training [1], which builds on SIT [2], is one aspect of such care, focused on making individuals more resilient to adverse psychological effects of combat. On the other end of the spectrum, various therapeutic approaches exist [3] for healing the individuals who already suffer from combat-related psychological disorders. VR and physiological measurements are being applied both in the treatment of psychological consequences of combat, like posttraumatic stress disorder (PTSD) [4], and in SIT for military personnel [5]. Their application in PTSD therapy may potentially be enhanced by physiology-driven adaptive VR stimulation [6], [7]. In VR exposure therapy, a treatment method for PTSD and other anxiety disorders, the therapist operates a user interface to deliver gradually to the patient the virtual stimuli of anxiety-provoking situations [8]. Physiology-driven adaptive VR stimulation attempts to optimize and customize the therapy by relieving the therapist of repetitive interface manipulation and monitoring of the patient's physiology. Considerable similarities of SIT for tactical

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decision making to exposure therapy [9] suggest possibility of applying physiology-driven adaptive VR stimulation to SIT.

1. Stress Inoculation in the Military Setting

SIT attempts to improve stress resistance by training a set of skills that make an individual capable of responding more favorably when confronted with stressors in real life. It is described as "a flexible individually-tailored multifaceted form of cognitive-behavioral therapy" [2]. As such, SIT has been successfully used in a variety of clinical settings, including PTSD treatment [10]. Furthermore, SIT has been successful in non-clinical context, e.g. with individuals who need to cope with death of a beloved person or unemployment, and professional groups who experience high levels of stress during their regular work [10].

SIT is conducted through three overlapping phases, as expounded in reference [2]. In the initial, conceptualization phase the trainees receive stress education, including explanations regarding the nature and effects of stress etc. In the second phase of SIT, related to skill acquisition and rehearsal, the trainees learn the stress coping skills and acquire them through repeated practice. The third and final phase of SIT entails the trainees' application of the acquired stress coping skills over a sequence of increasingly intense stressful experiences relevant for their real-life situation.

This paper is concerned with SIT for high-stress professional groups, like military personnel. There have been calls for emphasis on explicit training of stress coping skills, through integration of emotional, cognitive and behavioral control practice with realistic military training [1]. Mental readiness training approach is aligned with SIT, but has the focus shifted from lectures concerning stress to techniques directly integrated into more intense and operationally relevant training situations [1]. Thus, the third phase of SIT seems accentuated in mental readiness training.

Investigations have been conducted to ascertain the most appropriate protocol of stressor delivery for task performance in the military setting. One hypothesis has been that training of tasks while being simultaneously exposed to stressors may possibly produce undesirable mutual interference between task acquisition and stressor familiarization [11]. The authors have compared combined training, including simultaneous task acquisition and exposure to stressors, to phased training, in which the two are temporally separated [11]. In the authors' several experimental settings, effectiveness of phased training has been equal or superior to combined training [11].

Another available publication in the military context is a book written on the experiences and lessons learned from the Tactical Decision Making under Stress (TADMUS) project [12]. The project strived to develop training, simulation and decision support principles that would help mitigate the impact of stress on decision making. Significant agreement is noticed when comparing the TADMUS findings to the findings of the cognitive-behavioral therapy [9], including that skills acquired during the TADMUS training generalize to novel tasks and stressors, and that gradual increase in stressors is preferred to initial high-stressor delivery.

Recent review of VR applications for SIT [5] finds several studies within the military context. The reviewed studies show that training in VR with stressors may result in better performance during testing, than training in VR without stressors. Likewise, psychological and physiological stress may be lower when training in VR with versus without stressors. The review also provides support for the expectations

that SIT may provide protection against stress-related psychological disorders after encountering real-life stressors. Altogether, using VR technology for SIT holds promise for stress reduction and performance enhancement, warranting further research.

Physiology-driven adaptive VR stimulation in this paper will specifically target the third phase of SIT, applying only exposure-to-stressors part of the phased training [11], in hope to improve resistance to stress-related psychological disorders.

2. Physiology-Driven Adaptive VR Stimulation

Adaptive systems using physiology in a feedback loop have been around at least since the mid 1990's (e.g. [13]). Further examples of adaptation of computer systems based on emotions of their users, where emotion indicators are obtained from physiology, may be found in the affective computing field [14]. Concept of physiology-driven adaptive VR stimulation is related to influencing the emotional state of the "subject" ("patient", "trainee") in a controlled manner by display of stimuli in various media forms, like static pictures, sounds and synthetic virtual stimuli combined with real-life video clips. To this end, the concept includes time-synchronized stimuli generation to the subject, acquisition of the subject's physiological response, subject's emotional state estimation, and adaptive closed-loop control that leads to subsequent generation of new stimuli [6]. Any potential application of the concept may be derived by specifying the application-specific control strategy, with appropriate stimuli and emotional state estimation; the next section will outline the application to SIT.

Physiology-driven adaptive VR stimulation is decomposed into four logical subsystems: Stimuli Generator, Emotional State Estimator, Adaptive Controller, and Graphical Interface. The Stimuli Generator receives control signals from the Adaptive Controller and generates the corresponding stimuli. Control signals may specify the semantics (e.g. keywords), and/or emotional properties of the stimuli (e.g. valence/arousal values in line with the dimensional model of emotions [15]), together with the desired media forms. Control signals are resolved into concrete stimuli by comparing them against semantically and emotionally annotated stimuli database [16].

The Emotional State Estimator estimates the subject's emotional state in real time from the acquired physiological signals, e.g. in the form of valence/arousal values [17]. Generally, the subjects may also occasionally rate their emotional state, which can be provided to the Emotional State Estimator in addition to physiology.

The Adaptive Controller holds the decision-making logic regarding the best stimuli to deliver based on the subject's estimated emotional state. Thus, the Adaptive Controller needs from other subsystems all information potentially relevant for decision making. It is also the most appropriate subsystem for storing this information permanently into the Subject's Aggregated Knowledge Database (SAKD), for subsequent use. In particular, internal state of the Adaptive Controller at the end of each session can be serialized into SAKD, in order to be reloaded at the beginning of the next session. Reference Knowledge Database (RKD) is based on relevant data from literature, or integrates SAKDs of the previous subjects. The Adaptive Controller may use RKD in the beginning of the first session, for educated guess regarding the subject's characteristics when no other information is yet available, and in any decision making that needs to compare the individual subject to a larger sample of subjects.

The Graphical Interface is necessary in applications that may require collaboration between the "supervisor" ("therapist", "trainer") and the Adaptive Controller during the

session. Prominent example is VR exposure therapy for PTSD [6], [7], as the patients may be very sensitive to the potential mistakes by the Adaptive Controller. In such applications, the Adaptive Controller should by design have its decision making subordinate to the supervisor's decision making. It also needs to supply the supervisor with information useful for making appropriate decisions.

3. Adaptive Control Strategy for SIT

This section presents control strategy aligned with the third phase of SIT, to the best of the authors' knowledge. Whenever the stressful stimuli are delivered by the strategy, the subject may practice application of the stress coping skills learned in earlier SIT phases. The strategy is focused on delivery of stressors only, not on any professional task skills acquisition, thus corresponding to a particular part of the phased training approach [11]. The stressors are presented with the purpose of improving the subjects' resilience to stress-related psychological disorders that may occur after experiencing similar real-life stressors. According to the literature presented in section 1, it is advised to progress with intensity of stimulation gradually, rather than to jump immediately to the expected most stressful stimuli.

At the beginning of any session other than the first one, the information from the subject's earlier sessions is retrieved. This also includes initializing the state of the Adaptive Controller from the state stored at the end of the previous session. Every session contains several minutes of baseline physiological measurements, to allow for day-to-day differences in the subject's physiology.

The session then proceeds with multiple cycles of exposure and training stages. In the exposure stage, the subject is presented with various stimuli from the stimuli database, according to the currently unspecified search algorithm in the stimuli space. Durations of the stimuli may generally be time-limited and/or depend on behavior of the acquired physiological signals. Estimated emotional state from physiology, regardless of its actual representation in this application, may be used for ranking the stimuli based on their impact on the subject's physiology. Following the exposure to any particular stimulus, ranking of the stimuli is performed and a predicate that guards the initiation of the training stage is checked. For example, the training stage may be allowed to commence only after sufficient number of stimuli that elicit significant physiological reactions has been found.

In the training stage the subject tries to lower physiological reactivity to the high-reactivity stimuli from the exposure stage. Repeated exposures to these stimuli may be needed. The training stage may end when adequate success has been achieved, e.g. measured by the percentage of achieved habituations over the stimuli delivered in this stage. If the subject cannot achieve the required percentage of habituations, restrictions on the maximum number of repeated exposures allowed per stimulus may be needed to avoid infinite loop in the training stage. Exact definition of habituation to a stimulus is left unspecified at this point. However, it is expected to be defined in terms of change in the physiological reactivity relative to the first exposure to the stimulus, taking into account baseline differences if the stimulus is used across sessions.

After the training stage has been completed, various checks may be performed to determine if the session should end, e.g. whether maximum allowed time per session or maximum allowed number of stimuli per session has been exceeded. If the session should continue, new cycle of exposure and training stages is performed. Otherwise,

the internal state of the Adaptive Controller is serialized into the SAKD just before the session ends, to be retrieved when the subsequent session starts.

Acknowledgements

This research has been partially supported by the Ministry of Science, Education and Sports of the Republic of Croatia.

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SECTION II

EVALUATION STUDIES

To date, some cybertherapy applications have improved the quality of health care, and later they will probably lead to substantial cost savings.

However, cybertherapy is not simply a technology but a complex technological and relational process.

In this sense, clinicians and health care providers that want to successfully exploit cybertherapy need a significant attention to clinical issues, technology, ergonomics, human factors and organizational changes in the structure of the relevant health service.

Wiederhold & Riva, 2004

NeuroVR 1.5 in Practice: Actual Clinical Applications of the Open Source VR System

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Abstract. At CT 2007, we presented NeuroVR (http://www.neurovr.org), a free virtual reality platform based on open-source software. The software allows non-expert users to adapt the content of 14 pre-designed virtual environments to the specific needs of the clinical or experimental setting. Following the feedbacks of the 700 users who downloaded the first version, we developed a new version – NeuroVR 1.5 – that improves the possibility for the therapist to enhance the patient's feeling of familiarity and intimacy with the virtual scene, by using external sounds, photos or videos. The key characteristics that make NeuroVR suitable for most clinical applications are the high level of control of the interaction with the tool, and the enriched experience provided to the patient. Actually, NeuroVR is used in the assessment and treatment of Obesity, Alcohol Abuse, Anxiety Disorders, Generalized Anxiety Disorders, and Cognitive Rehabilitation.

Keywords. Virtual Reality, Assessment, Therapy, NeuroVR, Open Source

Introduction

The growing interest in medical applications of virtual reality (VR) is highlighted by the increasing number of scientific articles published each year on this topic: searching Medline with the keyword "virtual reality", we found that the total number of publications has increased from 45 in 1995 to 291 in 2008 [1].

Although it is undisputable that VR has come of age for clinical and research applications, the majority of them are still in the laboratory or investigation stage. In a recent review [2], Riva identified four major issues that limit the use of VR in psychotherapy and behavioral neuroscience:

- the lack of standardization in VR hardware and software, and the limited possibility of tailoring the virtual environments;
- the low availability of standardized protocols;

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- the high costs (up to 200,000 €) required for design and testing;
- most VEs in use today are not user-friendly; expensive technical support or continual maintenance are often required.

To address these challenges, we presented at CT 2007 the NeuroVR software (http://www.neurovr.org): a free virtual reality platform based on open-source software [3]. The software allows non-expert users to adapt the content of 14 pre-designed virtual environments to the specific needs of the clinical or experimental setting [1].

Following the feedbacks of the 700 users who downloaded the first version, we developed a new version: NeuroVR 1.5.

1. NeuroVR 1.5

Using NeuroVR 1.5, the user can choose the appropriate psychological stimuli/stressors from a database of objects (both 2D and 3D) and videos, and easily place them into the virtual environment. The edited scene can then be visualized in the Player using either immersive or non-immersive displays. Currently, the NeuroVR library includes 14 different virtual scenes (apartment, office, square, supermarket, park, classroom, etc.), covering some of the most studied clinical applications of VR: specific phobias, cognitive rehabilitation, panic disorders, and eating disorders. Specifically, the new version now includes full sound support and the ability of triggering external sounds and videos using three different approaches: the keyboard, timeline or proximity.

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

NeuroVR Player leverages two major open-source projects in the VR field: Delta3D (http://www.delta3d.org) and OpenSceneGraph (http://www.openscenegraph.org).

2. Clinical Applications

The key characteristics that make NeuroVR suitable for most clinical applications are the high level of control of the interaction with the tool, and the enriched experience provided to the patient.

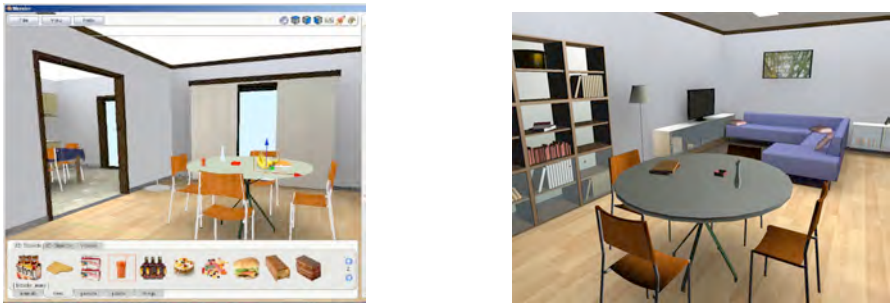

Figure 1. The NeuroVR Editor (*left*) and Player (*right)*

These features transform NeuroVR in an "empowering environment", a special, sheltered setting where patients can start to explore and act without feeling threatened. Nothing the patient fears can "really" happen to them in VR. With such assurance, they can freely explore, experiment, feel, live, and experience feelings and/or thoughts. NeuroVR thus becomes a very useful intermediate step between the therapist's office and the real world. Actually, NeuroVR is used in the assessment and treatment of Obesity [4], Alcohol Abuse [5], Anxiety Disorders [6], Generalized Anxiety Disorders [7], and Cognitive Rehabilitation [8].

3. Conclusions

In this chapter, we introduced NeuroVR 1.5, the new version of an advanced platform designed for the creation and customization of highly flexible VEs for clinical psychology and behavioral neurosciences.

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

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The SNaP Framework: A VR Tool for Assessing Spatial Navigation

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Abstract. Recent work in psychology has leveraged the power of Virtual Reality (VR) to study the deterioration of navigation abilities in the elderly. Much of this research has focused on determining the behavioral measurements and paradigms appropriate for such diagnoses. We present a system, the Spatial Navigation Paradigm (SNaP) framework, which can be used to implement a battery of spatial navigation paradigms. This framework integrates a popular VR environment development platform with an extensible representation medium to allow for the precise control of paradigms, the switching between input and output devices, and the recording of accurate behavioral measurements. A preliminary study of the framework indicates that novice and expert VR users are able to quickly and easily specify and deploy experiments and that expert VR users can easily modify and extend existing paradigm implementations.

Keywords. Virtual Reality, Spatial Navigation, VR System, VR Peripherals

Introduction

Virtual Reality (VR) has been used to provide controlled environments for assessing, among other things, the deterioration of navigation abilities in elderly individuals and patients with Alzheimer's disease and dementia. VR as an assessment tool has not found widespread adoption, mostly because the development and deployment of VR environments exceeds the technical abilities of the average experimenter or technician.

Problems similar to this must be overcome if VR is to be widely adopted: We must make it easy for experimenters to deploy a VR environment, to choose between different input and output devices, to obtain a range of behavioral measurements, and to interface with other systems (EEG, fMRI, etc.). Similarly, we want to make it easier for experts to develop new environments and paradigms. As most existing systems [1-3] do not support these requirements, the Spatial Navigation Paradigm (SNaP) framework was developed to achieve these goals.

In this paper, we discuss the design and evaluation of our proposed solution, the SNaP framework. First, we review some of the approaches used to create VR-based spatial navigation experiments. Second, we briefly detail the architectural design of the SNaP framework, highlighting its features and configuration media. Third, we describe a usability study that was performed with both novice and expert VR users to assess the ease of use and flexibility of the SNaP framework.

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1. Existing Systems

In spatial navigation research, two methods have been used to implement VR-based experiments: (1) creating custom in-house systems composed of freely available or tailor-made components, and (2) using pre-packaged open source or commercial systems that integrate specific VR devices with a virtual environment generator.

Many research teams have created custom VR systems. Mraz et al. developed an fMRI-compatible VR system that relied on OpenGL, the C and Visual Basic programming languages, and the WorldUp environment generator software [4]. Maguire et al.'s and Pine et al.'s virtual city tasks used the Duke Nukem 3D game engine to create and render environments and to record behavior-based measurements [5, 6]. All of these teams used a custom VR setup that required at least one team member to have an extensive programming background. This requirement makes it very difficult for novices to use these, or similar, systems. These systems are often largely inflexible; it can be very time consuming to change an environmental landscape, monitor new behavior metrics, change the types of allowable user actions, or introduce new deployment contexts.

Although less popular, there have also been a number of pre-packaged systems created. The Presentation system [1] by Neurobehavioral Systems has been adapted for use in spatial navigation studies. Presentation uses a drag-and-drop GUI to create and control 3D stimuli, navigable spaces, and experiments. It interfaces with a variety of input devices, supports eye-tracking hardware, allows for the integration of fMRI and MEG devices, and contains a scripting language to handle complex paradigm logic. Although Presentation has been used for navigation studies, the created environments are neither immersive nor realistic enough to produce generalizable results.

Psychology Software Tools Inc. has developed VR Worlds 2 [2], a software system focused on creating realistic virtual environments for several research domains (e.g., drug rehabilitation, phobia therapy, and anxiety disorders). VR Worlds 2 combines a drag-and-drop interface with 3D object libraries, custom event handling, data logging, peripheral device interfacing, motion tracking, and fMRI support to create realistic virtual environments. Unfortunately, VR Worlds 2 does not give the user much control over the created environments: the user is not allowed to create an arbitrary environment and is limited to using pre-programmed environment options.

One of the newest suites that has become available is the open source NeuroVR platform by Riva et al [3]. NeuroVR is a Blender-based platform that contains a drag-and-drop, icon-based editor interface for creating and modifying rich virtual environments. NeuroVR comes with a library of pre-created 3D models, it can be deployed to a HMD or monitor, and it supports the inclusion of head-trackers, joypads, keyboards, and mice. Although targeted towards phobia and addiction research, it appears that NeuroVR could be an ideal platform for spatial navigation research. It currently lacks, however, many important features, including stereo rendering capabilities, physiological monitoring support, the ability to create blank canvas environments, and a scripting medium.

In short, there is no ideal approach that can be taken to create spatial navigation experiments. Custom systems are inflexible and require team members who are strong in programming. Pre-packaged systems are useful for novices but are purposely generic, do not support experimental protocols, and are limited by the types of peripherals they support. Extensions and additions to these systems are also difficult, thus complicating

the setup of experiments. Our framework is aimed at eliminating some of these problems.

2. The SNaP Framework

Motivated by the problems and deficiencies inherent in both custom and pre-packaged systems, we designed a hybrid system. Our system combines the strengths of custom systems (e.g., environmental control, strict stimulus control, custom metric monitoring) with those of pre-packaged systems (e.g., drag-and-drop interface, visual programming language). The SNaP framework allows for on-the-fly usage of multiple hardware media and experimental paradigms, overcomes the limitations inherent in pre-packaged systems, and decreases the time and effort required to implement and deploy an experiment.

The SNaP Framework was built using the Virtools development platform [7]. It uses XML schemas, a VRPN server, and two Python modules to specify, configure, and deploy VR-based spatial navigation paradigms. The deployment of a spatial navigation paradigm proceeds as follows: First, the experimenter creates an XML-based *parameter file*. This parameter file contains information about the different experimental phases, blocks, and trials of an experiment, as well as the input and output peripherals to be used.

After the user has written a parameter file, a paradigm specific batch script is used to deploy the experiment. This batch script passes the parameter file to the first Python module, the *VR Configuration Creator*. This module controls and supervises the execution of the experiment. The VR Configuration Creator converts each trial specified in the parameter file into a *configuration file*. A configuration file is an XML formatted document that specifies the interface configurations (i.e., the input, output, and alternative devices and requested virtual environment), environmental setup, paradigm-specific information (e.g., goals, trial type, and presence or absence of feedback), and behavioral measurements that are required for a single experimental trial.

This configuration file is then used as input to the second Python module, the *VR Launcher*. This module starts the Virtools VR Player (to play the desired virtual world) along with the VRPN software (to capture peripheral device data) and opens the virtual world, or *Virtools composition file*, that was specified in the configuration file. Each Virtools composition file in the SNaP framework includes all of the 3D models and logic necessary to control the parsing of configuration files, virtual environment modifications, behavioral measurement recording, and trial goal monitoring. Once a participant has completed a trial, the VR Configuration Creator writes the next trial-specific configuration file and indicates to the VR Launcher that it can render and execute the next virtual environment. This process repeats until all trials have been completed.

To simplify the creation of new environments and paradigms, an expert user can start from, and expand, a template environment. This template contains all of the logic and modules required to implement new paradigms. Using this template, we were able to implement five popular spatial navigation paradigms; it only took approximately five hours to design, implement, and test each paradigm.

All paradigms share a single experiment specification file format, environmental objects, behavioral interaction techniques, navigational methods, support for input and

output devices, and methods for gathering behavioral measurements. Multiple levels of results are recorded; participant path information and camera frustum bitmap files are automatically recorded for every paradigm. Paradigm specific behavioral results can also be easily added or adjusted to meet a user's needs. As most measurements are the same across paradigms, similar algorithms and timing schemes are used, making it easy to compare results obtained with different paradigms and participants.

With this architecture, it is easy to switch between paradigms, input devices, and output contexts, and to include a wide range of measurements. To switch between input devices, for example, a user only needs to change the 'input device' keyword in the parameter file. The SNaP framework currently supports joysticks, keyboards, mice, space mice, trackers, wands, EEG and fMRI devices, the Nintendo Wiimote and the Wii Balance Board as input devices. The SNaP framework also supports the use of CAVEs, HMDs, single and multiple monitors as output devices.

3. Evaluation

It is difficult to compare new VR systems to existing ones because each system supports different paradigms, virtual environments are rendered differently, behavioural measurements are recorded using custom techniques, and the steps required to design and deploy a virtual environment vary from one system to another. The best one can do to judge a new system is to evaluate its usability and determine if the system supports the skill sets of its target audiences.

A usability study was performed to assess the effectiveness and user satisfaction of the SNaP framework. In the study, eight participants (four male and four female) were asked to perform tasks using the SNaP framework. The participants were between 19 and 48 years of age. They included computer and VR novices (3 participants), computer experts and VR novices (3 participants), and computer and VR experts (2 participants). Novice users had minimal or no exposure to either computer programming or virtual reality; experts users were very familiar with the technology in question and used it on a regular basis.

All participants were required to use the configuration media to specify and then deploy two spatial navigation experiments. Participants had to create a 2 phase, 8-trial parameter file that would be used to deploy an existing spatial navigation paradigm. Once a parameter file was written, the participant was required to run the batch file associated with the implemented paradigm. If the task was completed successfully, the participant was able to run through the sample experiment that had just been written. This task was performed once more using a different existing paradigm.

VR experts were asked to perform two additional tasks. Both tasks required the VR experts to make significant modifications to the types of feedback available in an existing paradigm. In the first task, participants made a number of hidden objects appear temporarily; in the second task, participants changed an implementation to enable a dissonant sound to be played whenever there was a collision with an object.

Recorded measurements included the time to task completion, the number of errors made, and the amount of help requested. All participants were able to complete the first two tasks in less than twenty minutes (a mean time of 10 minutes and 8 minutes for the two tasks), they made fewer than two XML typographical errors, and they asked the experimenter, on average, one question. For the additional expert tasks, each task was

completed in less than twenty minutes, with an average of four compilations made and two questions asked.

At the completion of the study, participants were asked to fill out a modified version of the IBM Post-Study System Questionnaire [8] to assess their usability beliefs. The results indicated that all users were satisfied with the system and felt that experiment specification and deployment and peripheral switching was easy. All of the computer and VR novices also felt that the usage of XML as a configuration media was an appropriate choice; they indicated that it was very easy to understand and that the XML format greatly helped them. The expert users (computer and VR experts) agreed that it was easy to extend the currently implemented paradigms and that it would be quite simple to implement a new paradigm using the provided template environment.

4. Conclusions

The SNaP framework assists novices and experts in designing, specifying, and deploying VR-based spatial navigation paradigms. The framework addresses the needs of experimenters and developers. Experimenters do not need an extensive programming background; they are given the capabilities to tailor different spatial navigation paradigms to their needs, and they can deploy experiments in a simple way with multiple input/output devices. Expert users are given control to edit existing paradigms and to create new paradigms using the provided template environment.

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Mobile Immersive Virtual Technologies for Professional Communities of Practice

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Abstract. This paper presents the development of an Immersive Virtual Technology (IVT) system serving a community of practice consisting of psychotherapists who use virtual environments for therapy and treatment of anxiety disorders. The psychosocial theoretical background includes the ethnomethodological approach, Situated Action Theory and the Intersubjectivity of the Utterance model. The dialogical importance promoted at each level of the analysis phases becomes the key to a deeper and more fluid understanding of the assumptions and meaning that guide the actions of and interactions between therapists and patients. The entire system design process is inspired by a dialogical perspective, which aims to effectively and non-rigidly integrate the design stages, analysis in context of use, ergonomic evaluation, creation of the virtual reality (VR) system, and final work on the clinical protocol in use.

Keywords. Immersive virtual technologies (IVT); mobile; usability; community of practice; e-health

Introduction

This project aimed to support the development of an Immersive Virtual Technology (IVT) system, serving a community of practice consisting of psychotherapists who use virtual environments for therapy and treatment of anxiety disorders.

This required the fine tuning of clinical protocols for 3D virtual reality environments (the town square, the lift, the supermarket, the underground station), developed in the framework of the Vepsy-Update project ("Telemedicine and Portable Environments in Clinical Psychology", European Project – IST 2000 – 25323), developing mobile interfaces enabling ergonomic, wireless use of 3D virtual environments and tools for the fruition of virtual environments supporting communication within the therapists' community of practice.

1. Method

We focused on two psychosocial aspects: on the one hand a user-centred approach to refining virtual environments [1], and on the other the training of a community using these environments, modelled on the structure of a community of practice [2].

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With respect to the first aspect, we wanted to put an ergonomic research process to the test in a virtual environment for clinical psychotherapeutic applications, with the aim of plugging the gap created by the lack of recognized methodological and assessment standards in this sector. Through a path winding through the two research projects described in the opening paragraphs, we have demonstrated the theoretical and methodological cornerstones of our approach, with particular emphasis on the need for ever greater adherence to the actual context of use from the viewpoint of ecology of process. Given the lack of standard virtual reality systems for the various disorders and the relatively few officially recognized clinical protocols, we considered it essential [3] to involve all those interested in or with knowledge of the clinical aspect in evaluating the ergonomic dimension. We thus included not only the therapists but also the patients themselves, both considered as "expert users of virtual reality environments used in psychotherapy". The involvement of independent therapists proved not just useful but absolutely essential in analyzing how clinicians with different theoretical backgrounds, expectations, and ideas actually used and interacted with the system.

The conduct of user-based tests on outpatients as well as psychologically healthy users and the opportunities for researchers to have direct contact with patients (e.g. helping the therapist in the technical preparation of the setting at the beginning and end of the session, or by being available at any time to note down the patients' comments and observations) boosted the production of significant data for our goals.

From this perspective, we tried to integrate the ergonomic study with the technical development of the environments, to overcome a division caused by the uncritical adoption of models historically consolidated in the development of technological artefacts in two processes: the first, "idealistic engineering" ("design and produce") and the second "empirical refinement" ("make it, sell it and see how it goes…").

2. Results

Community training take place in two phases:

a) the fine-tuning of an interface enabling *mobile* use of the environments;
b) the construction of the Community of practice of the users of the virtual environments developed. Phase b) is still in progress but will be concluded by June 2009.

Fine-tuning an interface, enabling mobile use of the environments, validated technology usability. As the ultimate purpose of the project was to provide use of the virtual environments developed in IVT mode on mobile terminals, we fine-tuned an interface suited to this purpose. Specifically, the following functions were included to facilitate communication between users (therapists and patients): access to TIV; receipt and exchange of therapist-patient messages; vocal therapist-patient connection; execution of actions requested by the therapist; recording of the actions performed by therapist and patient on database. Particular attention was dedicated to the development, in web technology, of an administration interface accessible by the therapist able to allow him/her to: manage the exchange of messages with the patient, evaluate the actions recorded by patients; prescribe the actions to be performed by the patients; perform research and summary analysis. The choice of Origami type mobile terminal provided a tool with similar size and weight to a PDA device but a larger screen, a microphone for communication, a Windows XP operating system equivalent to the normal version for PCs (that therefore enabled the use of the 3D environments already

developed) and above all capable of multiple connectivity through the LAN, WiFi and GPRS network. The web application was developed using Asp.Net technology. A semi-automatic mechanism able to manage the function without interfering with the effective use of the environments or communication between therapist and patient, to guarantee correct synchronisation between the two applications, used without requiring a permanent connection. The start screen of the web application consists of a simple panel that allows rapid access to the functions available.

3. Conclusion

There is an undoubted expansion of the specific role of the researcher expert in the ergonomic aspect. This role, often found in a "technical/technological" context only and limited to a few phases of the planning cycle, is here extended to the entire project, including training in the use of *mobile* environments.

This result opens new prospects for the production and validation of virtual environments with respect both to analysis of their usability and the training of new users.

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Interpersonal Relationships, Coping Strategies and Problematic Internet Use in Adolescence: An Italian Study

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Abstract. In a few years the Internet has become one of the most relevant means of socialization and entertainment for Italian adolescents. Studies have established a correlation between poor interpersonal relationship, poor cognitive coping strategies and Problematic Internet Use. The aim of the research was to study the characteristics and correlates of Problematic Internet Use in an Italian sample of adolescents. 98 Italian adolescents aged 14-19 were administered checklists assessing Problematic Internet Use, quality of interpersonal relationships, and cognitive-driven coping strategies. Of the participants, 36.7% are characterized by Problematic Internet Use. This subsample showed poorer interpersonal relationships and cognitive coping strategies compared to the non-problematic subsample. Overall quality of interpersonal relationships and cognitive coping strategies were found to be predictors of the level of Internet Problematic Use.

Keywords. Internet addiction, adolescence, interpersonal relationships

Introduction

In a few years the Internet has become one of the most relevant means of socialization and entertainment for Italian adolescents. Internet enable young people to "experiment" with identities and interact with others while maintaining anonymity. This can lead to a sense of belonging that could be very addictive to those who have difficulties in socializing offline. The "normal" use of the Web could therefore be changed into an addictive behavior (literature estimates the prevalence of Problematic Internet Use ranging from 7.5% [1] to 70% [2]).

Studies seem to have established a correlation between poor interpersonal relationship and Problematic Internet Use [1-3].

There is a substantial lack of studies that assessed the prevalence and correlates of Problematic Internet Use in a sample of Italian adolescents, and is therefore of particular interest to further study the reciprocal influence between Problematic Internet Use, a weak interpersonal environment and dysfunctional cognitive strategies.

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1. Aim

The aim of the research is to assess the relationship between Problematic Internet Use, overall quality of interpersonal relationships and cognitive-driven coping strategies of adolescents.

2. Sample and Method

98 adolescents aged 14-19 years old (mean=16.28), recruited in a Milan high school. 46 participants are males (mean age=16.59), 52 are females (mean age=16.00). Participants were administered the following checklists:

- IAT- Internet Addiction Test
- TRI – Interpersonal relations Test
- CCSC - Children's Coping Strategies Checklist
- Internet usage questionnaire
- CBCL - Child Behavior Checklist

3. Results and Conclusions

No gender differences were found in any of the checklists administered. Participants were divided in "problematic Internet users" and "non problematic Internet users" on the basis of the cutoff suggested by IAT for problematic use of the Web. 36.7% of the participants (N=36) turned out to be characterized by Problematic Internet Use.

Compared to non-problematic adolescents, this subsample showed a significantly higher weekly Internet usage time (21.05 hours vs. 8.89; t=4.2; $p<.001$), a significantly higher mean score on the CCSC Avoidance scale (2.44 vs. 2.20; t=3.30; $p<.01$), and worse social relationships mean score on the TRI (90.31 vs. 94.80; t=-1.97; $p<.05$).

The variables measured were inserted as predictors in a linear regression, and the IAT score was used as an outcome. A significant 3-predictor model emerged (F= 6,590; $p<.01$; $R^2=.270$; N= 98). The TRI score of overall quality of interpersonal relations was a first significant negative predictor of IAT score ($\beta= -.337$; $p<.05$). Avoidance Coping score on TSCC was a second predictor of IAT score ($\beta= .380$; $p<.01$), and Active Coping score on TSCC was the third predictor of IAT score ($\beta= .225$; $p<.05$).

Results confirm literature data in this Italian sample of adolescents. Young people that have poor interpersonal relationships are at risk of developing Problematic Internet Use. The intertwine of this result with the cognitive elaboration strategies show that adolescents that are more eager to use Avoidance strategies are at increased risk of developing difficulties interacting with the Web.

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Walking in an Immersive Virtual Reality

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Abstract. The aim of this study was to investigate the effects on gait induced by a completely immersive Virtual Reality (VR) with and without perturbation. Ten healthy subjects were analyzed during over-ground walking in different conditions: standard gait, VR gait and perturbed VR gait. Results showed that subjects immersed in the virtual environment walked slowly, with decreased cadence (-13%) and stride length (-28%) as well as increased base of support in terms of step width (+20%). The perturbation of the VR caused an interesting effect: many computed parameters, still away from the standard gait condition, improved if compared to the unperturbed VR condition. In conclusion, walking in VR leads to gait instability, which is less pronounced in presence of perturbation, probably due to the reweight of sensory inputs. This study could represent the first step for the application of the proposed VR environment to pathological subjects.

Keywords. Virtual reality, gait analysis, biomechanics, postural stability

Introduction

Much of our brain and nervous system is devoted to the processing of sensory input, in order to construct detailed representations of the external environment. This elaborate processing would be of limited value, however, unless we had a way to act upon the environment that we are sensing. In fact, visual, vestibular, and proprioceptive sensory information play a key role in postural and gait stability, and indeed the integration of this multisensory information is the basis for the control of body spatial orientation and movement [1].

Recently, the use of motion capture and Virtual Reality (VR) has been directed towards developing paradigms aimed at altering the contribution of vision during gait and posture and recording the effects, thus opening up many new research possibilities in behavioral neuroscience. In the last decade VR has been used to investigate the role of optic flow in human walking [2], to explore the effects of visual perturbation on gait [3-5], as well as to evaluate the effects of visual perturbation on static posture [6], but there are still many lacks: the effects of perturbation-free VR on gait and posture are still unknown, and "spontaneous gait" and free movement in VR environments are still undetermined [5]. Most importantly, at present there are no studies reporting a system able to merge the subject's virtual representation and the virtual environment.

The aim of the current study was to investigate the effects on gait induced by VR with and without visual perturbation. For this purpose a novel system that integrates a motion analysis laboratory and VR was developed and tested on healthy subjects.

1. Materials and Methods

1.1. Subjects

Ten healthy subjects (5 females, 5 males) participated in this study (mean age: 33 ± 7 years). The study was approved by the local ethical committee and all subjects gave their informed consent.

1.2. Experimental setup

The peculiarity of our setup was the integration of different components: motion analysis laboratory, graphic workstation (Motion Builder™, Autodesk, CA) and Head-Mounted Display (HMD) (Glasstron, Sony, JP). The motion analysis laboratory was equipped with an optoelectronic motion analysis system (Vicon 460, Vicon Motion Systems, Oxford, UK) with six cameras operating at 120 Hz, two force platforms (Kistler, CH), and a synchronized video system. The system was able to synchronously acquire the position of retroreflective passive markers (spherical, 14 mm diameter) placed on the subject, the ground reaction forces and the movies on the frontal and sagittal plane. Retroreflective markers were attached on each subject according to Vicon Plug-In Gait full-body marker set (Fig. 1).

A virtual laboratory environment was created in order to closely resemble the real laboratory with a human model (avatar) inside (Fig. 1 and Fig. 2). Subject position, measured by means of markers and optoelectronic system, was used to update the avatar position in real time, as well as to record subject's movements for offline analysis. The HMD was connected to the graphic workstation and was able to display the avatar point of view of the 3D virtual laboratory in real time (Fig. 2).

Figure 1. Subject wearing the HMD and markers was immersed in the movement analysis laboratory and consequently represented in the virtual laboratory.

Figure 2. The image on the screen is the same of that one displayed on HMD and represents the virtual laboratory seen from the avatar perspective, while subject is walking.

Different conditions were tested: standard gait (SG), gait in VR (VRG) and gait in perturbed VR (15° roll of the virtual laboratory – VRG15).

With regard to gait analysis trials data processing was computed using Workstation software. Following spatio-temporal parameters, usually related to gait instability, were then analyzed for each proposed condition: walking speed, cadence, stride length, step width, stance period (percent of gait cycle), and double support period (percent of cycle).

1.3. Statistical analysis

Gait parameters were compared among three proposed conditions using Friedman ANOVA for repeated measures ($p<0.05$) followed by Wilcoxon paired test with Bonferroni's correction for the significance level ($p<0.017$).

2. Results

All gait parameters were influenced by the VR conditions, as reported in Table 1. Subjects immersed in the virtual environment (VRG) walked slower than in standard condition (SG): the statistically significant walking speed reduction (-46%, $p=0.005$) was caused by the combined effect of decreased cadence (-14%, $p=0.007$) and diminution of stride length (-33%, $p=0.005$). At the same time, subjects showed an increased base of support in terms of step width (+18%, $p=0.011$), longer stance time (+7%, $p=0.005$), and increased double support (+30%, $p=0.005$).

The comparison between VRG15 and SG showed the same statistically significant differences found between VRG and SG. The successive comparison between VRG15 and VRG pointed out interesting results (Fig. 3). There were not statistically significant differences in the step width ($p=0.83$). Conversely all remaining parameters showed

statistically significant improvements when compared to VRG: subjects walked faster (+14%, p=0.005), with increased cadence (+7%, p=0.01) and improved stride length

Table 1. Computed gait parameters in different conditions (values are expressed as mean plus/minus Standard Deviation).

	SG	VRG	VRG15	Friedman ANOVA
Walking speed [m/s]	1.07 ± 0.16	0.67 ± 0.16	0.77 ± 0.17	p=0.001
Cadence [step/min]	104.2 ± 10.5	90.3 ± 7.8	96.7 ± 9.1	p=0.002
Stride length [m]	1.23 ± 0.10	0.88 ± 0.18	0.95 ± 0.18	p=0.001
Step width [m]	0.15 ± 0.04	0.18 ± 0.03	0.18 ± 0.04	p=0.002
Stance [%]	61.9 ± 1.7	66.6 ± 3.1	64.8 ± 2.9	p=0.001
Double support [%]	24.1 ± 3.4	32.7 ± 6.3	29.4 ± 5.9	p=0.001

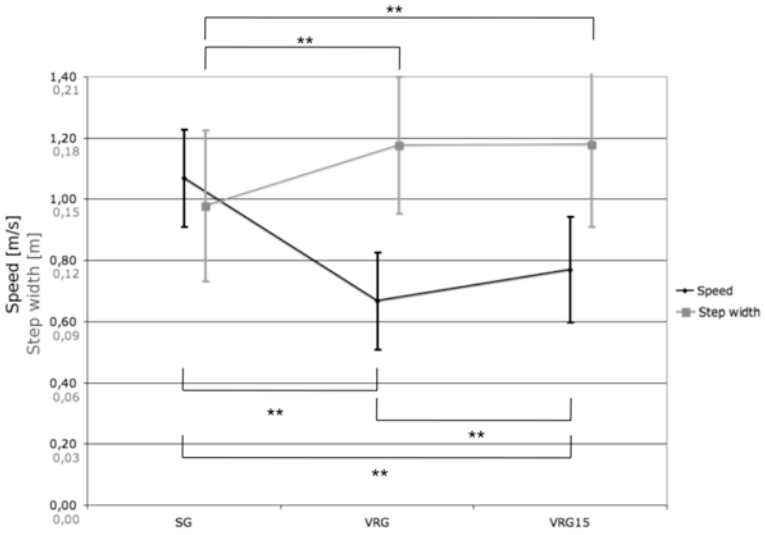

Figure 3. Walking speed (black line) and step width (grey line) reported in the three analyzed gait conditions ** p<0.01.

(+7%, p=0.013). Stance time decreased (-3%, p=0.007) as well as double support time (-10%, p=0.005).

3. Discussion and Conclusion

The purpose of this study was to investigate the effects of immersion in virtual environment on gait. The system was designed to satisfy our aims and it overcomes the primary limitation reported in previous studies, related to the usage of the treadmill for gait analysis in VR. To authors knowledge this VR system is the first one that allows free gait, full offline analysis, a surrounding and convincing environment, and the vision of own body movements, an important feature in system with HMD [7].

The virtual environment we developed is a virtual laboratory very close to the real laboratory (dimensions, colors, objects) and thus we hypothesized that the

performances of gait in VR would be comparable to those reported in real environment. Even more we provided an altered virtual laboratory (15° roll VR) and we expected the perturbation would decrease gait performances.

Results about gait analysis show that consequences of immersion in the virtual environment (i.e.: VRG) are evident: subjects are not able to walk as they do in the real world. Specifically, decreased velocity and stride length, increased step width, increased stance time, and double support, have all been identified as markers of gait instability and are the basis of the characteristically 'cautious' gait pattern commonly observed in elderly people. These findings agree with those reported in previous studies about the less stable gait during treadmill locomotion in perturbed VR [4,5], but are not aligned with our expectations. Many could be the causes of the observed behavior: poor re-weight of sensory information, fear to freely walk without seeing obstacles, and/or absence of a preliminary training to VR.

As for gait in the perturbed virtual environment, we expected the weakest gait performance, but we observed an increased performance with respect to VRG. Previous studies have never tested a similar hypothesis thus other authors do not support this result; only Richards and colleagues reported that subjects walking on a treadmill respond to scene rotation (30°/s roll) by slowing down [3], but our experimental conditions were completely different. The cause of the observed behavior could be related to the potential better details related to the different viewing angle (e.g. floor-wall corners, more furniture) as well as could be the result of the re-weight sensory inputs, with less weight accorded to perturbed vision and as a consequence the adoption of an automatic motor scheme, similar to gait pattern reported in eye-closed gait.

At the end of the analysis, the thesis that better explains our results is related to the different re-weight of sensory information, but a deeper investigation is needed to confirm it. In conclusion, this preliminary study reports that the system we developed is able to alter visual inputs and assess consequent effects on human movement. It is attractive for clinical application and we believe that VR technology provides an excellent tool for neuroscience research.

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Designing a Serious Game for Young Users: The Case of Happy Farm

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Abstract. The interactivity and attractiveness of video games are increasingly deployed for educational and training purposes in what are called "serious games." This paper describes Happy Farm, a serious game targeting young people and aimed at increasing their awareness of the risks connected to the consumption of psychoactive substances. The development of the game is driven by the premise that credibility and usability are pre-conditions for persuasion. The achievement of these qualities is pursued in the design and is generally testified by the results of the users' evaluation. Suggestions for the improvement of the game are also outlined.

Keywords. Serious game, Persuasive technology, Drug prevention

Introduction

Serious games [1,2] represent a growing area of computer applications that use videogames to improve users' awareness or skills (e.g. in cognitive training [3]). In addition to being appealing, serious games also offer the advantage of an interactive learning modality, which allows the user to engage in some behavior instead of remaining passive. Abt [4 quoted by 14] states that video games are able to provide a "dramatic representation" of a subject and allow players to take on realistic roles, to cope with problems, to make decisions, and to get immediate feedback from their own actions without actual harm.

Happy Farm, the serious game presented here, is designed to address young people and increase their awareness of the risks involved with consuming psychoactive substances. Similarly to a previous serious game developed by the same research group [5], this software can be adopted by social workers and teaching personnel within larger prevention programs (one of the main information channels for young people in Europe [6]). In order to be persuasive, however, this kind of software needs to be perceived as credible by its final users [7] [8]. In Happy Farm, credibility resides in the perceived accuracy of the information provided and in a verisimilar depiction of the night world. The strategy with which these dimensions were embedded in the game is described in the paper, followed by a synthesis of its evaluation.

1. Game rationale

Happy Farm was created with Macromedia Flash Professional 8. The game environment is a club called "Old Farm," which includes a bar, a chill-out zone, a garden, a parking, and a dance floor. All characters (i.e. bartender, dancers, DJ, dealer, best friend, cute girl, crew, nerd, bossy guy) are anthropomorphized animals (Figure 1a) including the main character (Figure 1b). Aspects of the social environment such as the characters' behavior, expressions, and dressing style or the music associated with different moments of the narrative and areas of the club are carefully selected. The cartoon-like style with anthropomorphized animals populating the scenes adds an ironic perspective on the situation, which is appreciated by a young audience and decreases any expectation of a fully realistic graphic representation.

Playing the game does not require specific instructions. The narrative develops through 26 scenes, each one lasting about one and a half minutes. At specific points in the plot, the player is asked to choose among risky or safe behaviors (see Figure 2a), influencing the subsequent development of the narrative. Some immediate consequences of the chosen behavior are shown soon after the selection through an animated sequence (Figure 2b). At the end of the game, the user is given a straightforward synthesis of his/her night out, like in any final screen of a classic video game match.

At relevant points in the narrative, the player has the option to browse a book describing characteristics of an illegal substance, its short-term effects (Figure 3a), and the legal aspects connected to its use. It also contains advices about solving difficult situations, and an image gallery. Substances included are ecstasy, alcohol, marijuana, ketamine, LSD and cocaine. Two dangerous phenomena are described, namely abuse and consumption of different substances. Short-term effects are privileged over long-term given the time span of the story narrated in the game (i.e. a night). Information is provided with plain language and images.

The connection between actions and consequences as well as the ability to see the link between events is considered a powerful educational or persuasive strategy [9].

Figure 1. Scene of the game with anthropomorphized animals as characters (left). Main character (right).

Figure 2. Nodal point of the game, where the user chooses among possible behaviors (left). Scene depicting the possible consequences of LSD (right).

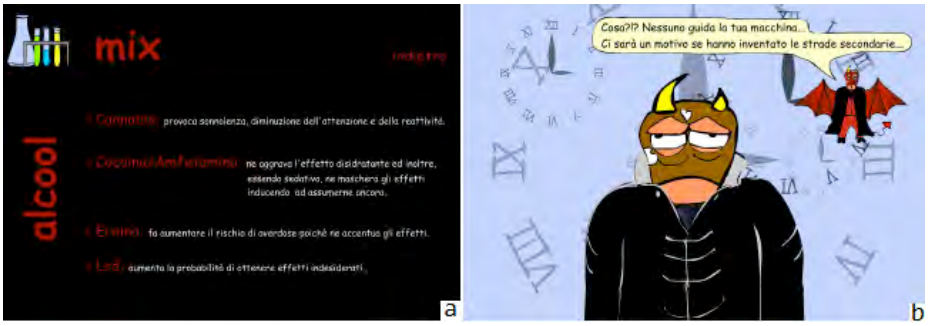

Figure 3. Excerpt from the information book (left). Devil whispering bad advice to the main character (right).

Embedding information in the narrative, giving optional access to objective facts about biological and legal consequences, and contextualizing risks in familiar scenarios increases the game's persuasiveness. Crucial choices are emphasized and correspond to key moments where the user intervenes; thus, the choices—and their consequences—appear to belong to the user.

To further emphasize the dilemmas encountered while trying to enjoy a night out, the main character is accompanied by an angel and a devil throughout the duration of the game (Figure 3b). They alternately appear before or after a choice, in order to provide good advice or to tempt. The negative consequences are depicted in a practical fashion (e.g. family fight, big expense, loss of driver's license, poor figure) as well as the temptations (e.g. getting relaxed, forgetting, or seducing).

2. Design: A user-driven approach

Two common techniques to involve users in the design phase were adopted: brainstorming [10] and affinity diagrams [11]. The former aims at producing ideas in a group thanks to the participants' heterogeneity and to a facilitator. The latter is a bottom-up process aimed at grouping ideas within commonly negotiated categories. The former encourages creativity, the latter allows systematization.Two distinct groups of 20 and 22 students, respectively, (mean age 22.2) were involved in the design phase, the first generating ideas through a brainstorming and the second organizing them

through affinity diagrams. The participants were informed beforehand that the collected information would be used for a video game to increase awareness of the risks connected to drug consumption. These techniques were used to collect ideas and personal experiences about a typical night in a club as well as samples of the language used by 20-somethings. The suggestions received helped define the game scenes and dialogues.

3. Users' evaluation of usability and credibility

Once a Beta version of Happy Farm was completed in Italian, the evaluation of its usability, attractiveness, and credibility was carried out with final users. The evaluation consisted of a game session and a questionnaire administered after it. The items were either specific to Happy Farm characteristics or adapted from common usability questionnaires such as [12]. They consisted of 28 statements to which users could agree or disagree on a five-point Likert Scale.

A total of 175 people (63 females and 112 males, mean age 22.6) were questioned in two popular cafeterias and an international music festival in Italy. They were requested to use the game, to provide some personal information (age, education, job), and then to fill in the anonymous questionnaire.

The results were generally positive (Percentages are referred to players who responded "strongly" or "completely agree", namely elected the positive degrees in the Likert scale). Usability was rated high: for instance, 89.4% users found it easy to play, 91.6% found the story clear, and 82.6% understood the meaning of the icons. Regarding attractiveness, 66.7% users liked the game, 70.4% found the graphics to be funny, and 69.8% felt involved in the narrative. Regarding credibility, 63.1% users declared that the dialogue suited the story, 58.5% found that the voices suited the characters, 65.6% found the story credible, and 75.9% found the drug consumption effects credible. The complexity of the game (42.4% found the game too easy) and the music selection (42.6% respondents chose the middle point of the scale) were marked as areas for improvement.

In order to check the effect of the respondents' anagraphic characteristics, a MANCOVA on the responses for each item was performed, considering gender and education as fixed factors and age as a covariate. The analysis yielded significant results for the main effects of gender for the item "I liked the game" [$F_{(1;130)}$=5.582, p=0.20], with males rating the game more positively than females. The main effects of education for the item "Game was easy to play" was also significant [$F_{(1;6)}$=2.889 p=.012], with higher education respondents finding the interface easier to use. Main effects of education [$F_{(1;6)}$=2.246 p=.043] and age [$F_{(1;130)}$=8.044 p=.005] were found significant for the item "I found a good correspondence between my choices and what were represented as consequences in the game", with older and less educated respondents finding better correspondence.

4. Conclusions

This paper describes the design choices and the reasons behind the development of Happy Farm, as well as the users' evaluation. It shows that usability, attractiveness, and credibility are to a great extent achieved. The high rate of credibility in particular

shows that the game has an important requisite for being persuasive. The results of the evaluation also suggest areas of improvement. For instance, the game could attract a wider audience by making characters and situations more appealing to women. In addition, the game could attract players already familiar with it and be used in a longer awareness program by adding more complexity [13]. Future developments can then include more choices, to generate a larger variety of plots covering more situations, and different levels, connecting level upgrades to the users' ability of making safer choices

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High Resolution 3D Models for the Teaching of American Sign Language

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Abstract. Millions of Americans in all age groups are affected by deafness and impaired hearing. They communicate with others using the American Sign Language (ASL). Teaching is tutorial (person-to-person) or with limited video content. We believe that high resolution 3D models and their animations can be used to effectively teach the ASL, with the following advantages over the traditional teaching approach: a) signing can be played at varying speeds and as many times as necessary, b) being 3-D constructs, models can be viewed from diverse angles, c) signing can be applied to different characters (male, female, child, elderly, etc.), d) special editing like close-ups, picture-in-picture, and phantom movements, can make learning easier, and e) clothing, surrounding environment and lighting conditions can be varied to present the student to less than ideal situations.

Keywords. American Sign Language, ASL, 3D Models, hearing impaired, deafness, rehabilitation

Introduction

Despite the fact that close to 10 million Americans from different ages have some degree of hearing impairment, and that ASL is the fourth most commonly used language in the U.S., most universities do not teach ASL because "it is not an academic language" [1].

The American Sign Language (ASL) is a complex visual-spatial language that is used by the deaf community in the United States and English-speaking parts of Canada. It is a linguistically complete, natural language. It is the native language of many deaf men and women, as well as of hearing children born into deaf families. It is usually taught as a person-to-person interaction and to a lesser extent using videos and books. Teaching ASL is a challenging task. ASL has a very complex grammar. Unlike spoken languages where there is just one serial stream of phonemes, sign languages can have multiple things going on at the same time. This multiple segmentation makes it an exciting language for linguists to study and a hard language for hearing impaired people to learn. ASL has its own morphology (rules for the creation of words), phonetics (rules for hand shapes), and grammar that are very unlike those found in spoken languages. ASL and other sign languages have been described as "gestural" languages. This is not totally correct because hand gestures are only one component of ASL. Facial features such as eyebrow motion and lip-mouth movements are also

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significant in ASL as they form a crucial part of the grammatical system. In addition, ASL makes use of the space surrounding the signer to describe places and persons that are not present [2,3,4].

1. Specific Aims

To develop and validate a digital library of high resolution 3-D models for the teaching of the American Sign Language.

2. Methods

Signs, face expressions, and body postures used in ASL will be obtained from trained interpreters, books and videos, and reproduced in 3-D meshes of human figures covered with high resolution textures and rigged for animation. These poses will be used as Key Frames to produce sequences which mimic ASL words and phrases. Clips will be rendered and stored constituting a library, from which they can later be used to construct larger animation/video segments similar to ASL speech. Once corrected by a Senior ASL Interpreter, they will be presented in DVD collections to three interpreters and three hearing impaired persons who will try to identify their meaning. Results among interpreters and subjects will be compared to establish the utility of the collection before testing it in a larger population.

Classical modeling and animation techniques as well as traditional cinematic production of digital content will be used. Initial models will be male and female adolescents and young adults. Later, constructed animations can be translated to other characters. Poser® 6 or 7 by e-Frontier® (http://www.e-frontier.com/) will be used for character creation. Either Poser 3D meshes or those produced by Daz3D® (http://www.daz3d.com) will be used and covered with textures from the same manufacturers or from independent creators acquired from web stores like Renderosity© (http://www.renderosity.com). Expression morphs and signing poses will be created in Poser® as this is the greatest strength of this program. Freeware utilities (MorphManager, etc.) are then used to delete unnecessary morphs from the file to make it smaller. Poser® is not good at lighting and smooth and fine controlled animation, and for that reason, the models will be transferred to 3D Studio MAX® which is an industry gold standard for computer animation (www.autodesk.com/3dsmax). Animations will be produced at 720 x 480 pixels which correspond to DVD quality content in NTSC American standard. They will be rendered at 30 frames per second and will include ½ second of a base position at the beginning and end. Rendered uncompressed AVI files will be the source files of the library. Once the modeling and animation phase is concluded, copies of the AVI videos will be transferred to Premiere® which is a non-linear video editor. In Premiere audio or subtitles can be added to the animation as well as other necessary editing modifications. From Premiere® the animations will go to After Effects® in which special effects can be introduced like “ghost” movements, picture in picture of close-ups, rotoscopic (drawing over the video) animations, etc. Encore® will be used to author CDs, DVDs including chapter generation and title and subtitle pages which lead to the chapters. Premiere®, After Effects®, and Encore®, are products of Adobe® (http://www.adobe.com). Procoder® and other converters will be

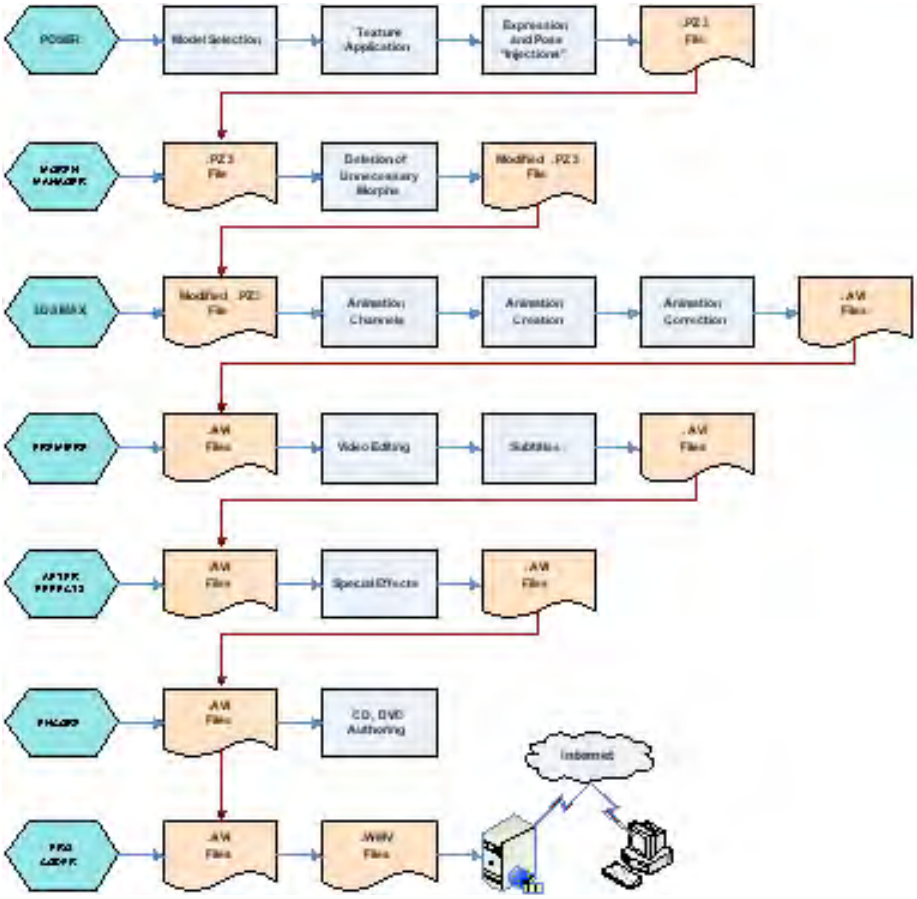

Figure 1. Schematic representation of the development process.

used to generate videos suitable for the web, iPods, mobile phones and other applications (Figure 1).

3. Results

The final library should contain: a) the complete American Manual Alphabet, b) no less than 1000 sign words, c) no less than 50 icons (facial expressions, gestures, and body language), d) no less than 50 baby (kids) signs, and d) no less than 25 common phrases. Currently, approximately 30% of the library has been developed (Figure 2).

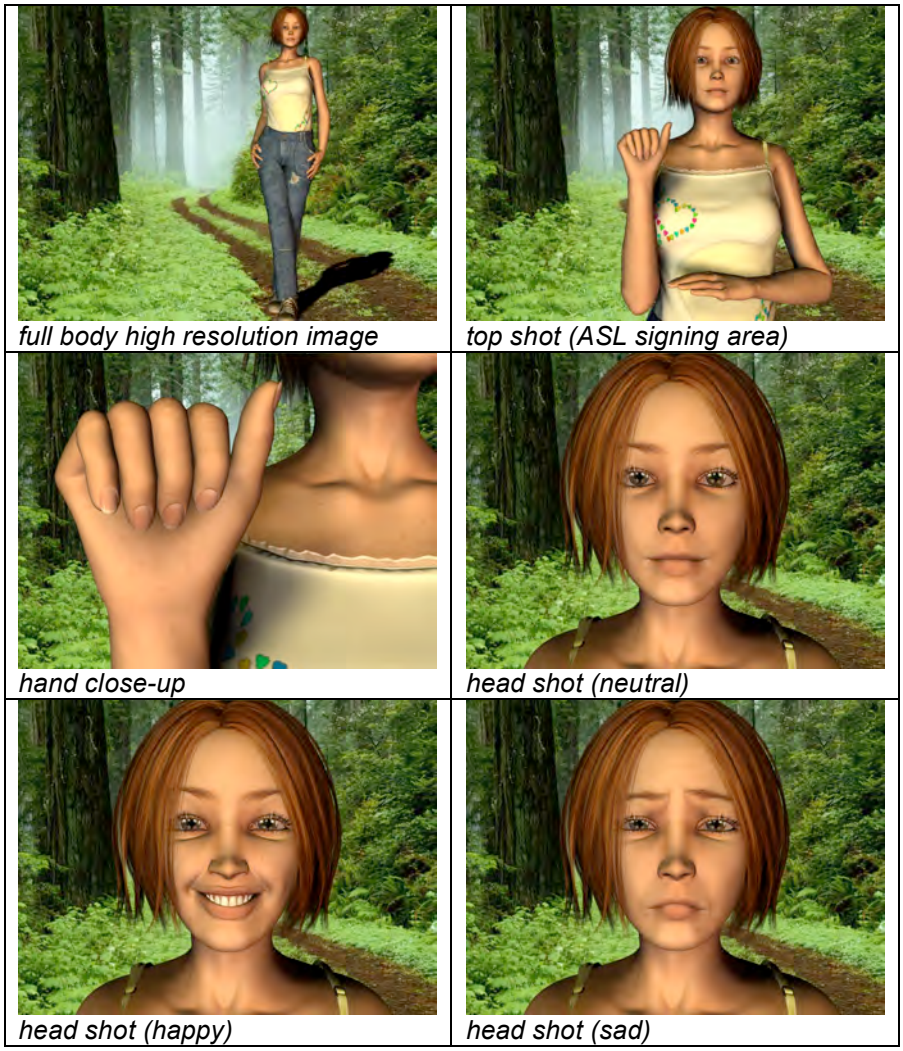

Figure 2. Example of one of the characters.

4. Validation

All models and the resulting animations will be presented to and corrected by a Senior ASL interpreter from UC Davis Medical Center's, Medical Interpreting Services. The library will be burned to DVD and presented to three different ASL interpreters and three hearing impaired patients. The number of correctly interpreted signs will be determined as well as the concordance among interpreters and patients.

5. Future Goals (new projects)

- To continue developing the library with new words and constructs in a permanent effort to make it richer.
- To develop specialized libraries of signing terminology (medical, legal, etc.)
- To produce diverse electronic and printed content using the library. Content can be in the form of CDs, DVDs, web-based instruction, videoCasts to iPods and mobile phones, computer games, books, flyers, etc.
- To promote the learning of ASL as a second language not only with families and friends of deaf people, but in high schools and colleges alike.
- Considering that one-third of the adult population will develop some degree of hearing loss, it would be wise to contact adult and senior citizen associations and to promote the teaching of ASL at least to fulfill basic daily communication requirements before affected people lose communication capacity.
- To network with research groups working on automated English-to-ASL translation systems to propose the use of the library.

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Addiction to Internet Replies

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Abstract. This research introduces a new addictive behavior in cyberspace, which is called Internet Reply Addiction. This phenomenon was found and empirically investigated in Korea where addictive behavior on Internet reply is common. This research suggests that the cause of this kind of addiction can be inferred from the Confucian cultural tradition that oppresses free expressions of individuals in real life settings.

Keywords. Internet Addiction, Reply Behavior, Confucian Culture

Introduction

Most Korean websites of organizations and even individuals such as celebrities allow any viewers of the website to comment on what is on the website or anything that is on viewers' mind. This usually has a form of posting and replying to a certain posting or comment previously made/provided by the website or other contributors. This "posting and reply posting" type of two-way communication is getting more and more popular among the Internet users in Korea. However, too much use of replies seems to cast a shadow on the future of this two-way communication in cyberspace. For instance, websites which provide news and postings of other viewers on certain issues or websites of celebrities that garner all kinds of comments by fans and "anti-fans," can instigate a certain type of people to unleash their hidden desire of posting their replies repeatedly on multiple sites. Dramatic examples of this type of repeated posting on a single website/multiple websites are reported in newspapers and on personal blogs as well. According to a major Korean newspaper [1], 0.84% of a Korean website visitors posted replies to news postings; 3.4% of the "repliers" produced 50.6% of all the replies; on average these "heavy" repliers produced 70 plus replies per person during a one month period; each of 137 "super heavy" repliers produced more than 1,000 replies during the same period; one "ultra super heavy" replier produced more than 7,000 replies during the same period. In line with this report, a Korean personal blog [2] provided evidence that one person posted the same replies to a web posting 7,720 times during a 5 day period from June 26 to June 30, 2008 on a single website. With the increased popularity of reply postings on Korean websites, cases of "malignant replies" seem to increase not only in terms of number but also in terms of their destructive effects

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on the repliers and the original contributors. According to another newspaper [3], cases of psychologically/socially damaging replies containing emotionally insulting words/curses and cases of the Internet posting-related defamation lawsuit are on the increase. Seriously enough, cases of suicides attributable to malignant replies were also reported [4]. Since "addictive behavior" can be defined [5] as "behavior that is excessive, compulsive, beyond the control of the person who engages in it, and destructive psychologically or physically," excessively repetitive reply postings fit the definition of addictive behavior. Consistent with our observation, one online survey reported that "netizens" may suffer from addictions to the Internet reply posting, game and shopping [6]. According to this report, roughly 20% of the survey respondents said that they feel nausea when they refrain from posting replies to postings of their interest. In addition, most respondents said that they have difficulty in controlling their behavior although they are aware of their addictive behavior. Drawing on a synthesis of these observations and extant research on addiction, we posit that excessive reply posting can be addictive. Thus, we would like to name this new type of Internet addiction as "reply addiction." We empirically investigate the phenomenon of Internet "reply addiction" in Korea.

1. Methods

Although reply addiction phenomenon is quite new, there is some clue as to the demographics of the Internet repliers: the majority of the repliers are male and the repliers are well represented in all age groups. However, little is known as to what causes reply addiction. Without prior research to rely upon, the reasons why website visitors become addicted to this kind of behavior have to be found from the definition and the characteristics of addictive behavior. As shown elsewhere, addictive behavior may do some good for the respective person since addictive behaviors reduce stress. We would like to draw on this aspect of addictive behavior and posit that reply addicts are getting "something good (i.e. reducing stress) " out of engaging in the excessive behavior. One big source of stress for Koreans is the Confucian collectivist cultural tradition where individuals are supposed to conform to social norms in terms of verbal and behavioral expressions in public. Confucian and Judeo-Christian cultures differ greatly with respect to the dimension of collectivism and individualism. An individual's goals in Western cultures have primacy over group goals. In a similar vein, it is observed that Chinese, Japanese and Koreans, all of whom share a Confucian cultural background, are collectivist in terms of their cultural orientation. Thus, most Koreans feel strong social pressure to comply with social norms regardless of their personal preferences. An old saying in Korea goes like this: "Rough edges of a stone call for a chisel." Koreans in general are said to keep themselves away from standing out in public. If this conventional wisdom still works in Korea, free expressions of individuals' feelings in public must be inhibited. We thus would like to posit the following: The higher the stress coming from the pressure of being forced to conform to social norms in public, the more likely for people to engage in the addicted behaviors to reduce the stress. Thus, in the context of posting and reply posting on websites, we would like to empirically prove the following hypothesis.

H1: The higher the stress coming from various social pressures, the more likely for website viewers to be addicted to reply to reduce the stress.

We posted a recruiting message on 5 major Korean Internet portal sites where would-be reply addicts are supposed to hang out during the period of March 1-March 31, 2008. In this posting, we asked anybody who thinks that they are addicted to "reply" to take a survey on our own survey website. Specifically, following questions were asked.

1. Your sex,
2. Your age,
3. Do you think that you belong to middle-class? [Yes or no],
4. Your educational level (name of your final degree),
5. Average number of replies you have done to a website posting of your interest
6. "When writing replies, I feel liberated". Rate your agreement with this statement. [1 very much disagree 2 disagree 3 neutral 4 agree 5 very much agree].

2. Results

We had 567 participants in the survey. A mean number of average "replies" posted by survey participants was 172 and this number shows that they are, in fact, reply addicts who spend high amount of time and effort in posting replies to the website postings of their interest. The mean score of responses on question #6 was 4.3. Our data show that these self-reported reply addicts are mostly over 35 years old men who are well-educated and middle-class. These men are likely to suffer from the burden of the Confucian cultural protocol, which requires conformity to the social norm and does not allow deviant expressions and actions from the referent group members. Because of the Confucian cultural tradition, these addicts are supposed to maintain their public dignity by inhibiting themselves from showing sometimes extreme emotions in public. In order to empirically test H1, we conducted a simple regression analysis where the dependent variable is the agreement score from question #6 and the independent variable is the average number of replies (i.e. the mean score on question #5). First, the following regression formula was created:

$Y = AX + B$ where Y: The degree of perceived liberation X: Average numbers of replies A, B: Regression coefficients.

We then used SAS 8.02 software package to run the regression and obtained the following result: F-value: 72.25 P-value: 0.003. The results show that the regression model is statistically valid with p-value of 0.003.

3. Conclusions

As the average number of reply postings increases, the degree of perceived liberation increases. In other words, people become addicted to "reply" on websites since the addiction gives them liberating feeling from various social pressures including conformist

Confucian tradition. That is, Korean men who comprise the bulk of reply addicts appear to get addicted because they feel their stress reduced when they repeatedly post (sometimes malignant) replies on websites. The fact that this unique phenomenon of reply addiction is observed only in Korea to date seems to show the interplay of the high level of Confucian cultural influence in Korea and the ease of escape from the social pressure through the widespread use of highly-developed IT infrastructure of Korea. Thus we may conclude that reply addiction in Korea is possible and in action due to following two factors. 1. People in general have access to broadband high-speed Internet almost everywhere in Korea at a very affordable price. Thus, despite the demographic differences, many people are actively using the Internet. Therefore, virtually unlimited access to the Internet gives them a chance to be more expressive and hide behind anonymity at the same time. 2. People who are deeply stressed in their lives by various social pressures including Confucian cultural tradition tend to get addicted to reply to website postings to reduce their stress; they have been waiting for the right chance to dump their frustration and feel liberated at least in cyberspace.

Acknowledgement

This work was supported by the research fund of Hanyang University (HY-2007-I).

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Tools, Perspectives and Avatars in Blended Reality Space

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Abstract. *Blended Reality Space* is our term for an interactive mixed-reality environment where the physical and the virtual are intimately combined in the service of interaction goals and communication environments aimed at health support and rehabilitation. The present study examines the effect on rated *presence* and *self-presence* of three key factors in the way blended realities may be implemented for these purposes. Our findings emphasize the importance of tangibility for presence, but suggest that presence and self-presence are unrelated phenomena. These findings will be incorporated into design principles for our planned work to develop free movement-based interactions for motor rehabilitation as well as blended-reality spaces for collaboration between hospitals, care organizations, and the home.

Keywords. Blended Reality Space, Tangibility, Presence, Rehabilitation

Introduction

Blended Reality Space is our term for an interactive mixed reality environment where the physical and the virtual are intimately combined in the service of interaction goals and communication environments aimed at health support and rehabilitation [1]. The present study examines three key factors in the way blended realities may be implemented for these purposes: (i) the extent to which tangible tools play a role in interaction; (ii) whether a first-person or a third-person perspective is provided from the user's point of view; and (iii) if a third-person perspective (of a self-representing avatar) is used, how closely the representation matches the appearance of the user. We focused on the effect of these variables on rated presence [2] and self-presence [3]. The study is novel because it combines manipulations of tangibility with those of viewpoint, avatar identity, and examines their effect on both perceived presence and self-presence.

1. Blended Reality Space and Our Hypotheses

Blended Reality Space is an emerging kind of interaction space where the physical and the virtual are closely combined [1]. Through this physical-virtual combination, the physical objects provide users with clues about the virtual environment and help them develop skills in their environment, such as picking up, positioning, altering, and

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arranging objects [4]. The aim of this study is to gather further insights for strategic combinations of such key factors as *Presence*, *Tangibility*, *Perspective,* and *Avatars* for the development of effective Blended Reality Spaces. These factors are still under-explored as to how they effect perceptions of emerging interaction space.

Various scholars have debated the definition and value of the concept of presence. Presence is described as the perception of a virtual experience as a physical experience. Self-presence is an extension of the sense of self-identity, and is seen as the extent to which a participant feels a virtual representation of self to be accurate [2,5]. Presence in a virtual environment (VE) traditionally depends on shifting attention from the physical environment to the VE, but does not usually require the total displacement of attention from the physical locale [6]. Presence is also not constrained to high technology situations, because - according to some authors at least - we may feel quite high presence when reading books or watching movies [5]. The present study used a Nintendo Wii video game and console, commonly available and widely used technology that can provide a satisfying and involving gaming experience even with relatively inexpensive technology, including computer graphics with quite low resolution. Based on earlier findings, we arrived at the following hypotheses:

Hypothesis 1: *Participants who use a physical tool will feel more presence than participants who use only their body as a tool, with both 1st and 3rd person perspectives.*

Many researchers have experimented with sensor-based techniques for interacting with virtual entities via the manipulation of physical objects in space. Such interaction concepts are often termed "tangible" and have been frequently discussed in the HCI (Human Computer Interaction) literature. The main idea of such a tangible interface, built on movement and position sensing techniques, is to provide physical forms, which serve as both representations of and controls to digital information. The applications make the digital information directly manipulable with our hands and perceptible through our peripheral senses by physically embodying it [7-9]. The effects of tangibility on presence have yet to be fully studied and explicated, but our expectation was that a physical tool would enhance the sense of presence.

Hypothesis 2: *Participants who have a 1st person perspective on the game will feel more presence than with 3rd person perspectives, both with a tool and without.*

A 1st person perspective duplicates the natural view of one's own actions by providing interaction with the blended reality space as if from the players' own physical viewpoint [10]. With a 3rd person perspective, they see their own representation as an avatar whose bodily movements reflect their physical movements in real time [10]. Because of this difference, we expected a stronger feeling of presence to be elicited with a 1st person perspective.

Hypothesis 3: *Participants who play with an avatar similar to self will feel more presence than participants who play with an avatar dissimilar to self.*

Hypothesis 4: *Participants who play with an avatar similar to self will feel more self-presence than participants who play with an avatar dissimilar to self.*

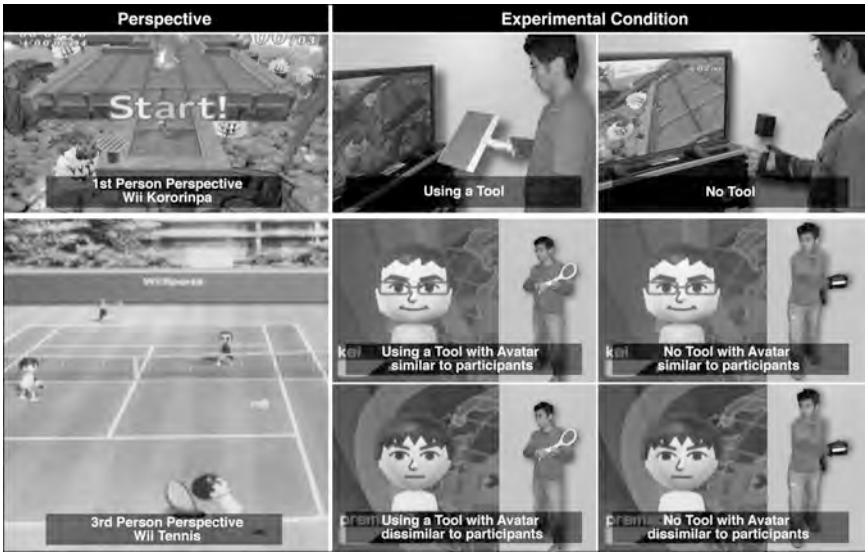

Figure 1. Experimental Conditions

Hypothesis 5: *Participants who use a tool will feel more self-presence than participants who use their body as a tool for both an avatar similar and dissimilar to self.*

Avatars provide a concrete representation of the players' actions and identity [11][12][13]. We expected that there would be both higher presence and self-presence when the avatar resembled the player more accurately. We also expected that using a tool with either kind of avatar would produce higher presence than not using a tool.

2. Method

To test these hypotheses, we created several different versions of blended reality space, based on the Nintendo Wii gaming environment, its wireless movement-sensing Wiimote interaction device, and a 60" plasma display (as shown in Figure 1). For the present study, the simplest avatar-oriented game from various Wii games was chosen: Wii tennis (3rd person view) and Kororinpa (1st person view). Wii tennis requires a swinging motion of the handheld Wiimote to hit the virtual ball, while Kororinpa requires more delicate hand movements of the device to guide a marble through virtual mazes. For the tangible (with tool) conditions, we embedded the Wiimote in a physical tennis racquet or maze board (Figure1). For the no tool conditions, the Wiimote was worn in a glove on the back of the participant's dominant hand. In the third-person view conditions, the avatar used was either the pre-supplied one (identical for all participants) or was one designed by each participant to resemble him or herself, known as a Mii. Miis are customizable and allow the participants to capture a likeness or caricature of themselves, or others.

Sixteen participants (20 to 65, average age 37 years) volunteered and took part in the study. After each game in the various conditions, the participants filled out a questionnaire regarding their feelings of presence and self-presence. Subjects were

asked to rate each question on a scale from poor to excellent, which were translated by the experimenter into a numerical scale from 0 to 5. T-tests were used in order to compare the means of the dependent variable scores. The questionnaire consisted of 28 questions, which in total correspond to six factors thought to be correlated with presence and self-presence: Awareness, Immersion, Involvement, Naturalness, Realness, and self-presence. We partially based this on the presence questionnaire published by Witmer & Singer in 1998 [6].

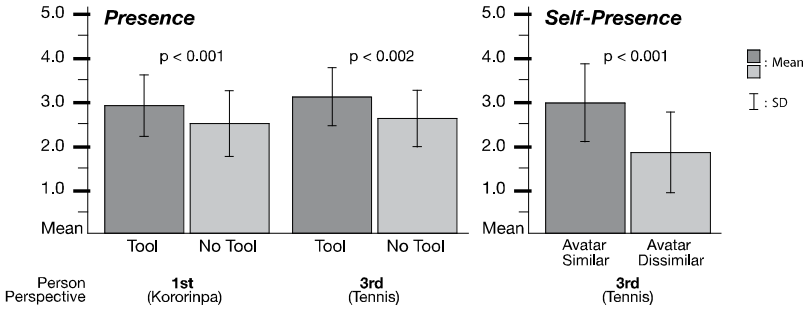

Table 1. Effect of tool, perspective and avatar on Presence and Self-presence

3. Results

As we predicted, there was significantly higher **presence** when using a tool versus no tool for both 1st and 3rd person perspectives ($p < 0.005$, paired T-test). But there was no significant effect on **presence** for playing from a 1st person versus a 3rd person perspective for either tool or no tool. There was also no effect on **presence** of playing with an avatar similar versus dissimilar to self. There was however a highly significant increase in **self-presence** when playing with an avatar similar to self versus dissimilar to self ($p < 0.001$, paired T-test), but no effect of playing with a tool versus no tool.

4. Discussion and Conclusions

Our findings confirm the importance of incorporating tangible tools in blended reality spaces aimed at eliciting a high sense of presence, but suggest that tangibility has no effect on self-presence. Although a 1st person perspective is of course more natural than a 3rd person perspective on one's own actions, it did not increase presence, which is an interesting and important finding for the future of blended reality spaces (see also [10, 14,15,16]). Accuracy of the virtual representation of self strongly affected rated self-presence, but did not affect presence (see [3, 17]). Thus, presence and self-presence appear, on the basis of our overall results, to be quite unrelated phenomena. The latter may be more important for social presence than individual presence, which suggests a tension in providing for both - but also gives hints for a nuanced approach to design.

The results will contribute to the design and implementation of strategic combinations of tools, perspectives, and avatars for various application scenarios. These findings will, for example, be incorporated into design principles for our planned work to develop free movement-based interactions for motor rehabilitation as well as

blended reality spaces for collaboration between hospitals, care organizations, and the home.

Acknowledgements

The authors would like to thank the study subjects for supporting the collection of data. The authors also thank Priyantha Wijayatunga for thoughtful suggestions of the statistical data. Kei Hoshi is a Ph.D. student partly supported by the Swedish Institute.

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Facial Synthesys of 3D Avatars for Therapeutic Applications

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Abstract. People with autism spectrum disorder (ASD) find it difficult to recognize and respond to emotions conveyed by the face. Most existing methodologies to teach people with ASD to recognize expressions use still images, and do not take into account that facial expressions have movement. We propose a new approach that uses state of the art technology to solve the problem and to improve interactivity. It is based on an avatar-user interaction model with real time response, which builds upon the patient-therapist relationship: it is designed to be used by the therapist and the patient. The core technology behind it is based on a technique we have developed for real time facial synthesis of 3D characters.

Keywords. facial animation, computer graphics, autism spectrum disorder, therapy, rigging, modeling, animation, HCI

Introduction

Many efforts have been done to teach people with ASD to recognize facial expressions with varying results [1,4,5], but none focused on using real time facial synthesis. Most methodologies use Paul Ekman's approach [2] based on photographs of facial expressions. Besides having severely limited interactivity, they fail to reproduce the dynamics of a facial expression: far from being a still image, it is the voluntary and involuntary contraction of muscles that produce different facial movements.

Our methodology is designed to assist people with ASD to recognize facial expressions in a playful way. The system will run on PC and Xbox 360, so it can be used by specialized personal or directly by relatives of the patients.

1. Method / Tool

The core technology builds on a facial synthesis method [3] we have developed, that eases the real time animation process. The main research challenges arise from the synchronization and realism problems, the support for the reusability of facial components, and the need for an avatar-user interaction model with real time response.

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Our methodology uses a videogame based approach, where the avatars can adopt different appearances, like human, cartoon or fantastic creature. It contains a set of exercises embedded in the gameplay that reinforce the learning process and generate a real time avatar response based on direct therapist input or on a set of predefined rules.

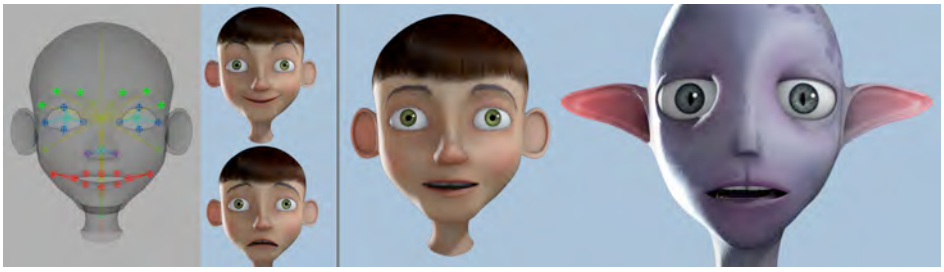
We also include a facial expression editor capable of displaying 3D characters in real-time. This allows the therapist to adjust or create new exercises on the fly, without the need of artistic or technical skills.

2. Results

To achieve high quality facial synthesis it is crucial to have an efficient rig that animates in real time (a rig is a set of controls that allow the animation of a character). We consulted several specialists to determine how the characters should look like, especially for non-human avatars. They suggested that the position and proportions of the eyes and mouth should follow the anatomy of the human face, so that the patients can easily map what they learn from the avatar to real life.

We have developed and extensively tested a sophisticated facial rig that deforms in real time, has anatomically correct deformations, and is easy to adapt. Thus, this rig becomes the foundation of the system pipeline. It will ensure that the characters animations follow a consistent artistic style, to ease the process of recognizing facial expressions and emotions. Figure 1 shows screen shots of some of our avatars, the rig that drives character animation and two facial expressions (happy, sad).

The user interface includes: a 3D avatar on the main window, the facial expression the user needs to match, the score and the level of difficulty of the game. On the main game area, the avatar displays a sequence of expressions and the user needs to match the expression display on the upper right part of the screen. These expressions are generated randomly at the beginning of each exercise. There are different types of exercises: match the facial expression on all of the face, match the facial expression on the upper part of the face or match the facial expression on the lower part of the face. Figure 2 shows a child playing the game and the videogame user interface.



(a) (b) (c) (d)

Figure 1. (a) rig, (b) expressions, (c) and (d) examples of our 3D models (copyright 2009 Face In Motion).

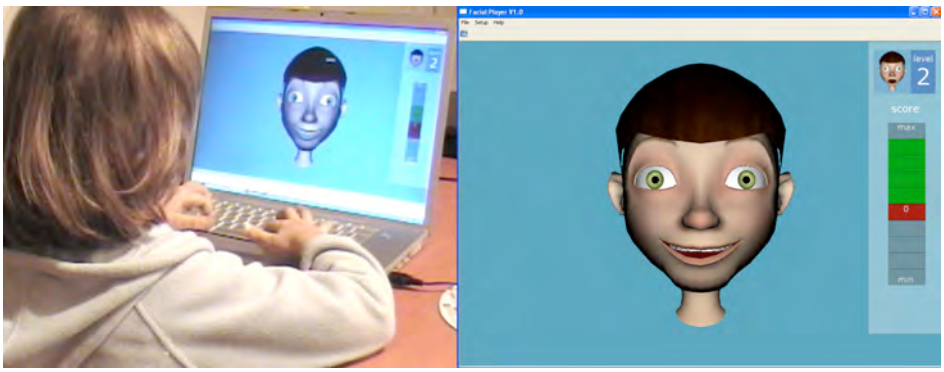


Figure 2. User playing the game (left), game user interface (right) (model copyright 2009 Face In Motion).

3. Conclusion

We argue that current technological advances in character animation can substantially improve the way we teach people with ASD to recognize facial expressions and emotions. Our approach introduces on a novel and sophisticated interaction model that enables patients to learn by imitating the avatars' movements. Future work includes a field test with therapists and patients for further validation of the methodology, and suggestions for new exercises to be integrated in the system.

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A Free Tool for Motor Rehabilitation: NeuroVR 1.5 with CamSpace

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Abstract. NeuroVR 1.5 is a cost-free virtual reality platform based on open-source components, allowing professionals to easily modify a virtual world, to best suit the needs of the clinical setting. The goal of the present project is to extend the functionalities of this platform by allowing users to interact with the virtual environment by using gestures detected by a webcam. To this end, we used CamSpace Beta 7, a cost-free and user-friendly computer vision technology. We describe how this integrated approach can be used to implement cognitive and motor training programs, involving partial or full-body movements.

Keywords. NeuroVR, CamSpace, open-source software, elderly, motor rehabilitation

Introduction

NeuroVR is a cost-free virtual reality platform, designed to allow non-expert users to easily modify a virtual environment (VE) and run it using an immersive or non-immersive system [1].

The updated version of this tool (NeuroVR 1.5) includes new features, such as new virtual environments, cheaper hardware components and more possibilities for personalization. The possibility to customize the VEs, by introducing video and sounds reproducing the patient's real life contexts, is intended to facilitate the transfer of learning [2].

A limitation of the current NeuroVR interface is that the use of joypad or mouse is not easy for users with motor limitations, such as elderly or brain-injured patients. Further, the current interaction modalities with NeuroVR do not allow the creation of VR-based motor rehabilitation exercises.

To address these issues, we extended the functionalities of NeuroVR by allowing users to interact with the virtual environment by using gestures. To this end, we used CamSpace Beta 7, a cost-free and user-friendly computer vision technology.

The use of human gestures (hands and full body) to control activities into the virtual environment allows the user to overcome the limitations of age and disability.

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Further, this approach permits to design specific training exercises for motor rehabilitation and balance disorders [3].

1. Video capture technology for motor rehabilitation

Several video-capture gaming platforms have been developed for motor rehabilitation. One of the major developments was the release of VividGroup's Mandala Gesture Extreme (GX) platform in 1996, together with a suite of interactive, game-type environments. The platform has been adapted for applications in rehabilitation and been used to treat elderly patients who were unstable and at high risk for falling.

Later, Sony developed its very popular EyeToy application designed to be used with the PlayStation II platform. Compared to these commercial tools, CamSpace is a totally cost-free and highly flexible tool, as it needs only a pc and a webcam to work.

2. A clinical scenario

Mark is a stroke patient suffering from a mild neglect and upper-limb motor disabilities. A rehabilitation program for the recovery of neglect and motor functions was developed using NeuroVR and CamSpace.

Mark is asked to enter the NeuroVR park, and to walk along the central pathway (Figure 1). CamSpace Beta 7 has been configured in a way that, to move into the VE and to catch objects, the use of both arms is required (Figure 2). Some objects have been placed on the right and left sides of the path; the therapist encourages Mark to pay attention to these objects and to join his hands if the same object is present on both side. Since this movement is quite difficult for him, he can stop and take the time necessary to execute the movement. In the first trial, a sound appears on the left side when as a target is approached; the intensity of the sound is gradually reduced as the patient improves. The number of distracting and target objects can be progressively increased.

Figure 1. A screenshots of NeuroVR Park

Figure 2. A screenshots of CamSpace applied to NeuroVR Park

3. Results and future work

Preliminary testing involved the following actions:

1. 360-degrees rotation;
2. Grasping an object with opponent fingers or hands;
3. Forward/backward movements.

Results of testing demonstrated the feasibility of the integration of CamSpace with NeuroVR. In particular, outcomes of evaluation indicated that actions 1-2 are fully working, while forward/backward movements require further adaptation. A demo clip of the application of CamSpace to NeuroVR is available.

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Virtual Reality Interventions for Rehabilitation: Considerations for Developing Protocols

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Abstract. This paper is a preliminary report on a work in progress that explores the existence of practice effects in early use of virtual reality environments for rehabilitation purposes and the effects of increases in level of difficulty as defined by rate of on-screen objects.

Keywords. Virtual reality, rehabilitation, practice, difficulty, rate

Introduction

It has been suggested in the rehabilitation literature that an inconsistency in outcome of traditional physical and occupational interventions could potentially be addressed with new training approaches that incorporate technology [1]. Recent research addressing the use of technology in rehabilitation has provided some encouraging results. Specific to virtual reality (VR) applications, there is a reasonable amount of research that indicates "people with disabilities can learn motor skills in VR and transfer this learning to real world performance" [2].

Although such results are encouraging, there is a call for caution and continued systematic evaluation in the literature. For example, "more rigorous studies are warranted to further investigate the conditions under which VR can be implemented effectively, including: optimum scheduling and intensity of intervention, profiling those patients who are most likely to benefit from VR-training and appropriate follow-up." [3]. The current study addresses one aspect related to VR scheduling, practice effects, and one aspect of intensity of intervention, rate of on-screen objects.

Toward determining optimal scheduling for VR interventions, we addressed the possibility of practice effects occurring in the early phases of VR interventions. We define practice effects as the degree of improvement in performance due to increasing familiarity with therapeutic equipment during initial treatment sessions. As virtual reality equipment can be complex and foreign to the average person, it is not unreasonable to expect that participants will need to develop a certain degree of familiarity with the equipment before meaningful therapeutic progress can be made. The enhancements in performance that can be observed during initial treatment sessions may not all be due to the demands of the treatment regime but could instead be

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a reflection of the initial adjustment process to the VR equipment that each user must experience. Practice effects could occur no matter the degree of impairment of the individual and should be separated out from real therapeutic improvements in motor skill. Therefore, we address the question - Do practice effects occur on a once-a-week, four-week schedule of VR use?

Another consideration in using VR applications for rehabilitation is the initial choice of level of task difficulty. There are a number of parameters that could be adjusted in such programs to alter level of difficulty (e.g., range of motion, speed of response). One benefit of VR environments is that they allow for the high degree of motor repetition in treatment that is associated with neuro-reorganization [2] and, subsequently, improvements in post-stroke function [1]. Given these findings, it would seem desirable to increase repetition by increasing the rate of on-screen objects but how might we determine optimal rates at the outset of treatment? This study investigates how the performance of persons with normal mobility varies as the rate of on-screen objects is manipulated.

1. Methods

1.1. Materials

The VR system used in this study is the IREX (Interactive Exercise and Rehabilitation Systems) by Xperiential Systems. The IREX system uses cameras to capture a person's image against a green background and project it onto a monitor. A virtual scene is inserted by the program and combined in real-time with computer-generated action. The user can then see themselves in a virtual world on the monitor placed in front of them. The applications are similar to video games, but the patient uses their body to control the game, not a game controller.

There are numerous activities to choose from in the IREX software, (e.g., snowboarding, soccer, boxing, racing, and even mountain climbing). Each virtual scenario is designed to employ a specific type of movement to complete the exercise successfully. For example, in the scenario reported in this paper, Birds and Balls, the user must direct controlled upper limb movement and grasping of a series of balls falling from the top of the screen. If the user exhibits the optimal speed and fluidity of movement as his/her hand makes “contact’ with the virtual balls, the balls will transform into birds and fly away. If the movement is too fast or jumpy the balls will “pop.” Thus, this particular virtual scenario would be an option for upper-limb rehabilitation.

1.2. Procedures

Participants were seven persons with normal mobility (no motor or balance deficits). Only participants over the age of 55 were tested. Participants engaged in a forty-five minute session spaced one week apart for four weeks. Sessions occurred in the Glenrose Rehabilitation Hospital in Edmonton, Alberta, Canada. Participants were tested at four different rates of on-screen objects – Level 1, M=42 objects/minute, Level 2, M=47 objects/minute, Level 3, M=57 objects /minute and Level 4, M=117 objects/minute. Rate reflects both speed of individual objects and number of objects.

The mean rate of on-screen objects for each level in the program was not a statistic that was available to us at the outset of the study. Levels could only be chosen according to the numerical labels given by the program, which ranged from 1-10. For our four levels we chose the program labels of 1,3,6,9 with the assumption that the increments between levels would represent an equal increase between levels. As the means indicate, this was not the case as there is a much larger increase between the third and fourth levels than between the lower levels.

2. Results

Proportion correct was analyzed with two non-parametric repeated measures analysis of variance tests (Friedman's). First, the variable "week" was tested as a within subjects variable. In order, the means for Week 1 through 4 were .843, .860, .884, .845 respectively (SDs = .107, .106, .071, .102 respectively). The analysis indicated there was no significant difference in performance across the four weeks, χ^2 (3, N = 7) = 4.54, p = .208. Therefore, no practice effects occurred on this schedule of intervention. Following this, an analysis of the level of test difficulty as represented by rate of on-screen objects (Level1, M=.953, SD=.063 Level2, M=.971, SD=.040, Level3, M=.912, SD=.112, Level4, M=.597, SD=.202) was conducted and showed a significant difference between levels, χ^2 (3, N = 7) = 13.8, p = .003. Participants performed poorly on the level with the highest rate of on-screen objects.

3. Conclusions

The results suggest that practice effects are not a concern for assessing therapeutic improvement on a once a week, four-week VR schedule. However, the initial choice for rate of on-screen objects needs to be carefully considered as a rate of 117 objects/minute was a challenge even for persons with normal mobility. Minimal increments increasing from 42 objects/minute up to 57 objects/minute were not a challenge for persons with normal mobility. Therefore, for applications involving upper-limb rehabilitation, a reasonable choice for initial sessions for persons with mobility impairment would be a rate of between 42 and 57 objects/minute.

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Virtual Reality Rehabilitation of Spatial Abilities after Brain Damage

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Abstract. Current rehabilitation of navigation and spatial orientation ability after brain damage is generally focused on training within the rehabilitation hospital or the patient's home as part of common physio- and occupational therapy sessions. To further promote generalization of gained abilities and to quantify functional improvements, this project aims at developing a Virtual Reality (VR) application that can be used for training and assessment of spatial orientation and navigation skills in brain-damaged patients. The training is administered after the standard hospital rehabilitation training is completed. Additionally, the program will be used as an assessment tool to quantify the participants' wayfinding performance. The data will be compared with real-world navigation performance in tasks of similar complexity to evaluate real-world transfer of the VR training. Currently, the application is under development and basic functionality and data acquisition are being implemented.

Keywords. Virtual Reality, Neuropsychological Rehabilitation, Navigation

Introduction

Cognitive processes that contribute to navigation and spatial cognition are widely distributed in the human brain. Consequently, deficits in wayfinding abilities are common after brain damage [1]. Nevertheless, after the initial neuropsychological assessment at the rehabilitation hospital, no explicit training of navigational skills is currently in use. Navigation practice and assessment are integrated into occupational- or physiotherapy sessions. Quantification of progress in navigation ability is based on patient observation. This approach is very time-consuming, making it difficult to assess parameters such as goal-distance, redundant routes, or orientation behavior (e.g. head-movement), and generalization of regained abilities across different locations is limited. To overcome these limitations, accurately measured patients progress throughout the training across several context. Additionally, to provide a dedicated training-tool for wayfinding ability, a VR training application is proposed.

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1. Methods

The proposed study is planned as a multiple baseline single-case design with up to 10 patients. For each patient an AB-design with additional follow-up testing will be employed after the standard rehabilitation of the healthcare provider is finished. Multiple baseline design refers to the concurrent testing of patients, where each patient starts the experimental training at a different point in time while all other patients continue with their current testing procedure (baseline or experimental treatment).

The patients will be recruited from two local rehabilitation hospitals. Recruitment is based on patient performance during the neuropsychological assessment at their respective hospital and referrals are made by the treating health-care professional. Standardized measures of general spatial ability (e.g. Mental Rotations Test, Surface Development Test [2]) and wayfinding ability (e.g. Object Perspective Taking Test [3]) together with a real-world navigation task and a comparable VR navigation task are used for assessment throughout the experimental sessions. A full list of all outcome measures can be found in table 1. Primary outcome measures test navigation ability while secondary outcome measures assess generalization towards spatial abilities in general.

The VR training is more complex than the virtual navigation task used for assessment and consists of several walkthrough scenes of houses and environments with increasing complexity. Participants have to make themselves familiar with the scenes to find several target locations and point to unseen objects (adopted from [4]). All user performance is recorded and analyzed in regard to navigation errors, timing and orientation behavior. As the training progresses, the environmental context changes slowly and the difficulty of the scene increases to promote generalization of gained abilities. More demanding tasks and naturalistic features like detours, locked doors, or poor lighting conditions establish higher difficulty. Rehabilitation principles like cueing, direct feedback, and reinforcement of behavior are also integrated into the application.

The training is created using Quest 3D and projected on a 120° stereoscopic three-screen-setup. For increased usability and data acquisition, user-movement will be tracked using an A.R.T. tracker. Furthermore, a space traveler mouse is planned as input device. This setup warrants high immersion and intuitive user interaction, thus providing a realistic training experience that is comparable to a real-life scenario.

Table 1. Order of experimental phases (left to right) and tests for each individual patient.

	Standard Rehabili-tation Service	**Pre-Treatment Assessment**	**Virtual Reality Trai-ning**	**Post-Treatment/Follow-Up Assessment**
Primary Outcome Measures		- Money Road-Map Test [5] - Zoo Test [6] - Object Perspective Taking Test [3] - Virtual Reality Navigation Task - Real-World Navigation Task - Santa Barbara Sense of Direction Scale [7]		Identical to Pre-Treatment
Secondary Outcome Measures		- Mental Rotation Task [2] - Card Rotation Task [2] - Surface Development Task [2]		Identical to Pre-Treatment

Figure 1. Training scene (left) and data visualization/playback (right).

2. Results and Conclusions

At the moment, the VR application is under development. The program currently consists of few stereoscopic 3D environments that feature recording and playback of all user-movement (Figure 1). These recordings are used to quantify the user's navigation ability and visualize performance for wayfinding or pointing tasks. More scenes, difficulty settings for each environment and verbal and visual instructions for therapists and patients are being added at the moment. A space traveler mouse is implemented for navigation within the 3D-world. Other input devices are also evaluated to guarantee simple and intuitive user interaction that is suitable for patients with little to no computer experience who recently suffered from stroke or traumatic brain injuries. First data will be collected as soon as the first patients are finished with the standard rehabilitation service of their health care provider and enough environments and difficulty settings are implemented to occupy several training sessions.

Compared to the standard training, the VR application provides more possibilities to manipulate the complexity of the training environment. Thus, it is expected that the patients will show further improvement and generalization in wayfinding ability beyond the effects of the standard rehabilitation. It is also predicted that the virtual navigation task is a suitable assessment tool for wayfinding ability and provides similar results to the assessment with a comparable real-world navigation task.

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Cybertherapy Meets Facebook, Blogger, and Second Life: an Italian Experience

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Abstract. Our project is based on the study of Cybertherapy in the international sphere (USA, Northern Europe) and on the application of this discipline to the Italian psychiatric and psychological reality. CyberTherapy can be used as an "aim", referring to it as real and proper therapy, which lives on personalized paths created by a qualified staff, conceived as ludic, for recreational, psycoterapic, and educational purpose. Moreover, Cybertherapy can be used as a "mean" (and in this way we want to propose it) with the aim of making the user, who feels a psychiatric or a psychological uneasiness, to become closer to qualified staff; a considerable advantage of this discipline is to reduce to a minimum the initial embarrassment which is created between the specialist and the psychiatric patient, uneasiness stirred up and accentuated by the problem, which is unfortunately not resolved in the Italian sphere of the Stigma.

Keywords. Avatars, Web 2.0, Virtual Reality Applications, Facebook, Second Life, Blogger, Internet

Introduction

The basic idea of our project is to use a computer and the web as a means to approach psychiatric patients; in this way we have tried to apply Italian reality to the subsequent scheme and cybertherapic methods.

Cybertherapy, defined the way in which it will be considered from now on, includes several branches:

- EMAIL-BASED THERAPY, which is based on an e-mail exchange between the service user and the operator;
- VOICE/VIDEO CONFERENCE THERAPY, where the communication takes place through programmes like Windows Live Messenger or through portals like Facebook which assure an instant messaging service, without considering that the first program allows the use of a webcam or a microphone;
- AVATAR THERAPY, which makes use of a 3D virtual reality like that built in Second Life; in this case the communication is more physical and the material is used through an approach by means of an avatar, a figure with human appearance, in most of cases, created by the user based on its personal taste.

Taken into account these concepts, we have organized our project, trying to differentiate it in the programs used and as a consequence in the approach methods to

the user with the purpose to give a greater pliability to the idea and thus, to the contact with the addressee.

1. Our approach tools

1.1. The Blog http://psichiatriaecybertherapy.blogspot.com

The heart push-button of the entire project is a blog, an on-line diary, an extreme ductile, and a recognizable mean in the hand of the user, in continuous updating, which firstly contains the explanation of the project in the first pages. Moreover, a series of contents is updated daily, which range from the contribution of the users themselves to congressional and cultural events, from the in-depth examination of important people in psychiatric history to the recommendation of web sites of relevant importance like that of NeuroVR or that of the Italian Psychiatric Association (Figure 1).

The idea is to build and constitute a headlight, a reference point in the web for all people affected by psychiatric disturbances or those that are in search for information, discouraging at the same time from making self diagnoses, while trying to make the profane reconsidered from a social point of psychiatric view, a scientific discipline still mistreated and seen suspiciously today.

The blog is enriched with a series of widgets (internet features) that in addition to being of great help also allow the site to gain more "appeal" and notoriety. The site contains a human cd calendar with pictures of common people; a space for news of psychiatric interest; a translator, which allows the reading of blog in several languages (English and Japanese); a logo properly designed, which recalls the group founded on Second Life (to which I will subsequently describe); a series of contacts and accounts to make the contact from the user easier; a chat that offers the chance to the user to leave messages; a playlist with audio tracks updated frequently, chosen with the intention to create an agreeable psychological atmosphere; a collection with monthly partition; a list of key words (labels and tags); the ability to click on news and posts of relevant interest; a visitors counter; a tracker of web pages; and an atlas, tools which give information to the staff of the site of daily accesses as well as the geographic origin of the readers. There is also a list of helpful links, pertaining to psychiatric and psychological interest; a list of comparable sites; and finally a list of readers subscribed by the users themselves, as well as a list of banners at the bottom of the front page that allow the blog's visibility through the exchange of links with other partner sites and several international search engines, which are tools that makes it possible to alter the placement of the blog at the very first positions of Google (the most relevant search engine of this time).

Figure 1. The Blog http://psichiatriaecybertherapy.blogspot.com

The blog is connected with a logic mechanism by a series of accounts, created with the aim to give wide choices to the user who approaches CyberTherapy, as well as other various tools.

1.2. Forum

The first tool is the FORUM, which involves the registration and the free participation of the users through threads published by themselves. The forum is made up of 5 sections and, at present, it is not attended by a lot of people due to an excessive staticity of the tool (this is the reason given by the users, who prefer to speed up the conversation with the project staff); we will deepen on this point in the conclusions.

1.3. Online TV

Another tool connected with the project is an ON-LINE TELEVISION, self-managed and comprising of an integrated chat that broadcasts film segments of psychiatric interest produced by the staff or taken directly from the YouTube platform, an important international video-sharing site.

1.4. Facebook

The users' favorite tool, however, is their Facebook profile, a platform of great interest in Italy. The "CyberMaster Quan" profile, created especially for the project, relies on more than 400 friends, people who autonomously reach CyberTherapy or have been

Figure 2. Second Life – CyberMaster Quan.

contacted by the staff for information or association purpose. Moreover, the mentioned Facebook account leans against two groups: "Psichiatria e Cybertherapy" and "I love CyberMaster," which collect supporters, persons involved in the work and people that have experienced cybertherapic services, etc.

1.5. Second Life (slurl: http://slurl.com/secondlife/Caspoli/248/26//)

Last but not least is an additional account in Second Life: it has been created as an avatar, which has been subscribed to a premium account that allows the avatar to possess private property on the multimedia platform. This platform has been built on real private practice with furnishings and advertising. Moreover, the "CyberMaster Quan" avatar is the chief of a big group of avatars called "CyberTherapy Italia" (Figure 2).

1.6. Conclusions on the tools

This is in brief, the tool apparatus used for the project.

The logic-scientific apparatus involves an approach path conceived to respect the standard of extreme transparency and simplicity toward the user who becomes familiar to Cybertherapy.

The path is this: the user visits the blog, reads the presentation and the informative posts, gains knowledge on the identity of the staff members, and- if the services offered by the project suit its needs- the visitor asks for a preliminary interview with CyberMaster (i.e. the master of the project) who, scheduled the consult and interviews the supposed patient through the explained tools in less than an hour.

The CyberMaster reports the consult in paper or computer format to the other members of the staff, who discuss the clinical case and express their opinions in terms of trying to find the correct dedicated treatment structures.

The CyberMaster, conveys the staff's impressions, performs another consult with the user, telling him the impressions of the staff.

This method is a very simple and effective mechanism that has been successful in terms of approach and number of users that have used the service.

2. Purposes

Different and various purposes compose of what we have set at the start of this experience: firstly, as we stated before, to evaluate the feasibility of the "CyberTherapy" discipline in Italy, we propose a methodological theory that is consistent with the clinic as well.

Complementary goals, but at the same time with great meaning, have given the chance to collect and analyze the very first Italian record of occurences of users that approach CyberTherapy, using non-psychiatric means like Facebook and Second Life. Another important goal, born during this experience and easily reached, has been the accomplishment and online promotion of Psychiatric Prevention. Unfortunately an consistent argument still relevant today is that it is not treated with the proper coverage and still struggles with Stigma.

3. Results and Conclusions

The results obtained appear very positive: the blog, in two months of activity has collected almost 3,500 single visits, which equates to a mean of 60 daily accesses from different people every day. We have received almost 40 contacts from people asking for a consult, among which we have selected 13 people on the basis of their needs that have received a total of 25 interviews (some of them needed a deeper study).

The preferred tools have been the blog itself, Facebook, and Second Life.

The blog, besides encountering 60 daily visits, has been used as an example for other projects. It relies on 18 regular readers who have been given support by linking our site in their blog's homepage. It has been changed into a place or a non-place of cultural exchange and continuous learning.

Our Facebook account, besides relying on more than 400 friends, is visited daily by people who keep track of our work on the web and through our groups, which encounter more or less 100 registrations for one and 150 the other. Moreover, the Facebook account allows active cooperation with other professionals that operate in the national psychiatric sector.

The Second Life account has immediately aroused interest and appreciation for its cultural value and its support. We have received several invitations to participate in online congresses as speakers, but unfortunately we had to refuse them due to the great amount of work needed for this project.

We consider ourselves satisfied and surprised for the results obtained in such a short amount of time. For this reason we are encouraged to go on with the project and open a new field in research, so that as many people can take advantage of the service we offer as possible, in terms of personal interviews and in terms of cultural commitment as a struggle against Stigma.

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Self Presentation in Blogs and Social Networks

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Abstract. Recent approaches to the study of identity in online contexts underline how people on the Internet have multiple identities and are at risk of identity fragmentation. Subjectivities are context-specific, negotiated with other people and actualized in Self Presentations. The aim of this study is to investigate how social media users deal with choices regarding their Self Presentation and how different profiles of the same person relate to one other. Thirty-six users with accounts on two blog-hosting services and one social network website answered an online structured interview and elaborated on the different choices of Self Presentation for each service. Content Results show users accurately and consciously choose the way they present their Self according to their aims, actual and potential readership, and the technical possibilities of the media. Answers also show that people online are conscious of the multiple presentations they enact, and they feel an underlining sense of unity and coherence, which may be traced back to the concept of Self.

Keywords. Internet, Web 2.0, Identity

Introduction

Online identity studies often underline that a person using the Internet with different profiles and contexts at the same time may be the fragmentation of both online and offline identity in incoherent, unrelated, and often fake pieces [1]. The aim of this study is to verify if different profiles created by the same users are linked to different identities and to investigate how users choose the different structural elements to present their Self.

1. Self, Identity, and Subjectivity

Theoretical framework [2] consists of the following:

- Subjectivity: contextual, negotiated during interaction, and guided by goals of presenting the Self in a strategic way;
- Plural identities: set of actions and convictions that are activated by the situation the person is in;

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- Self: set of all the representation a person has of him/herself, which helps give the person a sense of coherence and stability within the many Self Presentations acted in interactions.

1.1. Web 2.0: Blogs and Social Networks

Web 2.0 technologies, such as blogs and social network websites (SN) allows people without any particular technical abilities to be present online and to express their Self in an easy and prompt way through different channels. Subjectivity can be communicated in two different ways on blogs and SNs: content of posts and messages and design choices of the blog or the profile. This last feature is explored here as a significant element able to communicate the users' subjectivity.

2. Method

A structured interview regarding the choices in Self Presentation across three different social media (LiveJournal, GreatestJournal and MySpace) was created. Main areas of the structured interview were focused on textual structural elements (i.e. personal information, interest list), visual structural elements (i.e. header, icons) and interactive structural elements (i.e. email address, chat) [3]. A link to the structured interview was posted in two LiveJournal communities and on the private blogs of a facilitator [4]. Content analysis was performed on answers provided by participants to find patterns among different answers.

3. Results

Thirty-three women and three men took part in the study. Overall participants revealed to make conscious choices about every structural component of their blogs and profile on MySpace (i.e. "*I want my profile to reveal a little bit of who I am and what I can do with the images, colors, etc. that I use,"* Female, 18 - UK). Examples of verbatim for each category explored in the questionnaire are shown in Table 1.

Table 1. Examples of verbatim for the three areas of investigation of the questionnaire: textual, visual, and interactive structural elements.

Textual Elements	Visual Elements	Interactive Elements
Both journals express different parts of me (Female, 19, USA)	*The "pics" I use on LJ and GJ are graphics I made. The "pics" on MySpace are actual pictures* (Female, 18, UK)	*I don't want my RL friends trying to add my LJ, so I just don't link it anywhere* (Female, 18, USA)
Because I know people offline on Myspace who know me by that nickname (Female, 23, Australia)	*LJ images are about what I like, MySpace images are about my physical self* (Female, USA)	*I don't want people I knew [...] to find my LJ, since it's more personal* (Female, 22, USA)

Choices seem to be guided by the perception of the general relational contexts of LiveJournal, Greatest Journal, and MySpace: while LJ is a familiar and trusty environment (defined as "personal" and "familiar") and where there are specific rules, MySpace is perceived as dangerous and unfriendly (defined "creepy" and "a slum"). These perceptions consequentially drive the choices regarding Self Presentations: on LJ users present their self freely, on MySpace they will be more conservative in disclosing and presenting interests and personal information. GreatestJournal often is seen as a backup for LiveJournal and therefore is used only in case LJ is unavailable. Actual readership also helps users to determine their Self Presentation: LJ is linked to online activities and friends, while MySpace is linked to Real Life. Personal abilities (no knowledge of HTML or CSS) and technical boundaries of the Social Medium may limit Self Expression through graphics and blog design. Users are conscious to modulate their Self Presentations according to context ("*I am catering to a different set of friends and interests*", Female, 21 - Canada), but they stress that they feel an underlying sense of unity and coherence ("*I don't change*", Female, 51 – UK; "*I use the journals for different reasons so I didn't put exactly the same things*", Female, 23 - Spain)

4. Discussion and Conclusion

Results propound that MySpace, LiveJournal, and Greatest Journal users enact with different identities on different media outlets through several Self Presentations. While LJ is connected to a mainly online life and to people who are considered to be friends-never meeting in Real Life, MySpace is all about Real Life, though the two Self Presentations change accordingly. As already reported in literature [5], it seems that presentations are influenced by contexts and the people who inhabit them. From the answers to the interview, it is evident that behind the multiple presentations there is something, the Self that allows users to feel a sense of coherence and uniqueness, multiple Self Presentations notwithstanding. This suggests that the risk of identity fragmentation is slight, or at least it is not built into virtual environments, as often claimed by literature. The results of the research also support the theoretical framework, which seem consistent with the complexity of the field of study.

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Next Generation Stress Inoculation Training for Life Saving Skills Using Prosthetics

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Abstract. By integrating medical science with cutting edge simulation and training technologies, realistic prosthetic tissue, wounds, and part task trainers have been developed for the training of trauma care clinicians. The next generation of Stress Inoculation Training (SIT) includes the use of prosthetics developed based on human anatomy and physiology, material science, and nanotechnology. Testing has revealed that these products are highly useful and reliable.

Keywords. stress inoculation training, injury simulation, trauma care training, prosthetic tissue, medical skills training.

Introduction

Medical simulation training currently relies mainly on plastic forms, computerized mannequins, animals, and cadavers. All of these have significant drawbacks, such as incorrect anatomy (animals), lack of realism (plastic forms and mannequins), limited use (cadavers), and expense. Additionally, they do not replicate the majority of injuries encountered on the battlefield. Severe medical trauma creates major challenges for front line medics. Although the military is investing millions of dollars in training for soldiers, current training methods for combat medics need to be improved. Many scenarios designed for training medics employ simulation of some type, however, their limited realism calls into question their ability to fully immerse the trainee into combat medical situations. This is exactly the kind of experience that will properly prepare medics for actual battlefield injuries including broken bones, lacerations, severe bleeding and tissue damage. Many civilian-trained medical personnel are not psychologically prepared to face severe wartime traumatic injuries. ICS's Stress Inoculation Training addresses the need for realism to optimize trainees' performance under fire and other stressful conditions.

To supply more realistic military medical training, the U.S. Army Research and Engineering Command – Simulation and Technology Training Center (RDECOM – STTC) partnered with the Medical Research Materiel Command (MRMC) to research innovative technologies to simulate the look, feel, and smell of severe trauma. As part of this effort, RDECOM-STTC is managing a three year Severe Trauma Army

Technology Objective (ATO) to develop simulation technologies to prepare Soldiers to deal with the injuries encountered on the battlefield. The Virtual Reality Medical Center (VRMC) conceptualized and developed a unique injury simulator under the Severe Trauma ATO initiative as an adjunct to current combat medic training. The Injury Creation Science (ICS) technology represents an injury simulation capability that includes the prosthetics required to train medical professionals in procedures such as bypassing a compromised airway, inserting an intravenous port, preventing blood loss as a result of arterial and venous wounds, dressing burns, and expanding a collapsed lung. Initial ICS technology very realistically simulated a number of battlefield injuries such as amputations, eviscerations, blast injuries, punctures, and burns. Since the initial prototypes, VRMC has developed this technology into wearable "part-task trainers" that simulate injuries as well as allow combat medics to practice actual medical procedures common to the battlefield.

1. Review of Literature

Simulation for the development and refinement of surgical skills has come to the forefront in recent years [1]. Reznick & MacRae [2] note that the earlier stages of teaching technical skills should take place outside the operating room (i.e. on surgical simulators) with practice being the rule until automaticity in basic skills is achieved. ICS is based on surgical procedures and techniques to enhance medical training. Most of the technology funded by the Department of Defense in recent years falls into four categories:

1. PC-based decision teaching tools (e.g., STATCare)
2. Digitally enhanced mannequins (e.g., Combat Trauma Patient Simulator)
3. Virtual workbench technology (e.g., HT Medical Systems)
4. Total immersion virtual reality (e.g., Center for Integration of Medicine and Innovative Technology).

The computer and mannequin-based models listed above can be useful, yet they present technical challenges and compromised realism. The design of computerized surgical simulators must overcome the obstacles of choosing the appropriate soft tissue models and solving the underlying differential equations or algorithms [3]. Mannequins do not bleed convincingly during simulation, and different mannequins are necessary to represent patients with different injuries, body types, and age groups [4]. ICS seeks to overcome the realism problem by basing the trainer on a visually realistic simulation.

Wound simulation, or "moulage," began in 1834 with military mass casualty exercises in which artists painted injuries on the body. Hollywood makeup and theatre techniques followed, providing elements of realism such as blood and open fractures to the training simulation. In general, however, some of the more advanced Hollywood techniques have not been used in military simulation training. A number of companies offer casualty simulation kits online for trauma training. These kits are generally comprised of "stick-on" wounds with a limited subgroup of "bleeding moulage," but these do not claim to be medically realistic (only visually so). Forensic science currently employs simulated tissue and bone to test the effect of ballistics. Synthetic body parts are also used for performance testing of helmet and body armor. These simulations or recreations focus more closely on scientific realism than either moulage or Hollywood special effects.

Simulated skin has been studied much less than simulated tissue, although animal skin has been used for injury simulation studies. Jussila notes that the significance of simulated skin has been overlooked, even though its use increases the fidelity of experiments involving low-velocity projectile injuries or effects such as ricochets. Thali, Kneubuehl, Zollinger & Dirnhofer [5] created an artificial head they call the "skin-skull-brain model" which uses a silicon cap with synthetic fibers on a polyurethane skull to simulate skin. The silicon cap is artificial leather and prevents the bone fragments from scattering after the model has been struck by gunfire.

The bone simulant literature is also found in forensic science as well as in biomaterials research. Bone engineering in the biomaterials field, however, concentrates on grafts and resorbable biomaterials as temporary scaffolds [6-9] and therefore does not lend itself well to injury simulation.

In a 2004 study, Kneubuehl and Thali developed an artificial bone using polyurethane to compare gunshot wounds to swine bones. The design was patterned after human bone structure, with a compact outer layer covering a porous inner layer. Ordnance gelatin was injected into the bone's hollow core to simulate marrow. To simulate the periosteum, the bone was covered with a layer of latex. The comparison between the biological swine bones and the non-biological model in regard to loss of velocity and energy after striking bone, bone fragmentation, bullet deformation, and penetrating wound channel were absolutely equal. Other studies leave some doubt about similarity in terms of longitudinal fractures but still give good, consistent results [10]. A Swiss company, Synbone AG, manufactures artificial bones designed for teaching orthopedic techniques in fracture repair. This type of product may prove useful in the development of ICS.

2. Methods

The ICS prosthetics were designed to train and prepare military medics to accurately stabilize fallen warriors during combat while specifically addressing four practical needs: enhance realism to ensure an immersive training experience for medical professionals, minimize application/removal time, increase prosthetic durability and reusability, and comfort. The prosthetics are packaged in self-contained kits that include prosthetic wounds and the supplies required to provide an immersive training experience. Existing injury simulations require specialized skill, significant application time, and the prosthetic is neither reusable nor durable in most cases. An ICS prosthetic wound is physiologically accurate, highly durable, very comfortable to wear, and most importantly, ready-made, which minimizes the skill and time required for application.

The ICS technology is focused on research and development in support of the tactical combat casualty care (TC3) training mission, which includes Basic Life Support, Patient Assessment, Hemorrhage Control, Fracture Management, and Shock Prevention & Treatment. By merging the latest special effects technology with material science research, the ICS team is developing prosthetic human tissue and wounds for realistic trauma care training. The research conducted revealed some important information that may be useful in the development of simulated skin and tissue for the advanced trauma-training program. In particular, we have found information that reveals both biochemical and structural clues as to how to begin to quantify the physiochemical properties of skin and tissue. For example, skin water content and elastic properties are important contributors to the look, feel, and texture of skin. In

addition, some of the most important connective tissue components that have been identified provide a basis to begin modification of existing artificial substances to improve the level of realism in artificial tissue. A number of non-invasive and minimally invasive technologies have been identified that will assist in the creation of new synthetic materials that reproduce the critical aspects of tissue We will continue development of artificial tissue based on this finding, and will search for polymers that can have a graded hydration component.

VRMC and RDECOM-STTC worked together to significantly increase the medical realism of prosthetic injury simulation appliances. The collaboration offered the opportunities for further laboratory research and to develop improved materials that simulate the smell and feel of human tissue and fluids. The VRMC/RDECOM-STTC Integrated Product Team (IPT) refined the simulated skin and tissue of the earlier prototypes and built upon it to better replicate wounds for medical training. The skin was engineered based upon the configuration of the actual layers present in skin. Candidate silicone formulas were matched to the skin's layers through spectral analysis and nanotechnology applications. Studying human tissue using spectroscopy was critical to further developing the ICS technology. We used spectral analysis to evaluate the early ICS prototypes, and explored ways to improve them based on the quantitative data acquired during testing. With this data, we compared ICS prototypes to the properties of human skin. Additional work remains in this area and possible outcomes include identifying existing materials for simulation effects, developing hybrids, and developing completely new materials and methodologies.

Initial research indicated that although transparent silicone appliances would be favorable in terms of flexibility and packaging in the kits, these would require specialized expertise or training. The prosthetic appliances were then colored inherently to minimize application steps and to maximize ease of use, three shades of skin tone were developed to be used in the prototype kits. The prosthetic appliances were designed to affix to a human actor or mannequin as a patch, and consist of simulated skin, underlying tissue, representations of organs or structures, and a protective layer next to the wearer's skin.

3. User Test Results

Whether they were new or previously used, preliminary testing showed that stretching made little difference to the prosthetic appliances. Friction from tighter pants made edges start to peel after several hours, but pieces still would not come off the human skin. Even after showering, no difference was noticed in the prosthetic appliances. Wearing socks and shoes all day did not affect the edges of appliances adhered to ankles; the edges of the prosthetic appliances did not lift when adhered at the ankle, whether on the top of the foot or on the crease. During testing, the strength, realism, and ease of use of the prosthetic appliances were demonstrated.

During a trial usability test at the Field Medical Training Battalion (FMTB) in Camp Johnson, near Camp Lejeune, nine USN Corpsman squads were trained in 4.5 hours less than it would normally require because the ICS injury simulation products were used instead of the existing products. The application of the ICS prosthetics only took 1 hour on all patient actors and the prosthetics remained intact during the 6 hours of training, not requiring reapplication in between scenarios. The prosthetics are durable, where as existing products require re-application after dressings are applied

and removed by trainees during the scenarios. Patient-actors reported higher levels of comfort. Trainees reported higher levels of immersion during the training scenario.

4. Discussion

The ICS prosthetics have proven to be useful and reliable and provide a realistic training experience for health care professionals. After evaluating data from the U.S. Army Institute for Surgical Research, it is clear that a need exists for part task trainers to prepare military trauma care professionals for life saving procedures necessary to preserve the life of wounded war fighters. Many of these same procedures are done in civilian hospitals. Identifying common needs between field medicine and civilian hospitals can help reduce the estimated 98,000 people that die each year as a result of medical errors. It is imperative that we continue to train medical personnel by employing the highest level of fidelity and realism and leveraging the lessons learned from military training to civilian medicine.

5. Conclusions

Moving forward, VRMC and RDECOM-STTC are employing state of the art techniques and materials in the development of physiologically accurate synthetic tissue, a critical technology in the development of dynamic wound and medical procedure kits. In addition to the work cited in this paper, current research and development is focused on creating the next generation of kits, which include the materials required to train emergency medical personnel in performing a cricothyrotomy and chest tube insertion. We are refining prosthetic tissue technology and transitioning this capability to medical training applications.

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A Comparative Analysis between Experts and Novices Interacting with a Virtual Patient with PTSD

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Abstract. Virtual patients will provide a means to train the next generation of clinical residents. Interacting and engaging with virtual characters portraying standardized patients can have meaningful outcomes. As a cumulative set of data analysis, we investigate the comparison of how well novices, subjects without any clinical interviewing background, with experts, clinicians, or resident student clinicians with interviewing skills to assess if they could elicit the proper information from verbal interactions with a virtual character.

Keywords. Virtual Patient, Artificial Intelligence, Psychology

Introduction

Interactive Virtual Standardized Patients (VP) can provide meaningful training and development for clinicians, psychiatry residents, and medical students. These VP's portray embodied conversational characters with realistic representations of a mental or physical problem to be diagnosed or discussed. Our development of VP's involves advanced technologies that allow them to listen, act, and generate the appropriate verbal and non-verbal behavior for a particular presentation of a clinical issue. There have been numerous projects and studies building and evaluating virtual patients [1-3] for medical and psychological diagnosis, however more data metrics are required to fully understand how to build and use them.

This research presents the results of a study comparing novices and experts interacting with a virtual patient with Posttraumatic Stress Disorder (PTSD). Novices as being defined as test subjects that do not have any formal clinical interviewing or medical experience, and experts are being defined as resident clinicians or medical students. This work is a continuation of the virtual patient research developing and evaluating "Justina" [4] a virtual patient that suffers PTSD from a sexual attack. The initial subject testing of "Justina" was with psychiatry residents, and medical students and the goal of that study was to find out if the subjects could elicit the proper responses to make a diagnosis from a virtual patient system during a 15 minute interview. For this project we performed the same test as with the experts but this time using novices and wished to compare their interaction with how the experts performed. We wished to evaluate to see if the topics and questions the novices asked would

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naturally cover the categories and criteria of PTSD as defined in the DSM-IV manual or if the experts performed better in this task. Additionally, we were interested in what topics they did inquire about if they did not ask about the PTSD criteria.

The results of this experiment will assist in creating more engaging and realistic interactive virtual patients by expanding the domain of topics for the character and in understanding the differences between novices and experts. Additionally, this is an initial attempt to create a system for novices and experts alike that can help train or teach the proper way to interview a patient, or which topics should be discussed during an interview for a virtual patient with PTSD. As far as we know, this kind of comparison of experts and novices has not been performed with virtual patients with psychological issues.

1. Methods

The setup of the subject testing for the novice subjects was exactly the same as conducted with the experts, except that it was performed at the Institute and not at the USC Keck School of Medicine. The software system and "Justina" virtual patient were the same in all subject tests so as to keep the system consistent, even though the system could have been improved based on the testing with the experts. The subjects were videotaped as they performed the interview for later analysis of their non-verbal behavior, gaze, and interaction with the VP.

The subject testing method consisted of a set of pre-tests and questionnaires that were filled out electronically, followed by a 15-minute speech based verbal interaction with the virtual patient character, this was followed by an additional set of post questionnaires. The pool of subjects considered as novices consisted of staff, interns, and students from USC and The Institute for Creative Technologies. Several of the subjects were more computer savvy and had a deeper understanding of the technology underlying the virtual patient then the expert resident clinician subjects. There were 9 total subjects, 3 female and 6 male. All spoke in English; however there was 1 German and 1 Indian accent. This was compared against the 15 experts from the previous study.

2. Results

The data for the 9 novices was compared to that of the 15 experts in the previous study. The results showed that the subjects were not able to elicit the same information, as defined by the PTSD criteria in the DSM, as the expert clinicians during the 15-minute interview. There were many times when there were long pauses where the subjects searched their minds as to what they should be asking. Others understood that this was kind of like a game and attempted to game the system by asking questions in wrong ways or with just using single words. Not all of them treated it as seriously as the experts, partially because they have used systems like this in the past or wanted to explore the edges of the system. The data that will be presented and described in more detail will consist of the number and types of questions asked, the topics covered and a comparison of the experts results with the novice results. The questions asked by the subjects are classified into one of six categories dealing with the DSM PTSD criteria, such as the traumatic event, flashbacks, duration, and symptoms. Additionally, there was a category for general questions dealing with building rapport or clarification.

Figure 1. Virtual Patient Subject Testing Setup

There were more questions in the rapport category for the novices than for the experts, which meant they were asking questions about general things and not specific criteria to help make a differential diagnosis. The novices kept revisiting the same topic and questions more than the experts.

3. Conclusions

This was an initial study comparing a set of novices with a set of experts in their interaction with a virtual patient. The results yielded useful information in terms of the topics and set of question/response ratios for each of the DSM criteria needed for differential diagnosis of a virtual patient with PTSD. These results will help to improve the system and provide input into ways to more accurately guide a novice or expert user into asking the proper questions to build a more effective teaching tool. It was anticipated that the novices would not do as well as the experts; however, this was one of the first comparative analysis between novices and experts for virtual patients in the psychological domain.

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The Receptiveness of Stress Management Techniques by Military Personnel

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Abstract. Many military service members suffer from stress. Sixty Soldiers participated in a study designed to test receptivity to stress management techniques. Preliminary analyses of surveys and a focus group suggested that participants not only liked practicing relaxation techniques but would also continue practicing these after completion of the present study.

Keywords. Stress Management Techniques, Military Service Members

The views expressed in this abstract are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

Introduction

Anxiety (or "stress") is one of the most prevalent psycho-physiological problems in the USA, costing the nation up to $300 billion a year [1]. Military personnel may also experience stress as they tend to operate in very stressful environments. Stressed individuals tend to tense their muscles and breathe in a very shallow manner. A few stress management techniques (SMT) have been designed to alleviate these psycho-physiological reactions. Progressive Muscle Relaxation (PMR) [2] is designed to help individuals tense and then relax their muscles in a progressive manner (head-to-toe or toe-to-head). Similarly, Controlled Breathing (CB) helps show individuals how to use their diaphragms when breathing. Both of these techniques have proved efficacy to help treat anxiety [3-4] and other disorders. Sadly, the number of times that military service members spend in highly-stressful environments tends to outnumber the minutes invested in SMT. Furthermore, military service samples tend to be mainly composed of males who might perceive SMTs as "soft tools" for a rough world.

Therefore, the purpose of this study was to test the perception of cost and time-effective SMT by military medical personnel.

1. Method/Tools

This study's sample was composed of 60 participants randomly assigned and equally distributed to either an Experimental Group (EG) or a Control Group (CG). As a screening method, all participants answered both the Post Traumatic Stress Disorder Checklist for Military personnel (PCL-M) [5] and the State-Trait Anxiety Inventory (STAI) [6]. From Days 01-03, the EG would look at a different (but equivalent) video of an island zone ("Dream Island") [7] that contained an embedded script explaining how to practice both PMR and CB (see Figure 1 a and b for examples of one of the video screen shots and scripts). In the mornings, this group would practice these techniques while watching a video displayed on a screen (see Figure 2). During each of those three nights, they would watch the same video watched earlier in the day, but via a portable play station.

Finally, on Day 4, all participants answered the following questions as part of a Focus Group (see Figure 3): "How did you feel while practicing these relaxation techniques?; Which one did you like the best?; What did you like better, the verbal/written instructions, the video, or the virtual reality environments?; Would you use these techniques upon graduation?; How can we improve this relaxation program?; and How can we improve this relaxation program?"

2. Results

Most of the sample (n = 60) was composed of Caucasian (n = 43, 72%), males (n = 39, 65%), under the age of 33 (n = 30, 60%), married (n = 39, 65%) and with at least one child (n = 34, 59%). They were mainly officers (n = 36, 60%) in the Regular Army (n = 45, 75%) that had been previously deployed (n = 31, 52%) and were getting ready for another deployment (n = 38, 63%). Most of them (n = 48, 80%) had previous experience "…playing w/games, virtual reality, etc." Scores form both the STAI and the PCL-M suggested that our sample was similar to non-clinical normative samples.

During the focus groups, 21 participants from the EG expressed feeling either the same or more relaxed while practicing the relaxation techniques. Sixteen of them also

"Lift up your eyes to the blue sky where you see the rainbow. The colors shimmer in the light. It's a beautiful day. Now, gently tighten your abdomen and lower back and take a deep breath through your nose, counting from 5, 4, 3, 2, 1. Hold for 2: and then relax your abdomen and lower back and exhale: 5, 4, 3, 2, 1. Your body is beginning to feel heavy..."

Figures 1. a and b. An example of one of the "Dream Island" zones and scripts[1].

[1] The Dream Island software has been used previously in clinical/research efforts [7] However, for this study, these scripts were (a) translated from Italian to English and (b) the PMR and CB simultaneously practiced.

Figure 2. Participants watching the video in the AM.

Figure 3. Participants during the Focus Group.

seemed to like the video experience more than just written instructions about how to relax.

Interestingly, the question: "Which one did you like the best?" developed different type of answers. That is, some talked about the SMTs while others talked about the video scripts. Most of the participants seemed to like the CB technique followed by those that liked the PMR, and those that liked both. Most of them liked the first video (which included a rainbow), followed by those that liked the third, and those that liked the second one. Finally, half of the sample (n = 29) considered practicing these techniques after this study.

3. Conclusion

The present study was designed to investigate more about the receptiveness of SMT by military service members. Despite of a potential psychological "denial" or "Army Strong" mentality, the sample appreciated the importance of taking control of their minds and bodies. Further analysis by gender and rank might provide more information on visual preferences (e.g., rainbow) and SMTs. Gladly, even though participants did not seem to be especially stressed or anxious (per either the PCL-M or the STAI) at the beginning of this study, most of them did suggest wanting to continue SMTs for years to come.

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The Use of Biofeedback in Clinical Virtual Reality: The Intrepid Project

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Abstract. In our protocol for the treatment of Generalized Anxiety Disorders we use Virtual reality (VR) to facilitate emotional regulation and the relaxation process. Using a biofeedback biomonitoring system (GSR, HR, Thermal) the patient is made aware of his or her reactions through the modification of some features of the VR environment in real time. Using mental exercises the patient learns to control these physiological parameters and using the feedback provided by the virtual environment is able to gauge his or her success. To test this concept, we planned a randomized controlled trial (NCT00602212) , including three groups of 15 patients each (for a total of 45 patients): (1) the VR group, (2) the non-VR group, and (3) the waiting list (WL) group.

Keywords: Virtual Reality, Generalized Anxiety Disorders, Biofeedback, Intrepid project

Introduction

Generalized anxiety disorder (GAD) is a psychiatric disorder characterized by a constant and unspecific anxiety that interferes with daily-life activities. Its high prevalence in general population and the severe limitations it causes, point out the necessity to find new efficient strategies to treat it. Together with the cognitive-behavioral treatments, relaxation represents a useful approach for the treatment of GAD, but it has the limitation that it is hard to be learned [1-3].

Traditionally, relaxation techniques are verbally taught by a therapist or recorded on an audiotape, while recently a series of CDs of calming music have been used to help individuals to relax themselves, showing positive effects on anxiety reduction by achieving psychological benefits including distraction and sense of control over symptoms. These CDs strengthened the positive effect of calm and sedative music with relaxation techniques to achieve enhanced effects. To increase effectiveness, commercial relaxation DVDs also integrated visual stimuli. In this approach, the visual representation of the scenario supports the process of relaxation creating an isolated context in which the subject can feel to stay.

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1. Methods

1.1 Virtual reality and Biofeedback

In our protocol Virtual reality (VR) is used to facilitate relaxation processes in stressed or anxious subjects by visually presenting a relaxing environment. The advantage of VR compared to relaxing CDs or DVDs is its ability to induce a sense of presence in the users, which is defined as the "feeling of being in a world that exists outside of the self " [4-6]. The visual presentation of a virtual calm scenario can facilitate patients' practice and mastery of relaxation, making the experience more vivid and real than the one that most subjects can create using their own imagination and memory, and triggering a broad empowerment process within the experience induced by a high sense of presence. [7-8].

More, using a biofeedback biomonitoring system (GSR, HR, Thermal) the patient is made aware of his or her reactions through the modification of some features of the VR environment in real time. Using mental exercises the patient learns to control these physiological parameters and using the feedback provided by the virtual environment is able to gauge his or her success.

2. Materials

The virtual environment used in this project is designed as a tropical island facing on the ocean and containing a forest on its internal area. Patients can explore the island starting from the beach, which is the arrival point, reached by a boat. Following a footpath that guides through the forest, one can arrive to the start point, where different panels are represented to indicate the directions to go in order to reach the different clinical areas (figure 1). In each clinical area a relaxation exercise is arranged, that combines the virtual scenario and the biomonitoring system. In fact, the main feature of this training is that some elements of the virtual environment are directly modified by the physiological parameters recorded on real time on the patient. Thus, the patient receives an immediate feedback on his/her level of activation (as in traditional biofeedback techniques), but with the surplus value given by the physical environment that he/she is immersively exploring. The elements of the island that are triggered by patient's biological parameters are the following:

- Waves: the reduction of the physiological arousal corresponds to a reduction of the waves until the ocean becomes completely calm;
- Campfire: physiological parameters control the fire intensity, so that the reduction of activation results on reduction of the fire until it goes out;
- Clouds: the sky ranges from cloudy to completely clear and sunny (see figure 2);
- Waterfall: the reduction of the physiological arousal corresponds to a reduction of the stream intensity until the water stops.

One of the exercises is customizable by the therapist, who can choose words or images that remind the patient something stressful. This technique serves as a stress inoculation program, and the patient can experience the reduction in size –fading-floating- of the chosen item, depending on his/her ability to relax himself.

Figure 1. A screenshot of the island.

Figure 2. The different looks assumed by the sky depending on the physiological parameters

2.1. Procedure

To test the efficacy of the proposed approach we are going to set up a randomized controlled trial [9]. Patients who will enter the study must meet the DSM-IV criteria for Generalized Anxiety Disorder (GAD), and will be selected after a psychological interview, that will include a clinical evaluation with the administration of the following semi-structured questionnaires:

- PSWQ (Penn State Worry Questionnarie);
- BAI (Beck Anxiety Inventory);
- STAI – Y2 (State-Trait Anxiety Inventory);
- HARS (Hamilton Anxiety Rating Scale);
- GAD -7.

The study will include three groups of 15 patients each (for a total of 45 patients):

1. VR+BF: in this experimental condition patients will receive a treatment based on virtual reality, combined to biofeedback. Relaxation will be induced by

navigation on a virtual environment in which patient may move and interact, following auditory narratives that support images. A wearable biosensor system will provide suggestions to the therapist based on the reactions of the patients, and the biosensor data will directly modify the virtual reality experience in real time.

2. VR: in this experimental condition patients will receive a treatment based on virtual reality. Relaxation will be induced by navigation on a virtual environment in which patient may move and interact, following auditory narratives that support images. In this condition, the critical environment points that in the VR+BF condition were modified on the basis of biosensors activity, will be set on the lowest parameter and will not be modifiable by physiological parameters of the patient.
3. WL: this is a control condition, in which patients will be included in a waiting list and will not receive any kind of treatment.

Groups VR+ BF and VR will participate to 8 training sessions, each consisting in relaxation procedures consistent with the experimental target (virtual reality combined with biofeedback vs. virtual reality alone). The experimental groups, thus, will differ only on the basis of feedback used to induce relaxation.

In order to improve the efficacy of the training and to increase the effects of relaxation, patients will practice relaxation techniques outside therapist's office by experiencing a Homecare Scenario. This will be realized by presenting on a mobile device a non-navigable version of the same virtual environment experienced during the therapy.

Patient candidates to enter this study will be evaluated in the first session with therapist, in which they will undergo the psychological questionnaires described above.

Those patients, who will meet the inclusion criteria, then will start the 8-sessions relaxation program.

Relaxation programs, regardless the instruments used, will differ along the sessions, following this schema:

- the first six sessions are dedicated to relaxation of different body parts, one each 2 sessions;
- during the 7th and 8th sessions a stressful element will be included (patients will be asked to describe a particular stressful event of their life in order to induce a high level of stress). This event will be visualized in both the experimental conditions using images or key words that remind to it. After that, they will be encouraged to apply the learned techniques to relax themselves.

In this experiment we will use as dependent variables, to quantify the anxiety's level modification, both psychological and psychophysiological measures.

Psychological assessment: each patient will undergo a series of psychometric questionnaires that will give us a quantitative measures of his anxiety. These evaluation will be administered at the beginning and at the end of each training session:

- STAI Y1 (State-Trait Anxiety Inventory);
- VAS-A (Visual Analogue Scale for Anxiety).

Psychophysiological assessment: several physiological parameters (skin conductance response – SCR, heart and respiratory rates, muscle tension) will be registered during the treatment session, in order to obtain and monitor in vivo measures of emotional state of patients who belong to the experimental groups.

3. Expected results

Since Virtual Reality is known to be effective to induce relaxation, the first expected result is a bigger reduction of anxiety level in patients belonging to the two experimental groups, if compared with the control group.
More interestingly, our hypothesis is that the combination of virtual reality and the special kind of biofeedback used (which is able to directly modify the virtual environment) will result in better and faster relaxation learning, compared with virtual reality alone. If so, this new instrument to treat anxiety disorders could be applied and tested even in other anxiety-related pathologies.

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Transcranial Doppler: a Non-Invasive Tool for Monitoring Brain Activity in Virtual Reality Therapy

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Abstract. In this work, we propose the use of Transcranial Doppler Monitoring (TCD) as a tool to measure brain activity during the exposure to Virtual Environments (VE) used in clinical therapy sessions. The technique is non-invasive, and can be easily integrated with Virtual Reality (VR) settings. Moreover, it provides a high temporal resolution, which grants the possibility to analyze changes in brain activity during the evolution of a clinical session and to correlate them with specific events that may occur in the VE. We have performed two studies combining TCD with VR. Results of these studies show that it is feasible to use this technique in combination with VR settings designed for virtual therapy. It was observed that immersion and navigation modifications in the VE generated changes in brain activity that can be detected using TCD.

Keywords. Transcranial Doppler, Cerebral blood flow, Virtual Reality Therapy

Introduction

Clinical Therapy is one of the most challenging applications of Virtual Reality (VR). During the exposure to Virtual Environments (VE) in clinical therapy sessions, it is beneficial to monitor as much information from the patient as possible. Some information can be collected using questionnaires that analyze different factors of the VR experience, such as presence, immersion, or emotions [1-3]. However, the use of questionnaires has limitations. Most of them can only be used after the exposure to the VE, and therefore is not possible to have data pertaining to the temporal evolution of the patient during the session. In order to avoid this limitation, some studies have tried to adapt questionnaires in order to monitor different variables during the virtual experience. For example, a handheld slider was proposed as a new form of direct subjective presence evaluation [4]. Other studies used short questions, which were included in the VE during the VR experience to collect information on the level of anxiety [5]. These approaches can be useful to have information directly related with specific events. However, they can hardly interfere with the VR experience itself. This is why, in many cases, physiological measurements, such as electrocardiogram (EKG)

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or skin conductance (SC) [6], and neurological measurements such as electroencephalogram (EEG) [7] have been proposed as tools to monitor the evolution of the patient during the exposure to VE in clinical therapy applications.

In this study, we proposed an alternative neurological measurement tool that can be used to monitor brain activity during the exposure to VE. This technique is called Transcranial Doppler (TCD), a non-invasive measurement with high temporal resolution that can be easily integrated in the VR settings used in clinical therapy sessions.

1. Transcranial Doppler (TCD)

TCD was first used in 1982 [8]. It is an ultrasound diagnosis technique to control the hemodynamic characteristics of major cerebral arteries in normal and pathological conditions with high temporal resolution. Based on the Doppler Effect, this technique can obtain the instantaneous blood flow velocity (BFV) in the main cerebral arteries of the brain: middle cerebral arteries (MCAs), anterior cerebral arteries (ACAs) and posterior cerebral arteries (PCAs). Each of these vessels supplies different cerebral regions. Previous research has shown that Cerebral Blood Flow (CBF) increases when users are performing mental tasks [9]. When the neurovascular coupling [10] is adequate, BFV variations detected using TCD reflect changes in regional CBF due to brain activation in the areas supplied by the vessels under study.

TCD has important advantages when compared to other techniques. First of all, it has a high temporal resolution, which allows instantaneous monitoring of cerebral responses to specific events. Furthermore, it is non-invasive, so it is possible to use it in an ecological way in a great variety of environments. That constitutes its main advantage when compared with other techniques such as fMRI, which imposes serious restrictions to the experiments in which it is used, as long as the subject has to remain in supine position inside the magnetic resonance machine with minimum head movements while hearing annoying noises. The main disadvantage of TCD is its spatial resolution, which is limited by the size of the cortical areas supplied by the arteries under study.

1.1. TCD adjustment procedure

This technique requires that two probes be placed on the skull of the subject using a headband or a probe holder. The adjustment of the probes to their correct location is a process that can be easily performed by a neurophysiologist in a short period of time without requiring any previous preparation from the patient and without generating any inconvenience. Once the probes are located, the patient can be stood up or sitting during the VR session, as the system is compatible with both positions [11]. The location of the probes in the head has to be maintained during all the experiences, so the only restriction is that the patients cannot make abrupt movements during the session.

1.2. Cortical areas supplied by TCD monitored arteries

MCAs supply blood to the greater part of the brain. Their perfusion territory includes subcortical areas, large fractions of the frontal and parietal lobes, as well as the

temporal lobes [12]. Modifications in their BFV can be produced by brain activity associated with different kinds of tasks (such as motor tasks, memory tasks or even emotional states). Usually, BFV variations are used to analyze hemispheric dominance during these tasks. In any case, some parts of the MCAs perfusion territory are closely related with the processing of emotions (mainly parts of the parietal and frontal lobe, as well as areas of the temporal lobe with the limbic systems [13]), so their analysis would be interesting during clinical therapy sessions.

The other vessels that can be monitored with TCD have a smaller perfusion territory, thus we can obtain from them more detailed information about the brain areas that are activated. ACAs can be especially important in clinical therapy sessions, as long as they supply most of the medial areas of the brain, including the medial frontal cortex and most parts of the limbic system [12]. Such BFV variations are closely related with the emotional state of the patient.

1.3. TCD in psychophysiological studies

TCD has been used to analyze cognitive states of subjects in psychophysiological research [14-15]. These studies have shown that mean BFV obtained from TCD signals increases when users are performing cognitive tasks (such as reading, arithmetic operations, visual stimulation, attention, verbal tasks, motor tasks, visuospatial tasks and memory) when compared to baseline periods. Some of the previous studies have analyzed emotion-related changes in BFV and have found an emotion-related cerebral asymmetry [16-17]. A significantly higher increase is observed in the right than in the left MCA during emotional processing.

2. Results of TCD in Virtual Reality experiences

Although there have been many previous studies using TCD in neurophysiologic research, the first studies that analyze brain activity during a VR exposure have been developed by our group. The complete description of the experiences has already been published [18, 19], but a short summary is included in this section.

In order to monitor BFV signals during the exposure to this VE, a commercially available 2-MHz pulsed-wave TCD unit (Doppler-Box^{TM} Compumedics Germany GmbH) was used. The apparatus was connected to a PC in which DWL® Doppler software (QL) was installed. This software was used to receive the data from the Doppler Box and to save the selected variables on the PC hard disk for off-line analysis. Two dual 2-MHz transducers were connected to the Doppler Box. Both hemispheres were simultaneously monitored through the temporal window using two probes capable of simultaneous explorations at two different depths. In the first study [18], both MCAs and ACAs were monitored. In the second study, [19] only MCAs were monitored.

Thirty-two volunteers participated in the first study [18]. The VE used was a maze composed of several rooms and corridors. A joystick was used to navigate inside a CAVE-like system. TCD was used to monitor brain activity during the different navigation conditions (self-guided with joystick vs. automatic navigation). Fig. 1 shows an image of a user during the automatic navigation condition in this study.

Results show that the variations in BFV in left hemisphere arteries that occurred in the self-guided navigation condition when compared with baseline were significantly higher than in the automatic navigation. The variations in left MCA (MCA-L) could be

due to the motor tasks with the right hand to control the joystick. However, the variations in left ACA (ACA-L) are not directly related to this issue, and can only be explained by other factors such as differences in the emotional state or the level of presence that the user is experiencing during the VE exposure in the different navigation conditions. Presence questionnaires confirmed that the level of presence was different between experimental conditions.

Figure 1. User during the automatic navigation in the first study [18].

In the second study [19], forty-two subjects were exposed to different immersion (CAVE-like vs. single screen projection) and navigation conditions (self-guided with joystick vs. automatic navigation). The same VE was used. Only the navigation factor had significant influence in BFV variations in right MCA (MCA-R) and MCA-L. Differences in MCA-R BFV variations cannot be explained by motor tasks, as subjects used the right hand to control the joystick. A possible explanation of these differences could be found in the different degree of involvement of the users to create the motor plan in both conditions. The level of presence at each condition (which is different as measured by questionnaires) could also be having an influence.

3. Conclusions and discussion

TCD is a tool that can be easily used to monitor brain activity during the VR experience in clinical therapy. Its main advantage is that it provides a high temporal resolution that allows the monitoring of fast changes in BFV values caused by neural activity. The works in our group [18, 19] are the first to use TCD in combination with VR. These works show that it is possible to obtain robust BFV signals even during the exposure to a VR experience. Besides, the use of TCD does not interfere with the capability of the subjects to focus their attention on the VE. These conclusions show the feasibility of using TCD in combination with VR during virtual therapy. The use of TCD may help therapists to have reliable information on the brain activity of their patients and correlate its changes with specific events in the VR session.

The studies also show the feasibility of simultaneously monitoring BFV in different cerebral vessels during the exposure to VE. Two probes are used, so it is

possible to monitor both hemispheres. As different vessels supply different brain areas, an important issue in TCD studies is to identify the brain area most directly related with the task under study in order to select the more adequate vessel. MCAs are the vessels most commonly used, as they have the largest perfusion territory. ACAs have smaller perfusion territories, including most parts of the limbic system, thus can be especially useful in studies where emotional aspects have to be considered.

Taking all these aspects into account, we conclude that TCD is a significant measure to be studied that monitors aspects such as emotions and presence during exposure of patients to VE in clinical therapy sessions.

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Interactive Highly Realistic Virtual Reality as a Tool for Understanding the Genesis and Treatment of Psychotic Symptoms

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Abstract. Schizophrenia can be a devastating lifelong psychotic disorder with a poor prognosis. National guidelines in the UK recommend the provision of cognitive behavioral therapy (CBT) to all those suffering with psychotic disorders, but there is a lack of trained therapists in the UK able to provide such a treatment. Developing high quality automated technologies that can serve as an adjunct to conventional CBT should enhance the provision of this therapy, and increase the efficiency of the therapists in practice. The latter will occur by enabling alternate professionals to aid in the delivery of therapy, to enable behavioral experiments to be conducted in the clinic, and for sessions to be recorded and re-played such that the patient can deliver therapy to him or herself. As such the system will enable patients to become experts in, and providers of, their own treatment and decrease the number of sessions needed to be led by a trained CBT therapist. A key feature of any such system is the *level of realism* required to ensure a compelling session in which the user is not adversely affected by the system itself. This paper presents a high-fidelity virtual environment to help better understand the environmental triggers for psychosis.

Keywords. Psychosis, schizophrenia, realistic virtual environments, multi-modal

Introduction

Over the last several years it has become clear that the classical neurodevelopmental model of psychotic disorders such as schizophrenia fails to explain both the proximal events that trigger someone with unusual experiences into frank psychosis, and more generally, does not offer a way of understanding an individual's shifts up or down the continuum of psychosis [1]. On the other hand, Virtual Reality - Cognitive Behavior Therapy (VR-CBT) has been shown to substantially reduce the length of treatment and reduce relapse rates for the treatment of phobias, for example [2]. However, such VR systems have typically been developed for experimental purposes and used avatars and scenes, which cannot be manipulated interactively. They can therefore not be developed into a treatment tool for the variety of relevant contexts used in CBT for schizophrenia [4]. Furthermore, the level of realism of the virtual environment has to

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be carefully considered if the virtual scenes and the avatars are to be able to induce a feeling of presence and thus the same emotional response as in reality [3-6].

1. Methods

The environment used in the system is a highly realistic multi-modal (graphics and audio) virtual urban setting based on an actual street in the deprived area of Handsworth, Birmingham (UK), including both the environment and virtual people (avatars). The user of the system is standing at the bus stop waiting for a bus. The system is delivered with a HMD NVIS nVisor SX and a Polemus 6DOF Motion Tracker (figure 1). The virtual scene is then manipulated by altering parameters. Two scenarios were considered:

- background and a group of elderly ladies in the foreground,
- background and a group of aggressive young men in the foreground (figure 2).

2. Results

Subjects were students recruited from the University of Warwick. Detailed feedback, both through direct monitoring of user behavior, such as heart rate measurement and skin conductance, and pre- and post-exposure assessments including questionnaires and a semi-structured interview have provided key insights into the efficacy of the virtual environment. We have also been able to identify those environmental factors, which are most likely to be linked to the development of paranoid thinking and conversely, those factors that may attenuate paranoid experiences.

Figure 1. System setup

Figure 2. Scene from scenario

3. Discussion

Psychotic disorders such as schizophrenia carry major social and economic costs for sufferers, their families, and society. Clinical focus is now on early treatment in young people with emerging psychosis. Evidence based psychological interventions such as CBT are often not offered because of a lack of trained therapists. VR environments have typically been used to treat mental health problems such as phobias. A key

question was whether current levels of realism common in typical VR systems were sufficient to investigate psychosis, or whether a more high-fidelity, multi-modal approach was required.

4. Conclusions

The preliminary work presented here has shown that VR exposure can potentially be used to develop assessment and intervention techniques for psychosis. However, the presence of both high-fidelity visuals and audio was necessary to help trigger psychosis. More work is now needed to further investigate the safety, acceptability and suitability of VR in helping understand early psychosis.

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A Cross-Cultural Validation of VR Treatment System for Flying Phobia in the Mexican Population

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Abstract. Anxiety as a symptom or disorder is affected by multiple variables such as antecedent events, interpretation of the events, psychological vulnerability, and individual differences in the reaction towards an event. Nowadays, virtual-reality therapy is used as therapeutic tool for patients suffering from some kind of anxiety disorder. In Mexico, the National Survey on Psychiatric Epidemiology [1] informed that anxiety disorders are the most common disorders followed by affective disorders, which are more prevalent in women than in men. Among the different anxiety disorders, the category of specific phobias (7.1%) was the most common. Based on this demand, a collaborative effort between research groups from the University Jaume I in Spain and the National Autonomous University of Mexico (UNAM), initiated a project which purpose was the technological transfer of systems based on virtual reality for the treatment of Fear of Flying to be implemented and evaluated in the Mexican population. The treatment protocol developed by Botella et al., [2] has been applied to five volunteer participants. In this paper we present data of adapted treatment protocols in Mexican population that support the efficacy of VR of treatment of fear of flying, achieved by the Spanish research group.

Keywords. Virtual reality, fear of flying, phobias, cognitive-behavioral treatment

Introduction

Anxiety as a symptom or disorder is affected by multiple variables such as antecedent events, interpretation of the events, psychological vulnerability, and individual differences in the reaction towards an event. Cross-cultural research emphasized that different reactions from people depend on their social context, and they are different in each culture. In Mexico, the National Survey on Psychiatric Epidemiology [1] reported that anxiety disorders are the most common disorders followed by affective disorders. Among the different anxiety disorders, the category of specific phobias (7.1%) was the most common. We present the results obtained from a cross-cultural validation in Mexican population of the Fear of Flying treatment system developed by Botella et al. [2,3], which had been proved their efficacy in Spanish population and in process of cross-cultural validation in Holland and Mexico.

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1. Method

1.1 Participants

The clinical sample was conformed of five participants who had asked for psychological services to overcome the fear flying at the Psychology Health Center at UNAM. Women between 18 and 60 years old (M= 46.8 years old) consisted as our sample. All the participants met DSM-IV criteria for Specific phobia situational type (flying phobia).

1.2 *Experimental Design and Procedure*

Before the clinical implementation, an adaptation process was carried out to evaluate clarity and cultural pertinence of the program´s assessment instruments and treatment protocol as well as in the VR system developed by Botella et al. [2,3]. A content validation by ten acknowledging Mexican experts in the field was performed through several judges that scored: (1) cultural and contextual relevance, (2) wording, that the questions were stated correctly in linguistic terms, and (3) language, that the questions used appropriate words for Mexican population and (4) theoretical validity.
Once the assessment instruments were replace or adjusted based on the judges evaluation, the study started the initial evaluation including three baseline periods (1, 2 and 3 weeks), and the participants were randomly assigned to them. The reasons for choosing a multiple baseline design for this preliminary study is because the interest to observe with a greater degree of clinical details the differences and tendency of fear and avoidance ratings in Mexican population. Data obtained will offer the empirical database in order to compare control conditions with studies carried out with diverse cultural samples to prove cross-cultural efficacy of evidence-based programs.

2. Results

From the interjudge cross-cultural validation, results obtained of the assessment instruments used for the treatment of Fear of Flying by expert judges point out a high agreement degree. Table 1 shows the mean percentage of agreement among judges for the instruments, evaluated in four dimensions.

Table 1. Mean percentage of agreement among judges in four dimensions.

	Agreement among judges *(%)*			
Validation of assessment instruments	Relevance	Language	Wording	Theoretical Validity
Questionnaire of presence and reality judgment	99.17%	96.94%	91.11%	97.50%

Table 2. Mean scores in flying phobia protocol assessment questionnaires in Mexican population.

Questionnaires	Pre-treatment	Post-treatment	3 months follow-up
BDI	9.4	6.2	5.25
STAI-T	40	36.2	33.5

Data obtained from the clinical implementation were analyzed with non-parametrical statistics (Wilcoxon signed-rank tests), to estimate the significance of the efficacy data. The scores of the participants showed significance decrease from pre-test to post-test (STAI-T: Z= -2032; p< 0.05; DEFAS- Anxiety expectations, Z: -2.023; p < 0.05) and DEFAS Danger expectations: Z: -2.023; p < 0.05). Finally the statistics revealed significance differences from pre-test to three months follow-up in STAI-T (Z: -1.826; p < 0.05). In the Depression (BDI) measures, the ratings showed no difference between pre-test and post-test (Z:-677; p > 0.05).

3. Discussion

Preliminary results confirm the efficacy in the reduction of variables established as the study carried out by Botella et al., 2005. Findings support the hypothesis stated by Good & Kleinman [4], about the necessity to contextualize the treatment protocols and assessment instruments regarding social relevance and cultural differences. As expected with the main aim of this study, the data offers evidence about the convenience to cross-cultural validation for treatment protocols, considering that the emotional perception of the problems as well as the idiomatic expressions have to be adapted to the cultural and social context of the target population. The results obtained from the assessment instruments used for the treatment of flying phobia by expert judges showed a high percentage average agreement between judges in the dimensions of cultural pertinence, language, and theoretical validity in the dimension of wording the average scores above 90%.

On the other hand, the preliminary clinical data support significance decrease between pre-test and post-test in STAI and DEFAS measures. VR exposure was effective for the treatment of flying phobia in the Mexican population. The participants achieved improvement about their avoidance and fear. They were able to control their anxiety levels. All participants were able to fly in the three months after the treatment.

4. Conclusions

Currently, the replacement of the audios that have been adapted to the Mexican colloquial language are under validation, comparing the original version with the one adapted, in order to know which one gives the user a better immersion, sense of presence, and reality judgment. The audios will be changed with flight attendant's directions before, during and after the flight, as well as directions in the waiting area. We expect in the future to have the complete adapted system as result of this other study, in order to benefit and disseminate this treatment protocol to the Mexican and Latino population.

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Telepsychiatry and Cultural Barrier in Korea

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Abstract. This research was performed in order to empirically prove that telepsychiatry can result in overcoming of the Confucian cultural barrier which discouraged Korean patients from seeking psychiatric care. The Confucian culture of Korea forces its members to observe absolute conformity to the social norm. In this kind of culture it is very hard to admit one's mental illness and to seek medical help. Thus telepsychiatry might be a good alternative to face-to-face meeting-based psychiatry especially in culturally inhibitive places such as Korea. We conducted a telepsychiatry experiment using Instant Messenger with 93 volunteers who had an experience of seeing a psychiatrist in person. The result shows that people tend to think that telepsychiatry allowed them to break out of the Confucian cultural protocol which put heavy emphasis on avoiding any irregular thought.

Keywords. Telepsychiatry, Cultural Barrier, Korea

Introduction

Telepsychiatry refers to a term to describe psychiatric consultation done through none face-to-face environment usually through videoconferencing via Internet connection. This method of treating mental patients was proven effective in many western countries such as US [1], Canada [2], and Norway [3], However, no such treatment has been reported in Korea where the national IT infrastructure is one of the best in the world. In this research, the effectiveness of telepsychiatry will be examined with Korean subjects in order to determine the adequacy of practicing telepsychiatry in Korea. The Confucian teaching emphasizes respect and social order in society. Thus mental illness is seen as a threat to orderly management of society because any mental patient is likely not to observe traditional protocols of showing respect to seniors and the powerful, which then might be imitated by the mass, which can lead to a challenge against the governing elite. It is true that even in western societies, for a long time, mental illness was regarded as a threat to social order. However this attitude waned as western societies became democratic. Democracy brought openness in people and thus scientific solutions to every aspect of human problems including mental diseases [4]. Korea is still having difficulty in getting rid of the Confucian tradition even as it goes through many democratic reforms. Telepsychiatry can be another tool in aiding Korean society to overcome the Confucian cultural burden in

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the area of mental health care. We would like to present an empirical finding using telepsychiatric experiments in order to prove this proposition.

1. Methods

The Social stigma of receiving psychiatric care is immensely stronger in still tradition-bound Korea much more than in western countries. Korea has gone through rapid westernization in the last 50 years and transformed itself one of the most westernized countries in Asia. However, due to the long history of the Confucian teaching-based social culture, which does not even regard mental illness as real illness it is still very difficult to overcome prejudice attached to the people of mental health care needs. It is true that even in western countries, this stigma existed before. However democratic openness of western culture helped to relieve the social burden on mental patients in modern times [5]. Thus, in western countries there are generally two kinds of needs to utilize telepsychiatry [6]. One is for remote area residents who have difficulty in finding a psychiatrist nearby. Another is for convenience of receiving the care in more comfortable environment. In the Korean case, the first need is irrelevant since Korea is a very small country where major hospitals are reachable with little travel. The second need can be a factor that is applicable in Korean context since visiting psychiatric clinics still gives a lot of shame and fear on patients. But we would like to posit that one more factor should be considered in Korea when it comes to the effectiveness of telepsychiatry, that is, the Confucian cultural factor. There is a big chance that telepsychiatry might help bring down the Confucian cultural barrier because it can minimize negative emotions such as shame and fear. We propose a following proposition: “Telepsychiatric treatment helps Korean patients to overcome cultural barrier in receiving mental health care.” The aim of this research is to prove the validity of this proposition empirically by conducting experiments and a survey. We decided to use Instant Messenger as a tool for telepsychiatry. Even though it was possible to use video conferencing through Internet, we were concerned that having to show one's face to the doctor might discourage them to open up and discuss their problems due to heavy cultural negative influence on mental care. Thus, we decided to use a text-based chatting system such as Instant Messenger in order to make sure that the patients should be able to participate in the consultation with more care-free attitude. We selected 12 Internet user group sites, which were devoted to exchange health information including mental health among members. We posted a message in these sites in order to urge volunteering for telepsychiatric consultation experiments only if they had any experience of visiting actual psychiatrist's office for consultation. This posting was done in the period of Nov. 23-Dec. 1 2007 until we were able to let 110 volunteers to sign up for experiments. We then invited these volunteers to log on to Instant Messenger and asked them to join a chatting session one by one with a psychiatrist. This consultation session was conducted in the period of Dec. 5-Dec. 10 2007 until we had 93 volunteers show up on Instant Messenger session and the rest of volunteers decided not to participate eventually. During the session typical questions were asked as following.

1. What's bothering you?

2. I will explain why those are bothering you.

Volunteers were told about treatment options and asked to go to an actual psychiatrist to continue the treatment. After the session was over, each volunteer was asked to answer the following survey.

Q1. Do you prefer telepsychiatry to face-to-face meeting psychiatry?

(1) Yes (2) No

Q2. Please rate your degree of agreement on the following statement.

"Telepsychiatry helps me overcome cultural barrier in receiving mental illness treatment."

1(strongly disagree) 2(disagree) 3(neutral) 4(agree) 5(strongly agree)

2. Results

Based on the collected data from 93 volunteers, the result is as following. For the first question, 87% (81 volunteers) answered "Yes" whereas 13% (12 volunteers) answered "No." This means that overwhelming majority of people in this survey preferred telepsychiatry to conventional face-to-face meeting session. This question was asked to see demographic statistics on favorability of telepsychiatry. We also noticed that there were some people who seemed to prefer face-to-face meeting. The reason could be that more seriously ill patients would probably find it necessary to receive detailed care from a psychiatrist; they already had no fear or shame on receiving psychiatric care due to probable previous exposure to the actual psychiatric sessions. The second question was asked to gauge volunteers' feeling on the relationship between telepsychiatry and overcoming cultural barrier in order to prove/disprove our research proposition. Average score of degrees of agreement was 4.1, which indicated an "agree" level among varied degrees of agreement. In other words, surveyed volunteers on average agreed that they felt that telepsychiatry helped them to overcome cultural barrier in receiving psychiatric treatment.

3. Conclusions

We believe that this result proves the validity of our research proposition. However, the small number of sample subjects can be a liability in our claim, which should require further research with much larger sample. However we posit that this research should have its merit in terms of investigating the role of telepsychiatry in overcoming cultural barrier in more traditional societies. We can infer that Korean people tend to think that telepsychiatry helps them to break out of burden of fear and shame brought up by the Confucian cultural heritage. We conclude that doctors in Korea should consider telepsychiatry as one of mental treatment methods since it can help overcome cultural barriers that discourage patients from seeking mental health care.

Acknowledgment

This work was supported by the research fund of Hanyang University (HY-2007-I).

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Online Game Addiction among Chinese College Students Measurement and Attribution

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Abstract. This study made an initial attempt to measure and attribute online game addiction among Chinese college students. We generated three factors of online game addiction: Control Disorder, Conflict, and Injury, as well as proposed a comprehensive model that attributed online game addiction to three groups of driving forces: environmental influences (most significant), characteristics of online games, and personal reasons.

Keywords. Addiction, Online Game, Measurement, Attribution, China

Introduction

China currently has the largest population of Internet users (298 million) and online game players (187 million) in the world [1]. Noticeably, nearly half of Internet users in China are aged below 24 and are most likely to be addicted to online games. On Nov. 8, 2008, the first Internet Addiction Disorder Diagnostic Manual was issued in China, which triggered intensive debates.

Considering online game addiction as one of the most harmful behaviors among Chinese adolescents, researchers have made great efforts to examine this issue. We reviewed 78 academic papers in Mainland China and found that previous research bears two shortcomings.

Firstly, most researchers in Mainland China simply applied Goldberg's [2] or Young's [3] questionnaire into Chinese context to measure online game addiction. This process ignored the fact that Goldberg and Young's scales were originally proposed to measure Internet Addiction as a whole, while online game addiction was only one of the five types of Internet Addiction [4]. As a result, there is not a widely accepted scale to measure the degree of online game addiction in Mainland China. Furthermore, some researchers pointed out the necessity of investigating physical injuries of online game addiction but none has ever tried to include this dimension in the questionnaire.

Secondly, few empirical studies have been conducted in China to find out the underlying reasons of online-game addiction. Researchers tend to base their findings on qualitative observations to propose potential reasons, such as players' personal reasons

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(i.e., personality, social ability, and emotion control ability), environmental factors (i.e., influences from family and schoolmates), and characteristics of online games (e.g., anonymity, interactivity, etc.). But all these findings deserve further verification by quantitative studies.

In comparison, we reviewed English literature and found that great empirical efforts have been made to explore the reasons of online game addiction. For example, Vernberg, et al. [5] and Inderbiten, Walters & Bukowski [6] demonstrated that anxiety due to social relations would lead people to use the Internet as substitution and subject to Internet addiction. Tsai & Lin found that primary groups exert significant influences on Internet addicts and students who have classmates addicted to online games are more likely to play online games [7]. Leung argued that if parents do not play their roles well, children would turn to online games [8]. Choi & Kim [9], Noah [10] and Rouse [11] all proved that some characteristics of online games (e.g., goal, communication, beautiful images, team work, social relation, etc.) could release players from real-life pressures. At the same time, Granitz & Ward [12] and Okleshen & Grossbart [13] both indicated that the award system of online games would enhance players' sense of achievement. As we can see from the above-mentioned studies, researchers tend to discuss one reason at one time. Now it is high time for us to examine various reasons of online game addiction altogether.

To make up for the two shortcomings, this paper aimed to: 1) develop a sophisticated scale of online game addiction; and 2) propose a comprehensive attribution model of online game addiction.

1. Methods

Based on literature reviews and pilot in-depth interviews, we firstly formulated a 2-page questionnaire. Then, we invited five online game over-users and three psychological graduate students to a focus group discussing the validity, wording, and format of the questionnaire. According to their suggestions, we revised and finalized the questionnaire, which included the following four parts: 1) a 16-item scale measuring online game addiction, which for the first time covered questions about physical injury; 2) an 11-item scale attributing online game addiction; 3) questions about online game use pattern (e.g., game genres, time, etc.); and 4) demographics (e.g., age, gender, etc.).

We followed a stratified sampling procedure and did in-home surveys in 32 student hostels at Shenzhen University, China. We finally obtained 195 valid respondents who had been playing online games over the past 6 months, aging between 18 and 24 (Mean=20.8). The first-year (32%), second-year (35%), and third-year students (33%) account for nearly equal proportions of the sample. We purposely oversampled female players (47%) to make comparison with male players (53%). Not surprisingly, arts students (43%) are less than science students (57%) in this sample. The data was then analyzed by SPSS and, in addition to descriptive analyses, we conducted a series of factor analyses and regressions to answer our research questions.

2. Results

As for the 16-item scale measuring online game addiction, 12 items survive from factor analyses and they contribute three factors (see Table 1): Control Disorder (α=.82), Conflict (α=.87), and Injury (α=.75). They totally explain 65.9% of variances. Among them, Control Disorder includes emotional and time control disorder, which can be seen as a new dimension, and Injury includes physical injury (a new sub-dimension).

Combing the above questions into an Online Game Addiction Index (OGAI, Mean=28.2, SD=8.4), we then divided respondents into three groups: 14.3% of online game addicts (OGAI>37), 27.2% of dependents (28⩽OGAI⩽37), and 58.4% of normal users (OGAI<28). Most addicts are male (88.5%). Addicts dedicate more than half of their online time to game playing and prefer role-playing games (57.7%) to other online games.

Table 1. Rotated component matrix of online game addiction scale

Items	Extraction		
I would rather play online games than do other things, such as outside trip.	0.75		
I would neglect household activities to spend more time on online games.	0.84		
I would cut down the time with my friends and schoolmates to play online games.	0.79		
I have tried to cut down the amount of time on online games but failed.	0.73		
I repeatedly failed to control or stop playing online games.	0.71		
I spend longer time than originally intended when playing online games.		0.63	
The more I play online games, the more my attention is highly concentrated and deeply involved.		0.73	
I feel depressed whenever I need to stop playing online games.		0.76	
I feel deep sadness when I fail in online games.		0.75	
I will get angry and yell if anyone bothers me while I am playing online games.		0.81	
I feel exhausted and my eyes feel tired very often.			0.86
I lost sleep because of playing online games and this destroyed my health.			0.82
Eigenvalues	5.06	1.71	1.14
Percentage of variance explained	26.61	25.02	14.28
Factor name	Conflict	Control disorder	Injury
α	0.87	0.82	0.75
Mean	9.73	13.46	5.31
Standard Deviation	4.33	4.16	2.13

Extraction method: principal component analysis. Rotation method: varimax with Kaiser Normalization.

Table 2. Rotated component matrix of driving forces of online game playing

Items	Extraction		
I can express my feelings and opinions freely when playing online games.	.76		
I feel excited when playing online games.	.77		
I want to play more after being awarded for accomplishing tasks in online games.	.79		
I feel greater self-efficacy in online games than in real life.	.64		
I have few friends so I play online games to kill time.		.78	
I often feel depressed and unhappy, and playing		.50	

online games can help me relieve such feelings.			
I am a certain kind of introversive, and want to make more friends by playing online games.		.77	
My parents don't have time to communicate with me and I feel friends from online games are more close to me than real family members.			.70
Almost all of my classmates and friends play online games.			.75
My parents do not live with me so they cannot control my game playing.			.45
Eigenvalue	3.41	1.35	1.00
Percentage of variance explained	24.03	17.64	16.04
Factor name	Characteristics of online games	Personal reasons	Environmental influences
α	0.771	0.575	0.564
Mean	9.12	6.64	7.45
Standard Deviation	2.79	2.59	2.52

Extraction method: principal component analysis. Rotation method: varimax with Kaiser Normalization.

Table 3. Linear regression of online game addiction

	Online Game Addiction
Driving forces of online game playing	
Personal reasons	.064***
Environmental influences	.074***
Characteristics of online games	.062***
Online game use pattern	
Online game genre	.076
Time spent on online game	.036*
Demographics	
Gender	.207**
Age	.057
Grade	-.060
Income	.033
F	30.969***
Constant	-.064
R^2	0.482
Number of Cases	195

*$p<.05$; **$p<.01$; ***$p<.001$

As for the 11-item scale measuring driving forces of online game playing, 10 items survive from factor analyses and they contribute three factors (see Table 2): 1) personal reasons (α=.58), 2) environmental influences (α=.56), and 3) characteristics of online games (α=.77), which completely explained 58% of variances of the 11-item scale.
Finally, we took Online Game Addiction Index as the dependent variable and regressed it with independent variables, including the driving forces of online game playing (i.e.,personal reasons, environmental influences and characteristics of online

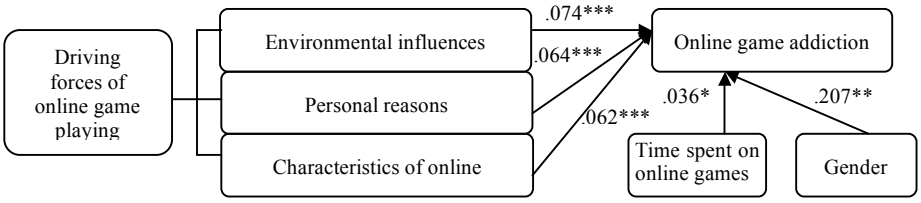

Figure 1. A comprehensive attribution model of online game addiction

games), online game use pattern (online game genre and the online game playing time) and demographics (i.e., gender, age, grade and the income). Table 3 reports the results.

As a result, we got a comprehensive attribution model of online game addiction as above (see Figure 1), in which environmental factors are most significant.

3. Conclusions and Discussion

This study made an initial attempt to measure and attribute online game addiction among Chinese college students. It has two academic contributions: 1) we developed a sophisticated scale of online game addiction and tested its validity and reliability; 2) we proposed a comprehensive attribution model illustrating that online game addiction is not only due to personal reasons, but also to environmental influences and online game characteristics. In fact, environmental influences are most significant in the attribution model.

There is a longstanding belief among Chinese adults (including researchers) that adolescents themselves should be responsible for their misdoing (including online game addiction). But our research proves that environmental influences are more powerful than personal reasons. Therefore, adults (parents in particular) should play a more active role in guiding and supervising adolescents' online game use. Although this study is conducted in China, we have developed a rather sophisticated scale of online game addiction that could be applied to other societies and our attribution model could be conducive to the intervention of online game addicts.

Acknowledgment

This research was supported by Shenzhen Propaganda and Culture Developing Fund.

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A Web-Based Tool for Cooperating Behaviors in Eating and Physical Activity Control

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Abstract. The field of information technology and the Internet for health care has developed rapidly in the last few years. Furthermore, new services devoted to improve personalized healthcare are emerging from current web-orientated research. Control of eating and physical activity behaviors can be performed in a computer mediated way as a social networking application. To this purpose, we designed and implemented a web application based on the cooperation between two communities: Patients and Nutritionists. The patients are able to cooperate as within a self-help group, while nutritionists can guide patients struggling with incorrect lifestyle and its consequences.

Keywords. Internet, social networking, software development

Introduction

The field of information technology and the Internet for health care has developed rapidly in the last few years. Recently patient-centered and consumer-centered healthcare systems have been developed [1,2,3]. Those systems allow the patient to participate in his healthcare process with an active role by collecting and managing his or her digital health documents and information. Moreover, new services devoted to improve personalized healthcare are emerging from current web-orientated research [4]. Among them social networking, which is based on relationships between actors [4], can represent a key to enhance changing weight behavior programs involving the web-technology and surmount the evidenced barriers. The delivery of structured behavioral weight loss programs can be feasible by Internet [5] and can potentially reach greater numbers of people maintaining the weight loss achieved [6], although participant abandon occurred and motivating on-line weight loss participants remains to explore [6,7]. Then, previous studies also showed that some online healthcare devoted applications had a high abandon rate after some time [8], however an approach based on social networking, e.g. membership to a community, could improve motivation in

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performing tasks [4]. Therefore, we designed and implemented a dynamic web application for controlling eating and physical activity behaviors based on the cooperation between two communities: the Patient community, i.e. people who decided to follow a healthy lifestyle to lose weight and the Nutritionist community, i.e. professionals who guide patients to reach a healthy lifestyle.

1. Methods

1.1. Modeling the Communities and Their Interactions

In this paragraph, we explained how we modeled the two communities and the cooperation between them. People who decided to follow a healthy lifestyle to lose weight formed the Patient community. This was a virtual community, i.e. patient did not meet each other physically, but they interacted online in a computer mediated way. They agreed to share information related to eating and physical activity behaviors with the other members of the community. In such a way, they could motivate and sustain each other in reaching the objective. We represented the Patient community with a circle (Figure 1). The circle belongs to a plane, meaning that there were not hierarchies in the patient group. The bold arrow contouring the circle means that everyone was able to communicate with each other, in a computer mediated way.

Professionals who guide patients to reach a healthy lifestyle formed the Nutritionist community. This was a virtual community too. They agreed to share their knowledge and experience to help patients. In such a way, the individual experience gap among nutritionists has been filled, and the patient does not perceive it. We represented the Nutritionist community with a circle (Figure 1). The circle belongs to a plane, meaning that there were not skill or experience differences in the nutritionist group. The bold arrow contouring the circle means that everyone communicates with each other, in a computer mediated way. An example of communication is the request of a nutritionist for an advice to another one to better treat a patient. Then, the two communities can communicate to each other by a bidirectional "communication bus," represented with the two vertical arrows (Figure 1). Patients share information relates to eating and physical activity behaviors with the Nutritionist community and nutritionist give them advices on their behavior.

1.2. Designing the Web Application

A Web application is composed by a data layer, usually a database or a file system structure, and uses a website as the front end. We designed the database to store data and information regarding the two cooperating communities. For the patients, in addition to demographical data, we considered height, weight, body mass index, daily physical activity, daily meals, and messages to other patients, interacting as in a self-help group, or nutritionists. For the nutritionists, we considered advices to patients or other nutritionists. Moreover, a file system structure collects digital pictures of patient meals, taken by the patient using a digital camera. In order to manage this Web application, we also defined the Administrator and the Manager roles. Managers register Patient users, or temporarily disable their access to the system, while Administrators can manage website contents, register both Manager and Nutritionist users.

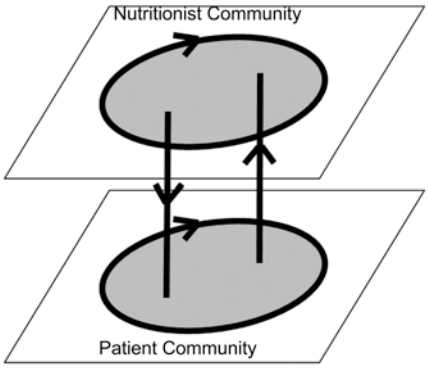

Figure 1. The communities and their relationships

The Web application has been implemented using Microsoft Active Server Pages technology, together with JavaScript scripting language. Active Data Objects technology has been used to retrieve web page content from the database developed using Microsoft Access®. Microsoft Internet Information Server has been used to perform connections between clients, which use a Web browser to request files, data, and services, and the Web server, which satisfies the client's requests. The data storage structures contain patient's data that require ensuring confidentiality and protection against unauthorized access and use. Those security features have been developed by a registration procedure of users, who have their own login and password.

2. Results

The developed Web system contains four sections giving every role, i.e. Administrator, Manager, Nutritionist and Patient, the specific required functions (see Table 1). The functions are presented as a menu in the left side of the screen (see Figure 2). The Web system graphical user interface was designed and implemented to ease filling data forms and better comprehension of displayed information. For a patient, the required information on eaten meals are limited to description and quantity, kind of meal, picture of the meal, and entered filling a three-field form. For a nutritionist, the meal picture supports the calculation of the in-taken calories (Figure 2).

Up to now, we made some preliminary informal experiments building Patients and Nutritionists communities, with a limited number of members, and performing the available functions to verify the correctness of communication workflow represented in Figure 1.

Table 1. Detailed functions available for each user role.

User role	Functions
Administrator	a) Managing website page contents; b) Registering and managing Manager user role; c) Registering and managing Nutritionist user role;
Manager	a) Registering and managing Patient user role; b) Performing statistics about web site usage.

User role	Functions
Nutritionist	a) For each considered patient: a1) Reading information about eaten meals, seeing meal pictures, calculate and store in-taken calories, a2) Reading information about performed physical activity and calculate and store calorie's consumption; a3) Sending advices about of correctness of the followed lifestyle; b) Inserting the value of calories for 100 grams of a food or ingredient; c) Sending a message to Patient community; d) Sending a message to Nutritionist community; e) Reading received messages from patients; f) Reading received messages from patients or nutritionists.
Patient	a) Sending a message to a patient; b) Sending a message to Patient community; c) Send a message to Nutritionist community; d) Reading the received messages from Patient community; e) Reading the received messages and reports from Nutritionist community; f) Sending information about eaten meals: description and quantity, kind of meal (breakfast, lunch, brunch, snack, dinner), picture of the meal; g) Sending information about performed physical activity: kind (i.e. footing, swimming, playing tennis, walking, riding bicycle), duration.

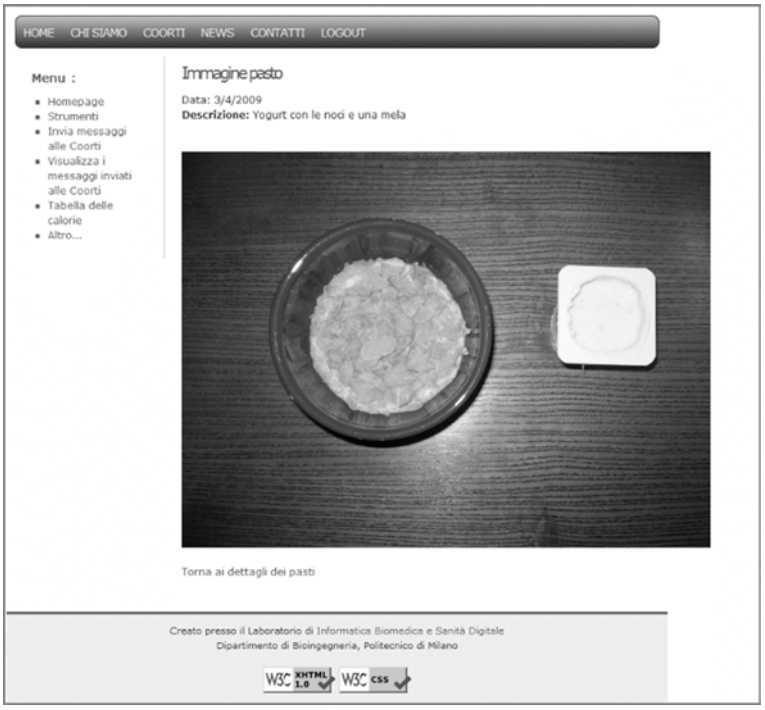

Figure 2. A breakfast picture sent a nutritionist to evaluate in-taken calories.

3. Discussion

The developed Web application involved the modeling of relationship between Patient and Nutritionist communities to cooperate for controlling eating and physical activity behaviors. We designed a web application and implemented it using the MS

Access®, however the design performed can be the base for implementations using other software tools - database management systems and web development environments - as we can consider the application a module to new generation personal health records [4].

The Web system graphical user interface was designed and implemented to ease filling data forms and better comprehension of displayed information, satisfying a requirement for reducing attrition towards the use of some online healthcare devoted applications [8].

In the developed web application, patients upload meal's pictures and nutritionists manually perform the calculation of the in-taken calories. In a near future, we can imagine that restaurants will make available online information about the food menu, so we will be able to include "mashups" [8,9], i.e. applications that can gather web site content automatically and to facilitate nutritionist tasks.

4. Conclusions

The developed Web-based tool allows collecting the all-eating and activity data of a community of patients and the patient-patient, patient-nutritionist, and nutritionist-nutritionist interactions. The patient can cooperate as in a self-help group, while nutritionists can guide patients struggling with incorrect lifestyle and its consequences.

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A Comparison of Different Survey Periods in Online Surveys of Persons with Eating Disorders and Their Relatives

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Abstract. Evaluations of Internet-based interventions offered to patients with mental or psychosomatic illnesses are mostly carried out in the form of online surveys. Up until now, the methods used in carrying out these evaluations have seldom been systematically investigated. This study tested whether modifying this time interval brings about changes in the respondents' response behavior and the make-up of the sample. Two survey strategies were compared: a post-block survey (with a variable time interval between the Internet-based intervention and the online survey) and a post-spot survey (time interval standardised to 90 days). In the post-spot survey it was possible to prove a higher response rate (39.9%) than in the post-block survey (28.0%) as well as a higher number of questionnaires completed correctly and in full. No differences were identified in the basic characteristics of the random samples. It was possible to demonstrate that the quality of the online survey could be improved by standardising the length of time. Standardisation of the time difference implies a controllable degree of influence on the quality of the evaluations.

Keywords. Internet, online consulting service, eating disorders, non-response, e-health, ex post facto study

Introduction

Internet-based research methods have been used increasingly in clinical psychology. This includes, for example, carrying out online surveys to evaluate Internet-based interventions for various types of mental and psychosomatic illnesses.

The design of such studies varies from *ex post facto* studies [1,2], pre/post comparisons [3] to one or more follow-ups [4]. The time interval between the post- or follow-up measures and the point at which the online intervention took place can also be seen as a potential influencing factor on the rate of return [2].

This investigation compares two online survey strategies which differ with regard to the time interval between the intervention (online consultation for eating disorders) and the subsequent online survey, in following factors: (a) *Response behavior* (questionnaires filled in incorrectly/incompletely, looking at the questionnaire without answering it, information volunteered), (b) *characteristics of the samples* (Age, Gender, Previous experiences of professional help) and (c) *Formal characteristics of the*

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intervention (identity of the online consultant, length of the online consultation process).

1. Method

Two online questionnaires – one for persons affected by eating disorders and one for relatives – were constructed in order to record the impact and effects of the *ab-server* online consultations. These questionnaires contained 17 items, consisting only of closed questions with response prompts. For some questions multiple answers were allowed. Affected persons and relatives who wanted to make use of the online consulting service were given an opportunity to voluntarily agree to take part in an online survey. These persons seeking advice could enter an e-mail address to which the invitation to take part in the online questionnaire was sent on the appropriate survey date. These invitations contained two links, which referred them to either the online questionnaire for affected persons or the questionnaire for the relatives.

Between 04/2005 and 11/2006, the effects of intervention were recorded on two dates to everyone who had sought advice, irrespective of how long ago the intervention had taken place ("post-block survey"). Between 12/2006 and 11/2007 people were invited to take part in the online survey, in each case 3 months (90 days) after the intervention ("post-spot survey"; see figure 1).

A total number of 1071 online questionnaires were sent out, with a total response rate of 31.9 %.

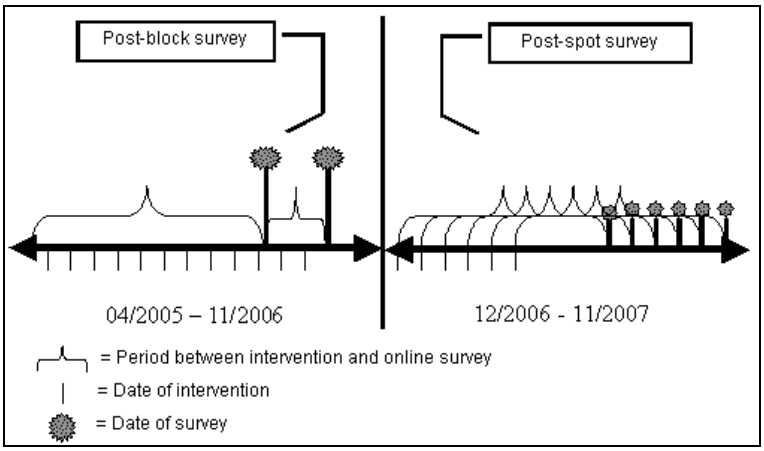

Figure 1. Modes of investigation in the post-block and post-spot surveys.

2. Results

The post-block survey had a response rate of 28.0%, the post-spot survey a response rate of 39.9%. This difference was verified statistically ($Chi^2 = 14.35$; $p \leq .001$). Furthermore, significant differences in the correctly completed questionnaires could be proved ($Chi^2 = 18.96$; $p \leq .001$). The investigation of random sample characteristics (age, gender, and previous experience of professional help) and of formal characteristics of the intervention (person of the consultant, duration of the consultation process) found no significant differences between the to survey methods.

3. Conclusion

It can conclude that a short time interval, such as that achieved in the post-spot survey by standardising it to three months, increased the motivation of the people seeking advice to take part in the online survey. Until now, the timing of a survey following an Internet-based intervention has been decided mainly on the basis of disorder-specific or pragmatic aspects. However, these results show that the time interval between Internet-based intervention and the online survey can be incorporated as an explicit determining factor. In particular, low-threshold Internet-based interventions, in which a high drop-out rate is recorded (and which therefore rely particularly on representative feedback), can benefit from standardisation of the timing.

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Playmancer Project: A Serious Videogame as an Additional Therapy Tool for Eating and Impulse Control Disorders

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Abstract. Reviews and few non-controlled studies showed the effectiveness of several specific designed computer video-games as an additional form of treatment in several areas. However, there is a lack in the literature of specially designed serious-games for treating mental disorders. *Playmancer* (ICT European initiative) aims to develop and assess a serious videogame that may help to treat underlying processes (e.g. lack of self-control strategies) in Eating and Impulse control disorders. Preliminary data will be shown.

Keywords. Serious games, mental disorders, cognitive-behavioral therapy

Introduction

To date, the use of new technologies increased in the treatment of several mental disorders, including: obsessive-compulsive disorders [1] schizophrenia [2], eating disorders (EDs) [3], and anxiety disorders [4]. Furthermore, additional virtual reality approaches have been successfully applied by minor mental disorders, such as: posttraumatic stress disorders [5, 6] and addictive behaviors [7]. As previously stated, computer games, could serve as an additional form of treatment in several areas, such as: schizophrenia [8], asthma [9], and motor rehabilitation [10]. Although, several naturalistic studies have shown the usefulness of serious videogames for enhancing: positive attitudes [11,12], problem solving strategies [13], and modifying abnormal behaviors [14], there is a lack in the literature of specially designed serious-games for treating mental disorders and of controlled studies. Based on the current difficulty to treat some specific areas (e.g. some personality traits, attitudinal and emotional aspects,

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impulsivity), in Eating disorders (ED) and Pathological gambling (PG), even after using evidence based psychological therapies, the purpose of *Playmancer* was to create and design a serious videogame that may help to treat these factors. Hence, the purpose of this presentation is to introduce the current state of this innovative research, showing the design of the study and preliminary results. The final goal of this research is to analyze the efficiency and effectiveness of using a serious videogame, as additional therapy tool, for treating mental disorders (namely ED and PG), when compared with a comparison group, where no additional videogame has been used.

1. Methods

1.1. Type of study and participants

A prospective longitudinal cohort study (patients and controls), following a quasi-experimental design, is being used. 60 Bulimia nervosa and 60 PG patients are participating in this study. All of them fulfill DSM-IV criteria for those pathologies.

1.2. Procedure

Psychometric and physiological measures administered previous to treatment, at the end of treatment and at 3 and 6 follow-up, will be used for the assessment of therapy outcome. All cases will be assigned to two conditions: standard cognitive-behavioral therapy (CBT) + weekly videogame vs. CBT without videogame.

Videogame: The 3D environment videogame to be used, "Islands", which is being created and developed within the European research project PlayMancer [16], to modify underlying attitudinal, cognitive, and emotional processes of specific mental disorders. Islands may help to improve the player's, relaxation, planning skills and self-control strategies.

Cognitive-behavioral therapy (CBT): The specialized CBT program will be composed of 16 individual out-patient weekly sessions, of manualized and validated program.

2. Results

In this presentation, we have introduced *PlayMancer*, and shown preliminary results of a first pilot trial. The PlayMancer platform relies on a modular architecture and brings together state of the art techniques from multimodal interaction, 3D engines, speech, and facial emotion recognition. An association between video gaming and physiological and emotional reactions of users will be demonstrated.

3. Discussion

The potential of serious games has been demonstrated thoroughly from both a research and a business standpoint. It seems that in last years, serious games have experimented

a steady growth of complementing treatments in the health area, and it seems that well-produced games for health can lead to informational and potentially behavioral improvements for their players. Despite this, there are few specifically designed studies for treating specific traits in mental disorders. With the *Playmancer* video-game, new interaction modes are provided by newly developed components.

4. Conclusions

Playmancer is an innovative approach, developed by multidisciplinary team, for linking physiological, emotional and behavioral reactions of mental disorder patients. The preliminary results of a pilot trial will be shown.

Acknowledgment

This work was supported by the PlayMancer project (FP7-ICT-215839-2007), which is partially funded by the European Commission. CIBEROBN is an initiative from ISCIII.

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SECTION III

ORIGINAL RESEARCH

Health care is one of the areas that could be most dramatically reshaped by these new technologies.

Distributed communication media could become a significant enabler of consumer health initiatives. In fact they provide an increasingly accessible communications channel for a growing segment of the population.

Moreover, in comparison to traditional communication technologies, shared media offer greater interactivity and better tailoring of information to individual needs.

Wiederhold & Riva, 2004

Cybersickness and Anxiety During Simulated Motion: Implications for VRET

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Abstract. Some clinicians have suggested using virtual reality environments to deliver psychological interventions to treat anxiety disorders. However, given a significant body of work on cybersickness symptoms which may arise in virtual environments – especially those involving simulated motion – we tested (a) whether being exposed to a virtual reality environment alone causes anxiety to increase, and (b) whether exposure to simulated motion in a virtual reality environment increases anxiety. Using a repeated measures design, we used Kim's Anxiety Scale questionnaire to compare baseline anxiety, anxiety after virtual environment exposure, and anxiety after simulated motion. While there was no significant effect on anxiety for being in a virtual environment with no simulated motion, the introduction of simulated motion caused anxiety to significantly increase, but not to a severe or extreme level. The implications of this work for virtual reality exposure therapy (VRET) are discussed.

Keywords. Anxiety, virtual reality exposure therapy

Introduction

Anxiety disorders represent a very significant proportion of disorders treated by clinical psychologists worldwide. Psychologists have worked to develop new interventions based on emerging technologies such as the Virtual Reality Environment (VRE). Two studies into virtual reality exposure therapy (VRET) reported improvements in efficacy of VRE as compared to control programs using *in vivo* cognitive behavioral treatment (CBT) [1] and imaginal exposure therapy [2]. In addition, two extensive meta-analysis studies [3,4] confirmed these findings.

While VRET holds great promise, there is a concern that the use of VREs may in themselves contribute to the anxiety reported by experimental participants and that this may interfere with the efficacy of the VRET for anxiety disorders. Kim [5] reported a significant correlation between anxiety and cybersickness in VREs in healthy participants. In contrast, in a study into patients diagnosed with persecutory delusions, researchers found that VREs did not result in increased anxiety responses [6].

In a study which assessed the neuroendocrine response to stress evoked by a VRE as compared to a control group, Kelly [7] reported that participants exposed to virtual environments recorded lower salivary cortisol levels than those who were required to deliver a speech to a virtual audience, suggesting that the exposure to the VRE was not the factor that increased the cortisol level.

Considering that VRE therapy is becoming more accessible for the treatment of a range of anxiety disorders [8] including fear of flying (aviophobia) [2], panic disorder and fear of open spaces (agoraphobia) [1], we are concerned that VRET may cause an increase in anxiety, thereby defeating the purpose of the clinical intervention.

Since many cybersickness symptoms are associated with simulated motion [5], we wanted to test whether being in a VRE alone would increase anxiety or whether the presence of simulated motion was necessary. If VRET interventions for anxiety could be delivered with no (or low) simulated motion, then this would alleviate concerns about anxiety increases occurring during therapy.

We hypothesized that there would be no anxiety reported (a) during immersion in the VRE, and (b) during use of a VRE with low simulated motion. Furthermore, we hypothesized that anxiety would increase when simulated motion was introduced, compared to a baseline.

1. Method

A within-subjects design was used to compare self-reported anxiety measures from a pre-treatment baseline (a single frame image), to a control condition (VRE with low simulated motion), and from the control condition to an experimental condition (VRE with high simulated motion). Participants acted as their own controls. Participants completed Kim's Anxiety Scale questionnaire [5] prior to immersion in the VRE after the control condition, and also after the experimental condition. Twenty-eight (18 male, 10 female) Macquarie University students aged 18 – 30 years volunteered to participate. Participants were healthy, with normal or corrected to normal vision. Written informed consent was obtained and this experiment was approved by the Macquarie University Human Ethics Committee. The VRE consisted of a setup with a 160° field of parabola curved projection canvas, with 3 color projectors, and Liquid Crystal Display synchronized shutter glasses (Figure 1). The pre-control condition showed participants a photograph of a snow-covered landscape for three minutes. In the control condition, the participant traveled slowly over snow-covered hills. The experimental condition was a virtual rollercoaster. Both the control and experimental simulations lasted for two minutes, and ran three circuits of the environment, making a 6-minute journey.

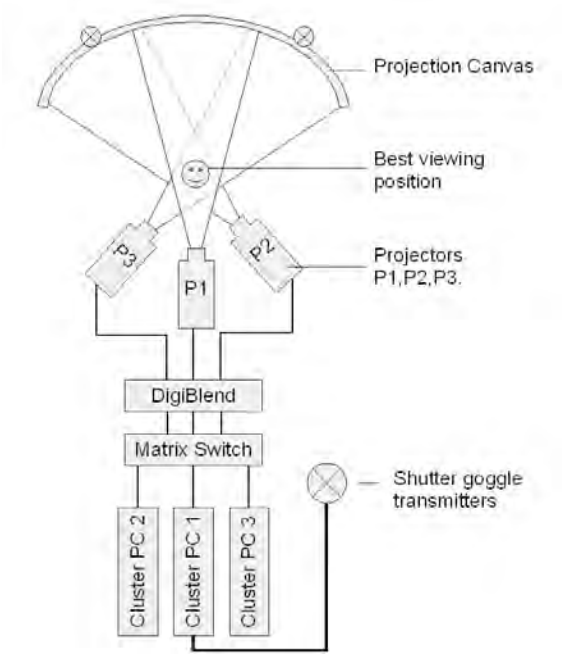

Figure 1. Diagrammatic view of Virtual Reality Environment.

2. Results

Table 1 shows the Anxiety Scale [5] results. The hypotheses were tested using paired sample *t*-tests. The *t*-tests were performed to examine the difference between the anxiety response to VRE in a Pre-Control (no simulated motion), Control (low simulated motion) and Post-Control (high simulated motion) conditions.

The prediction that there would be no significant difference between the Pre-Control anxiety and the Control anxiety scores was supported, $t(27)=-1$, $p=0.326$.

In contrast, there was a significant difference between the mean anxiety score of the Post-Control and the Post-Experimental mean anxiety score $t(27)=-3.382$, $p=0.002$. The results indicate that the introduction of simulated motion caused significant increases in anxiety for the participants.

Table 1. *t*-test results from the Anxiety Scale.

Pre/Post VRE Experiment	Mean	Standard Deviation	Significance
Pre-Control and Control	-0.071	0.378	0.326
Control and Post-Control	-0.714	1.117	0.002 *

* Significant $p<0.05$

3. Discussion

The main propose of this study was to explore whether VRET reported results are being compromised by the inherent effects of the VRE. Our investigation looked at whether the VRE was creating an anxiety response with our experimental participants. The results confirmed the prediction that participants do not report an increase in stress when they are immersed in a VRE. Our findings corroborate the results reported by Kelly [7] that it is not the virtual environment that is stressful, but what is performed or perceived by the participant in the VRE that is creating the stress response.

Furthermore, our research into whether exposure to simulated motion in a VRE causes an increase in anxiety, demonstrated that perceived motion in a VRE is sufficient to create mild anxiety as reported using the Kim Anxiety Scale [5]. Our analyses support the results reported by Kim [5] that navigation through a virtual environment can provoke an anxiety response. The results from this study infer that the effectiveness of VRET for treating anxiety disorders may be impacted where there is simulated motion.

Demonstrating that healthy participants do not find immersion in a VRE anxiety provoking appears to confirm the meta-analyses reports that VRE do not generate anxiety responses [3,4]. The main difference, between the meta-analysis studies and the Kim [5] and current study is that these two studies tested healthy young adults in comparison to the meta-analyses studies that exclusively assessed participants with a range of clinically diagnosed anxiety disorders, including Posttraumatic Stress Disorder, acrophobia, aviophobia and arachnophobia.

We need to be cautious about comparing the studies that test people with diagnosed anxiety disorders [1,2,3,4,8] with studies of healthy participants. Further research needs to be carried out to investigate whether healthy individuals' results can be projected to treatment options for individuals with specific clinically diagnosed anxiety disorders. Clients with an anxiety disorder are possibly responding to the VRE in a different way to healthy experimental participants. Future studies into anxiety responses in virtual environments will need to be conducted to determine whether specific anxiety responses are to be expected for particular anxiety diagnoses.

Baseline anxiety responses for standardized VREs need to be determined for healthy individuals. Once these are available, further work is required to clarify baseline readings for specific diagnoses such as phobias and other anxiety conditions. Definitions of what is a normal response for a healthy population as compared to a particular diagnosis will provide the opportunity for a therapeutic tool that would also be accessible for people with specialized accessibility needs.

VREs are an emerging therapeutic tool in the treatment of anxiety disorders. Our results imply that VREs will have a role in CBT. VREs are relatively easily adjustable

to meet the therapeutic stage of treatment. They can be less costly and often safer to use than *in vivo* treatments for the management of aviophobia or acrophobia.

In a therapeutic situation, where there is significant simulated motion in the VRET used for treating anxiety disorders, clients' responses to the treatment may be affected. It is possible, that the impact of the simulated motion may interfere with the clients' anxiety response. VRET may only be appropriate for certain types of anxiety disorder CBT procedures.

4. Conclusions

Virtual reality environments may be a useful tool for VRET in specific therapeutic cases. We conclude that immersion in a VRE is not in itself stressful. For this reason its use in CBT may be valid. Our results, however, show that once the VRE involves simulated motion, healthy adults report an increase in anxiety. With careful development of the VRE to avoid or limit simulated motion, VRET may become a valuable remedial instrument that can be targeted for graduated exposure therapy in a safe and reproducible setting.

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Neural Responses to Elements of a Web-Based Smoking Cessation Program

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Abstract. An increasing number of smokers are obtaining information from the web to help them quit smoking. In this study, we examined how smokers process different types of messages similar to those from a web-based smoking cessation program: personalization/feedback ("Jane, you are a 23-year old female smoker"), motivational ("If you quit smoking, you could save $1200 a year"), and instructional ("When you feel angry, talk to someone instead of smoking") messages. Using functional magnetic resonance imaging, smokers were exposed to the messages. On a later session, participants completed an online tailored smoking cessation program and started on a 10-week course of nicotine patch. Results show that participants indeed process the messages differently, activating brain regions associated with self-related processing (personalization/feedback), anticipated reward processing (motivational messages) and rules processing (instructional messages). This research is relevant for advancing web-based tailored interventions for substance use.

Keywords. Addiction, substance abuse, smoking, internet, neuroimaging.

Introduction

The Center for the Digital Future mentioned that the proportion of adults in the United States with Internet access now exceeds 78%. About 79% of American adults with Internet access (roughly 95 million) reported using the Web to obtain health information [1]. In this same survey, 7% of Internet users, or roughly 10 million individuals, reported using the Internet to help them quit smoking.

The Internet is currently the most prominent but only one of many emerging communications technologies enabling: (1) an assessment of characteristics relevant to the specific needs of the individual and (2) the *tailoring* of messages to the specific needs and interests of the individual. Web-based tailored interventions are more cost effective than traditional media for intervention. It reaches a greater number of people for a fraction of a cost. Web-based tailored interventions for smoking cessation have been developed extensively in the cigarette smoking area. Several tailored intervention systems are now available in general public domains (e.g., quitnet.com), some are provided by health care delivery systems (e.g., www.kponline.com), and pharmaceutical companies that make smoking cessation products (e.g., activestop.com).

In the past decade, tailored smoking cessation programs have demonstrated an overall positive impact when compared with generic, one-size-fits-all interventions [2-5]. In the present study, we examined how smokers process different types of messages from a web-based smoking cessation program: personalization/feedback messages

("Jane, you are a 23-year old female smoker"), motivational messages ("If you quit smoking, you could save $1200 a year"), and instructional messages ("When you feel angry, talk to someone instead of smoking"). Personalization/feedback messages pertain to the relevance of the message to the self and motivation and instructional messages pertain to the adaptation of the message to the specific behavior change needs and interests [6].

1. Methods

1.1.Participants

Thirty-one male and 10 female right-handed smokers with mean age of 38.34 (*SD* ± 11.52) participated. Eligibility criteria included having smoked a cigarette within the last 7 days, having smoked a minimum of 10 cigarettes on average per day and at least 100 cigarettes in a lifetime, and interest in quitting within next 30 days from study enrollment. Participants were not enrolled in other cessation programs or taking pharmacological treatment for smoking cessation. Participants smoked on average 16.10 (*SD* = 5.94) cigarettes a day for an average of 20.06 (*SD* = 11.45) years. Ninety percent of the participants had previously attempted to quit. Participants were motivated to quit (*M* = 8.84 [SD = 1.15] on a 10-point scale). They were also confident about quitting (*M* = 8.32 [*SD* = 1.60] on a 10-point scale). Participants had no current or prior history of head injury and psychiatric illness. They were between 21-55 years old, native English speakers, and had normal hearing and good visual acuity. Participants had no medical conditions that would inhibit their use of nicotine patch.

1.2. Procedure

Participants completed an MRI safety screening form and gave written consent. They also completed a standard baseline assessment about their smoking history, psychosocial, health, and demographic characteristics relevant to smoking cessation. Responses were used to create the tailored messages. Scanning took place during a later session. Using functional magnetic resonance imaging (fMRI), smokers were exposed to different types of smoking cessation messages, similar to those from our web-based smoking intervention program (www.projectquit.org). The messages were personalization/feedback, motivational, and instructional messages, plus two control condition messages: targeted ("The average smoker smokes 15 cigarettes a day") and neutral messages ("The true color of ocean water is neither blue nor white"). On a different day, smokers agreed to quit. They completed our tailored online smoking cessation program during their quit day and started on a 10-week course of nicotine patches. Participants were followed for four months after the quit date to determine abstinence rates.

2. Results

Prior work suggests that self-relevance of the messages appear to have a moderating effect of tailoring on quitting activity [7]. Indeed our previous neuroimaging study

showed that smokers process high-tailored messages differently from low-tailored messages, specifically it activates the areas of the brain associated with self-related processing [8]. The present work shows that exposure to personalization/feedback messages, relative to neutral messages, replicated the activations in the medial prefrontal cortex, [(-3, -60, 36), Z = inf, k = 1542], and precuneus/posterior cingulate, [(0, 45, 30), Z = 7.08, k = 3379], areas associated with self-related processing. See Figure 1.

We anticipate that motivational messages would elicit greater activation in areas associated with anticipated reward, including the ventromedial prefrontal cortex [9]. Figure 2 shows that when compared against neutral messages, exposure to high-tailored motivational messages indeed activated areas associated with anticipated reward, ventromedial prefrontal cortex, [(-3, 48, 3), Z = 5.72, k = 1025].

We anticipate that instructional messages would elicit greater activation in areas previously associated with rules and goals processing, including the dorsolateral prefrontal cortex [10]. Figure 3 illustrates that exposure to high-tailored instructional messages compared to neutral messages did activate areas associated with processing rules and instructions, dorsolateral prefrontal cortex, [(-48, 3, 54), Z = 6.55, k = 2218].

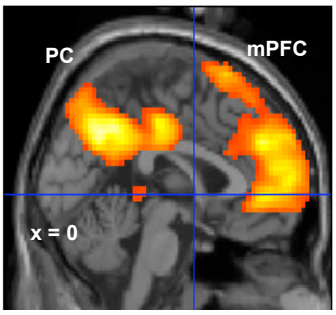

Figure 1. Brain responses to personalization/feedback messages showed increased activity in medial prefrontal cortex [mPFC] and precuneus/posterior cingulate [PC]. Activated voxels are displayed with $p <$ .0001 uncorrected, cluster extent ≥ 5.

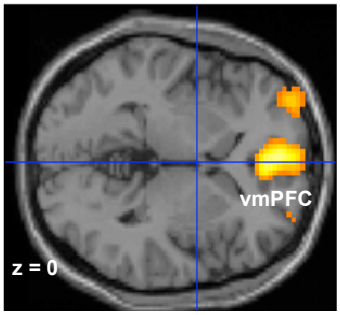

Figure 2. Brain responses to motivational messages showed greater activity in ventromedial prefrontal cortex [vmPFC]. Activated voxels are displayed with $p <$ .0001 uncorrected, cluster extent ≥ 5.

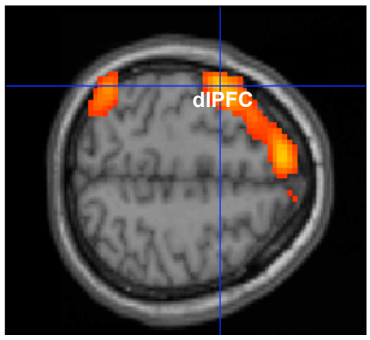

Figure 3. Brain responses to the instructional showed greater activity in dorsolaterial prefrontal cortex [dlPFC]. Activated voxels are displayed with $p < .0001$ uncorrected, cluster extent ≥ 5.

3. Novelty/Discussion

The present study shows that people respond differently to different elements of a web-based smoking intervention program. In sum, the message types we provided the participants appear to show good validity—personalization/feedback messages activate areas of the brain associated with self-related processing. Motivation messages activate areas of the brain associated with anticipated reward, and instructional messages activate areas of the brain associated with instructions and rules processing. This is the first project that attempted to systematically examine how people respond to the different tailored intervention messages using fMRI. In the present study, we will also examine the follow-up responses to test if responders (successful quitters) process the message types differently from non-responders.

This research is relevant to a new generation of web-based tailored interventions for tobacco and other substance use in two broad ways. First, by identifying specific brain regions influenced by different tailored message types, the results should provide insight into cognitive responses to the messages. Second, by examining the relationship between brain activation patterns and subsequent smoking cessation activities, we take an important exploratory step toward identifying biomarkers of message efficacy.

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Psychophysiological Arousal and Craving in Smokers, Deprived Smokers, Former Smokers, and Non-Smokers

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Abstract. This study investigates the biometric signature associated with tobacco craving and stress elicitation using principles of cue reactivity. Seventy-five non-smokers and smokers (half of whom were tobacco-deprived for 6 hours) took part in a standardized laboratory session during which they were presented with a series of film clips designed to arouse fear, amusement, or craving. Participants self-reported their emotional response to each film clip and wore non-invasive biosensors to collect physiologic data. Findings indicate different patterns of physiologic arousal for smokers than non-smokers; and that among smokers, deprived smokers had significantly different arousal patterns than non-deprived smokers. This article describes how the elicitation of stress and craving can contribute to the prediction of arousal patterns associated with tobacco craving and how this can create new opportunities for smoking cessation intervention. A comparison of each group's patterns of arousal and physiologic activity is presented, with particular focus on the differences between smokers and deprived smokers.

Keywords. smoking, psychophysiology, biosensors, cue reactivity

Introduction

Craving plays an important role in the maintenance of substance use, including cigarette smoking [1]. Cravings reflect the activation of motivational systems that have particular response patterns involving self-report, behavioral, physiological, and cognitive aspects [2]. The craving to smoke tends to increase particularly in the presence of smoking-related cues [3]. Previous studies of smokers have confirmed a positive relationship between exposure to smoking cues and measurable changes in subjective and physiological responses [e.g., 4]. The current study uses principles of cue exposure and non-invasive sensors to investigate the biometric signature associated with tobacco craving and arousal elicitation [5]. A cue exposure presentation was created using film clips to demonstrate positive and negative stress associated with emotional cues and cigarette smoking. Film clips were chosen as a cue-exposure tool due to their success in invoking arousal in the laboratory [6].

Wearable sensors allow for the non-invasive collection of individualized, biometric data that promise to enhance our understanding of emotional, physiological,

and behavioral responses [7,8]. In this study, biosensors were used to facilitate the collection of physiological data and response patterns in groups of smokers in naturalistic and laboratory settings. Comparisons of physiological responses to arousal and tobacco craving between smokers and non-smokers may enable researchers to differentiate arousal patterns associated with stress reactivity and craving.

This study included three phases. Phase 1 consisted of collecting continuous biometric data for 3 days using an armband sensor. In Phase 2, an experimental session was carried out in which arousal was measured through cue reactivity. In the third phase, physiological arousal patterns were identified. Statistical algorithms are presently being developed to accurately predict the arousal patterns of tobacco use and smoking behavior.

1. Method

1.1. Participants

Human subjects' approvals were obtained from the local institutional review board at the University of Hawaii and the United States Army and Materiel Command's Human Subjects Research Review Board (HSRRB). Recruitment took place in the local university community between April and September 2008. Information regarding the study was disseminated through flyers and classroom presentations, as well as public service announcements in the student newspaper and on the campus radio station. Inclusion criteria required participants to be at least 18 years old, fluent in English, and not undergoing any form of Nicotine Replacement Therapy for smoking cessation. Individuals were excluded if they reported any smoking-related health conditions, and/or required prescription medication that could affect the study results (e.g. hypertension, anxiety disorders, asthma, etc.). Based on their smoking history, eligible participants (N=75) were identified as non-smokers (n=23); former smokers (n=23); or current smokers (n=29). Former smokers were classified as those who had quit smoking at least 6 months prior to recruitment. Current smokers were defined as those who smoked a minimum of 10 cigarettes a day, and scored a 5 or higher on the Fagerström test for nicotine dependence. Smokers were randomized into 1 of 2 conditions — non-deprived (n=14) or deprived *(*n=15*)*. During the study, deprived smokers were requested to refrain from smoking for 6 hours, while non-deprived smokers continued with their normal smoking routine.

1.2. Materials and Measures

1.2.1. Self-report Measures

Following informed consent procedures, participants completed a standard demographics form, as well as three baseline questionnaires (Smoking History and Behavior, Situational Self-Efficacy, and a Questionnaire on Smoking Urges). Two additional questionnaires were also administered at follow-up (Self-Assessment Manikin and ITC-Sense of Presence Inventory), with the Questionnaire on Smoking Urges being provided both at baseline and follow-up.

1.2.2. Physiological Measures

A BodyMedia® SenseWear® PRO_2 armband was worn on the upper-right tricep for 3 days to measure each participant's biometrics in a natural setting. The armband collected a variety of physiologic data including heat flux (HF), skin temperature (SkT), galvanic skin response (GSR), energy expenditure (EE), and movement. Additional physiological data were collected during the experimental session using Thought Technology's ProComp Infiniti System in conjunction with Biograph Infiniti 3.1 software. Three Thought Technology sensors collected heart rate (HR), blood volume pressure (BVP), and respiration rate (RR). The armband was also worn during the experimental session in order to synchronize the participant's physiological arousal to the film stimuli.

1.2.3. Procedure

During Phase 1, participants wore the SenseWear® PRO_2 armband for 3 consecutive days to allow the monitoring of their biometric data outside of the lab setting. Smokers in the study were instructed to continue their normal smoking routines while wearing the armband, but to press a time stamp button each time they smoked a cigarette. This button recorded an annotation on the raw data so that smoking could be correlated with a physiological outcome. Never smokers and former smokers also wore the armband for 3 days, but were not required to press the time stamp button at any point during the monitoring. Before attending the experimental session in Phase 2, deprived smokers were asked to refrain from smoking for 6 hours. The experimental session was structured to include: a) a calibration phase; b) a stress elicitation activity (the expectation of public speaking) to collect baseline arousal levels; and c) a cue exposure presentation. The film presentation consisted of 12 validated film clips that elicited one of 3 types of arousal — fear, amusement, or craving — and 13 neutral clips alternating between experimental clips to eliminate delayed response patterns [9]. At the completion of each film clip, participants were asked to rate their arousal levels (e.g. select a specific emotion, valence, and intensity). Conducting a standardized stress event in the laboratory enabled the comparison of groups of smokers on their psychological interpretations of arousal.

1.2.4. Data Analysis

Simple descriptives were employed in Phase 3 to determine sample characteristics. Analysis of Variance (ANOVA) and cross-tabs were used to determine whether there were significant differences between the assigned groups. A 4 (group) x 5 (type of arousal) factorial Multivariate Analysis of Variance (MANOVA) was used to detect significant mean differences between the four groups using physiologic variables as the dependent variables and group assignment and type of film clip as independent variables. Standardized T-scores were used (M=50, SD=10), to allow comparison between variables with different measurement units. Follow-up ANOVAs and *post hoc* tests were used to further explore main effects and interaction effects, as appropriate. Crosstabs were used to explore group differences in the self-reported arousal following each film clip.

2. Results

Average age of the participants was 33.8 years (*SD*=12.6, range=19-65). The sample was 56% female; White (53%) or Asian (29%); unmarried (81%); and in good/very good health (79%). There were no significant demographic differences between the groups, except for age ($F(3,73)=4.53$, $p<.05$), where former smokers were found to be significantly older ($M_{FS}=41.1$) than non-smokers and smokers ($M_{NS}=30.6$; $M_S=30.7$).

Homogeneity of variance was violated for these analyses (Box's M=23842.7, $p<.001$). Several transformations to the data were attempted, but none were able to resolve the homoscedasticity. As a result, care must be taken when interpreting these results. Main effects were found for both group assignment (Wilks' $\lambda=.53$, $p<.05$) and type of film clip (Wilks' $\lambda=.78$, $p<.05$). A significant interaction (Wilks' $\lambda=.95$, $p=.91$) prompted further analysis. Follow-up ANOVAs explored mean differences between all possible interaction combinations. A Bonferroni correction was used in order to avoid inflation of the Type 1 error rate. Significant mean differences were found for the interactions on 8 of the 10 physiologic variables ($p<.01$, η^2 range=.01 to .26), with only EKG and EE being non-significant. Follow-up *post-hoc* tests on the fear, amusement, and craving film clips found 56 of a possible 144 comparisons with significant differences between non-smokers, former smokers, smokers, and deprived smokers across conditions. Smokers were significantly different from deprived smokers in their physiologic arousal to fear, amusement, and craving — with GSR and RR significantly different across all 3 conditions. Never smokers were significantly different from all other groups in their physiologic arousal to fear, amusement, and craving — with SkT, movement, and BVP significantly different across all 3 conditions. Former smokers behaved more similarly to smokers than to never smokers — with SkT, movement, BVP and RR significantly different from never smokers across the 3 conditions.

Overall ratings on the self-report questionnaires found that most participants matched their emotion to the intent of the film clip: 86.7% rated the neutral clips as calming or neutral; 91% rated the amusement clips as funny; and 75% rates the fear clips as scary or anxiety-provoking. Among smokers, 45% indicated craving a cigarette after watching a smoking clip; however, crosstabs determined that deprived smokers reported "craving a cigarette" 1.67 times more often than non-deprived smokers. Deprived smokers were 1.27 times more likely to report feeling anxious after a fear clip, and 1.43 times more likely to report feeling happy after an amusement clip. Neither the reported intensity nor the valence of emotions was significantly different between the two groups of smokers.

3. Discussion/Conclusion

Recording stress and arousal patterns in a laboratory setting has allowed the differentiation of response patterns between non-smokers, former smokers, current smokers, and deprived smokers. While several arousal patterns were similar across groups, real differences in physiological arousal were evident among deprived and non-deprived smokers. For example, GSR and RR were significantly higher when smoking stimuli were presented to deprived smokers. Therefore, it appears that GSR and RR may be important channels for understanding the way in which craving is expressed. Not only were physiological differences apparent between smokers and deprived smokers, but their subjective responses varied as well.

Another area with interesting implications is the finding that former smokers behaved more similarly to smokers than to non-smokers. This may imply differences in the. Further comparisons between former smokers and current smokers will allow a better understanding of the physiological aspects of craving behavioral and cognitive aspects of behavior change during smoking cessation associated with cessation and relapse. This is important, as the risk of relapse is known to be the most difficult aspect of addiction treatment [10]. These initial findings are being used to build a foundation for further analysis of the data and for refining predictive algorithms.

As data from this study continues to be analyzed, the focus will shift away from group comparisons to concentrate more acutely on individual and unique patterns of physiological arousal. Sensors offer new potential for capturing dynamic physiologic data that can be used to develop medical technologies and cessation interventions with tailored, personalized feedback based on individual response patterns [11]. Having the knowledge to understand and predict arousal and craving at an individual level promises improved interventions at all levels of addiction. This research aims to improve our understanding of the psychophysiology of craving and addiction and offers the interdisciplinary scientist a clearer direction from which novel treatment approaches and innovative medical technologies might develop.

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Changes in EEG Behavior through Feedback Presentation

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Abstract. Performance of brain-computer interface (BCI) will depend, to a great extent, on the ability of subjects to control their own electroencephalographic signals (EEG). To this end, it is necessary to follow a suitable training and to provide some type of visual feedback. The objective of this study is to explore the possibility of improving the EEG control via feedback presentation. Eighteen untrained subjects, divided in two groups, were trained using a BCI system based on virtual reality techniques, which submits subjects to a more familiar environment, such as controlling a car to avoid different obstacles. Different types of obstacles were introduced for each group. Significant differences in classification error rates between both groups were obtained during the last second of the feedback period.

Keywords. brain-computer interface, feedback, training techniques, virtual reality

Introduction

Brain-computer interfaces (BCIs) use the electrical activity of the brain recorded during specific mental activities to control an external device. Some BCIs are based on the individual's capacity to control some feature of electroencephalographic (EEG) activity. To this end, it is necessary to follow a suitable training and to provide some type of visual feedback allowing subjects to see their progress [1,2]. In order to improve the effectiveness of the training process, feedback needs to be attractive, thus motivating subjects to control their EEG signals. To get this objective, virtual reality technology can be used. Effectively, virtual reality is a powerful tool with graphical possibilities to improve BCI-feedback presentation, and has the capability of creating immersive and motivating environments.

The purpose of this study is to continue the work developed in previous research [3]. In this work, a group of subjects was trained using a BCI system, which uses conventional feedback (bar extension), while another group was trained using a BCI system, based on virtual reality techniques, which submits subjects to a more familiar environment, such as controlling a car to avoid puddles. The obtained results showed how subjects were motivated throughout the feedback period to control the car´s movement to avoid the puddle, achieving a good EEG control. However, a worsening of this control was noticed during the last second of feedback, due probably to the fact that subjects did not make an effort when they realized the puddle was almost behind them. To avoid this lost of EEG control, it would be necessary to help subjects to

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maintain concentration during all feedback period. In the study presented in this paper, and with the purpose of improving the EEG control during all feedback period, the same BCI system than the one proposed in [3] has been used, but different obstacles are incorporated at the end of the puddle [4].

1. Materials and Methods

1.1. Subjects and Data acquisition

Eighteen naïve subjects participated in this study (13 male, 5 female, right handed, age 23.3 ±1.4). Two groups of 8 and 10 subjects were formed and referred to as group 1 and group 2 respectively. The EEG was recorded from two bipolar channels with electrodes placed over the right and left hand sensorimotor area. Active electrodes were placed 2.5 cm anterior and posterior to electrode position C3 and C4 according to the 10/20 international system. The reference electrode was placed at FPz position. Signals were amplified by a 4 channel Coulborn V75-08 amplifier and then digitized at 128 Hz by a 12 bit resolution data acquisition card DAQCard-6025E (National Instruments).

1.2. Training protocol and Trial time

The training protocol consisted of 7 sessions, 2 without feedback and 5 with feedback. During each session, subjects were instructed to carry out 160 trials of 8 s each. The training was carried out discriminating between two mental tasks: mental relaxation and imagined right hand movements.

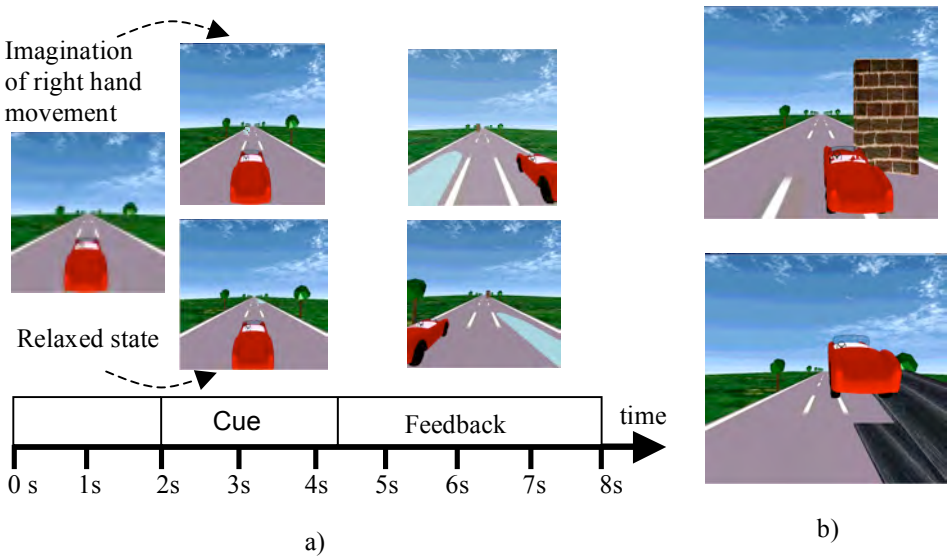

Figure 1. (a) Trial time. (b) Obstacles located at the end of the puddle.

The timing of the trial is shown in Figure 1a. Initially, in a scene of continuous movement, the car was driving down the middle of three lanes. At 2 s, a puddle-like obstacle, in the left or right lane, would come into view at the end of the road. If this appeared in the left lane, subjects should imagine right hand movements. If it appeared on the right, they should remain in a relaxed state. At 4.25 s, the puddle was situated beside the car, starting the feedback period when subjects were able to control the movement of the car to the left or right according to the mental task, to avoid the puddle (session with feedback). In sessions without feedback, the car remained in the central lane during the feedback period.

Subjects of group 1 were trained using the feedback based only on the puddle. Subjects of group 2 were trained using the feedback based on the puddle and, in addition, different obstacles located at the end of the puddle [4], specifically, walls (the car must avoid crashing into the wall) and ramps (in this case, the car must reach the ramp that would make the car jump so, the ramp was also located at the end of the puddle but on the opposite lane) as is showed in Figure 1b. With the aim of achieving a more realistic environment, sounds simulating a car engine, puddle splashes, and effects of the obstacles were introduced.

1.3. Signal processing

The signal processing included EEG feature extraction and classification, and was the same than the one used in [3]. The feature extraction consisted of estimating the average band power of each channel in predefined, subject specific reactive frequency bands at intervals of 500 ms (by digitally band-pass filtering the EEG using a Buterworth filter of order 5, squaring the signal and averaging over the 64 samples). The reactive frequency band was manually selected for each subject, checking the largest difference between the power spectra of two 1 second intervals: a reference interval (0.5 s – 1.5 s) and an active interval where a mental task took place (6 s – 7 s). The classification was based on linear discriminant analysis (LDA). Signal processing was done in MATLAB.

For each session, an error time course was computed with a ten times 10-fold cross validation of a linear discriminant (more detail in [3]), for each time point t = 500 ms. In sessions without feedback, the extracted feature parameters of the classification time points with the lowest classification error were used to set up the LDA classifier parameters (weight vector) for the following sessions with feedback. In the feedback sessions, the LDA classification result was converted on line to the length L of feedback car´s movement, which was updated on screen every 4 samples (32 ms), to make feedback as continuous as possible. A negative/positive value of L was translated into a left/right car´s displacement, indicating that trial was classified as a left/right trial.

2. Results

To obtain comparative results, an error time course, *Et* (in percentage), was obtained by calculating the average between the error rates of all sessions with feedback (see Figure 2). Continuous lines and dashed lines represent error curves for subjects of group 1 and group 2 respectively (the results for subjects of group 1 are the ones obtained in [3]). From the eighteen subjects, nine did not show any control in EEG signals (fine lines).

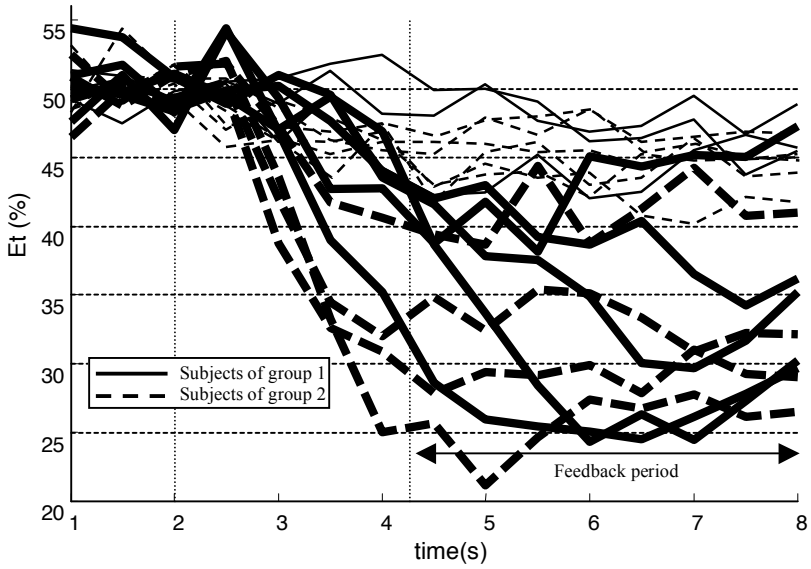

Figure 2. Average error rate of all sessions with feedback during feedback period for each subject.

The other nine subjects showed some control in EEG signals and their average error curves during feedback period were below error of 45 % (thick lines).

Analyzing the error time courses *Et* during the last second of feedback period (7-8 s) for subjects who showed some EEG control (thick lines), an interesting difference between the two groups (group 1 and group 2) can be observed. Effectively, curves show how error rates worsen during the last second of feedback when subjects had to avoid only the puddle (group 1), while the presence of an obstacle located at the end of it seems to help subjects to maintain the control of the EEG signals until the end of the feedback period (group 2). As is described in [3], an interesting parameter is the slope of the error time course, which can be used to indicate the steepness of a curve at a particular point. For each time course *Et*, a value *m* of slope was calculated each 500 ms (see [3] for more detail). A negative/positive value of *m* means a decrease/increase of the error rate. In this study, only the mean slopes obtained for each subject during the last second of the feedback period (7–8 s) have been analyzed. The mean ± SD slopes over all subjects of each group are represented in Table 1 (MeanG1 and MeanG2 for group 1 and group 2 respectively). Besides, the mean ± SD slopes over all subjects who showed some EEG control (thick lines in Figure 2) have also been calculated of each group ($MeanG1_{Control}$ and $MeanG2_{Control}$ for group 1 and group 2 respectively). Regarding subjects who showed some EEG control, it is interesting to observe how, effectively, the obtained mean slope over subjects of group 1 ($MeanG1_{Control}$) is positive,

Table 1. Mean slopes of the error time courses *Et* during the last second of the feedback period (7-8 s).

Group of subjects	Mean ± SD slopes
MeanG1	1.75 ± 2.49
MeanG2	-0.67 ± 1.16
$MeanG1_{Control}$	3.33 ± 3.15
$MeanG2_{Control}$	-1.31 ± 3.01

due to the increase of the *Et* error rates during this period. However, the obtained mean slope over subjects of group 2 ($MeanG2_{Control}$) is negative, due to the decrease of the error rates. The same remarks applied when all subjects are considered for each group (MeanG1 and MeanG2). Besides, the performed one-way ANOVA revealed significant differences between $MeanG1_{Control}$ and $MG2_{Control}$ ($F(1,7)=9.18$; $P=0.0191$), and between MeanG1 and Mean G2 ($F(1,16)=4.84$; $P=0.0429$).

3. Discussion

The results obtained suggest how it is possible to improve the EEG control presenting feedbacks whose effects are more immersive and motivating. Significant differences in feedback control between both groups were obtained during the last second of the feedback period. The incorporation of an obstacle at the end of the puddle, at the end of the feedback period, allows the subject to feel immersed and to be taking part in the task of avoiding the puddle during the whole feedback period. The subject manages to maintain concentration until the end of the trial, avoiding a loss of control of the BCI. In BCI systems, training must be as easy and attractive as possible. Changing the feedback presentation makes it possible to modify the behavior of the subject and in turn, their capacity to control the EEG signals. The graphical possibilities of a multimodal interface combining 3D display and sound seems to be a good option to develop training techniques helping subjects to achieve a better control of the BCI.

Acknowledgements

This work was partially supported by the Innovation, Science and Enterprise Council of the Junta de Andalucía (Spain), project P07-TIC-03310.

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EEG, HRV and Psychological Correlates while Playing Bejeweled II: A Randomized Controlled Study

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Abstract. Stress related medical disorders such as cardiovascular disease, diabetes, depression, and anxiety are serious medical issues that can cause disability and death. Interventions to prevent their development and exacerbation are needed. Casual video games (CVGs) are fun, easy to play, spontaneous and tremendously popular. People report that they play these games because they decrease their stress and improve their mood. This study tested this theory by comparing people playing Bejeweled II a popular CVG with control subjects measured under similar conditions. Electroencephalographic (EEG) changes after playing Bejeweled II were consistent with increased mood and corroborated with similar findings on psychological reports. Moreover, heart rate variability (HRV) changes consistent with autonomic nervous system relaxation or decreased physical stress were also recorded. It is concluded, therefore, that playing a CVG like Bejeweled II can increase mood and decrease stress. These finding have broad implications and include the potential development of prescriptive interventions using Bejeweled II to prevent and treat stress related medical disorders. Finally, these findings demonstrate a method using EEG, HRV and psychological correlates to understand the psychophysiological or cybernetic interconnection between participant and video game.

Keywords. Bejeweled II, casual video games, electroencephalography (EEG), heart rate variability (HRV), physical stress, mood.

Introduction

Approximately 9.5 percent of the U.S. adult population has a mood disorder[1]. Stress related medical disorders such as cardiovascular disease and diabetes are major causes of disability and death in the United States[2]. Cost effective preventive interventions that improve mood, decrease stress and are self-motivating are in immediate need. Casual Video Games (CVGs) are games considered fun, quick to access, easy to learn, and require no previous special video game skills, expertise, or regular time commitment to play[3]. CVGs are extremely popular with estimates that they are now a 55 billion dollar per year industry[4]. When surveyed CVG players often indicated they played to reduce stress and improve their mood. To test this hypothesis we measured changes EEG,

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HRV and psychological correlates pre and post video game play and compared the results to a control group. The level of significance was set at $p<.05$.

1. Methods

The purpose of the study was to determine whether playing a specific CVG called Bejeweled II (BJW II) could improve mood and/or decrease stress. Bejeweled II (BJW II) is a matching, sequencing game where participants string together like jewels for points. In this study we tested the hypothesis that playing Bejeweled II would produce physiological and psychological changes consistent with increased mood and decreased physical stress. Sixty-nine (n=69) participants were randomized into either a control group or BJW II. Conditions for both groups were identical except instead of playing video games the control group was instructed to surf the internet looking for articles related to health and to put them into a file on the computer desktop. Participants completed psychological assessments and then opened an envelope that indicated their group assignment. Both Bejeweled II play and control Internet activity lasted 20 minutes.

2. Results

EEG monitoring was used to determine mood changes and followed a standard protocol for collection of alpha brain waves[5]. It was hypothesized that playing casual video games would result in decreases in left frontal alpha brain waves which would be indicative of improved mood [6, 7,8]. Results outlined in table 1 illustrate that playing Bejeweled II did indeed change brain waves towards a more positive mood when compared to controls. Experimental participants also reported a significant improvement in mood on Profile of Mood States[9] (POMS) assessment. The pre-post game reductions in total disturbed mood compared with the control group are presented in table 1. Changes in individual POMS variables were as follows: Tension significantly decreased after Bejeweled II (p=.000) but did not significantly differ from control; Depression significantly decreased pre-post Bejeweled II (p=.002) but also did not significantly differ from control. Positive changes in Anger; Vigor; Emotional Fatigue and Confusion were all significant when compared controls.

Table 1.POMS Variables

	md	se	df	p
Left Alpha Changes	†Significantly differs from control p=.032			
Control (n=26)	.985	1.5	30	.503
Bejeweled II (n=32)	-3.3	1.3	31	.014+
Reduction in Disturbed Mood	†Significantly differs from control p=.009			
Control (n=31)	-2.6	2.4	30	.284
Bejeweled II (n=38)	-11.3	2.2	37	.002+
Reduction in Anger				
Control (n=31)	-.77	.56	30	.169
Bejeweled II (n=38)	-2.2	.5	37	.000+
Increases in Vigor	†Significantly differs from control p=.007			
Control (n=31)	-1.4	.80	30	.080
Bejeweled II (n=38)	1.5	.72	37	.037

Decreases in Emotional Fatigue	Differs from control p=.053			
Control (n=31)	-1.4	.53	30	.010
Bejeweled II (n=38)	-2.8	.48	37	.000[+]
Decreases in Confusion	[†]Significantly differs from control p=.000			
Control (n=26)	.26	.46	30	.576
Bejeweled II (n=32)	-2.0	.42	37	.000[+]

Table 2. Heart Rate Variability Changes

Control (n=30)	md	se	df	p	B II (n=40)	md	se	df	p
HR	-.82	.61	29	.184		-1.6	.53	39	.003
TP	488	151	29	.002		394	130	39	.003
VLF	-106	100	29	.290		-198	87	39	.024
LFN	1.8	2.7	29	.521		5.8	2.4	39	.015
HFN	-1.7	2.7	29	.533		-6.3	2.3	39	.008
LF/HF	-.24	.30	29	.458		.60	.28	39	.034

Heart rate variability (HRV) reflects the state of sympathetic (stress, anxiety) or parasympathetic (relaxation, calmness) activation in the body[10]. HRV is considered a marker of cardiac activity and is of great interest to health care practitioners[11,12,13]. Participants who played BJW II experienced statistically significant decreases in ANS activity with corresponding increase in variables associated with positive cognitive engagement. Results are presented in Table 2.

3. Discussion

This study demonstrated that playing BJW II changes EEG brain wave activity consistent with enhanced mood. These changes along with the concurrent reports of improved mood indicated by scores on psychological tests support the hypothesis that playing BJW II improves mood. Significant changes in all HRV parameters were reported pre-post BJW II. Cohen's delta or d[14] was used to compare differences in HRV means in the BJW II and control groups relative to an assumed common variance. Results indicated very large changes pre and post BJW II including decreases in heart rate (d= 1.3), VLF (d= 1) and corresponding increases in LFN (d= 1.6) and LF/HF ratio (d= 1.2). These changes are consistent with a "more power with less effort" response also reported by researchers[15] as TP and LFN increases coupled with VLF activity decreases after the relaxation response and meditation exercises. The data supports the theory that BJW II decreases physical stress and increases efficiency in a manner similar to these self-regulation techniques.

The results of this study suggest a potentially important role for the use of games like BJW II in physical and psychological disorders such as diabetes and depression. Other interventions with similar inherent characteristics like meditation[16,17] and card/board games[18] have demonstrated positive stress reduction and mood elevating benefits when prescribed in clinical populations. Thus, protocols with prescriptive parameters need to be developed and tested against disorders such as depression to determine the efficacy of such an intervention in a clinical population. Moreover, the methods used in this study represent a much needed rubric to further understand unique responses of humans while playing video games and as such provides new

opportunities for researchers and clinicians to develop tools for diagnosing and treating various physical and mental disorders.

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Mobile Serious Games for Collaborative Problem Solving

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Abstract. This paper presents the results obtained from the implementation of a series of learning activities based on mobile serious games (MSG) for the development of problem-solving and collaborative skills in Chilean 8th grade students. Three MSGs were developed and played by teams of four students, who had to solve the problems posed by the game collaboratively. The data shows that the experimental group had a higher perception of their own skills of collaboration and of the plan execution dimension of problem solving than the control group, providing empirical evidence regarding the contribution of MSGs to the development of collaborative problem-solving skills.

Keywords. Mobile serious games, problem solving, collaboration, primary school

Introduction

Research on computers and education has studied profusely the effects of ICT on student learning [1-3]. One of the areas in which the most evidence has accumulated regarding the contribution of ICT has been in the development of high-order skills and abilities [4]. Several studies have shown that under certain conditions, the integration of ICT into the curriculum can facilitate the development of the ability to solve problems [5-16] and collaboration among students [8,17-19]. Research has also shown that Serious Games, or games with an educational purpose, are an enormously valuable tool for the development of these kinds of skills. Such games have the capacity to better match the interests, practices, and learning styles of today's learners, and the character of these games is more favorable for confronting and resolving problems through collaboration with others when dealing with tasks [13,20-25].

In this study we follow Polya's definition [5], which describes four stages for problem solving: understanding the problem, designing, carrying out and evaluating the plan. Regarding collaboration, principles of positive interdependence, common goals, role identification, participants' assignments to a group and interaction were considered [7].

This report presents the results of a study that consisted of the development of a series of learning activities based on Mobile Serious Games (MSG) in order to develop problem-solving and collaborative abilities in 8th grade students from 5 Chilean schools. These activities were carried out during 3 months and involved educational content having to do with the evolution of species from science class.

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1. Methodology

The video games "Evolution", "BuinZoo," and "Museum" were developed for mobile "Classmate" devices. "Evolution" is a real-time, mobile, strategy video game in which the players must solve the problem of maintaining and developing four biological classes (fish, amphibians, reptiles and birds), each with three distinct species, within a varying and unknown environment. Players must manipulate variables related to the preservation and development of each species, such as reproduction, depredation, feeding, and evolution.

"BuinZoo" and "Museum" are trivia games that are played outside the school context, which allow for the reinforcement of concepts related to the science material learned in class. These activities are presented as a mission that the students must complete within the "Evolution" game, and which must be completed during a visit to a zoo and a museum respectively. During the visits each member of the group has to solve a set of individual and group questions that are presented to him/her in the mobile device, supported by the information available at each place, and by complementary information offered by the video games.

The students must also take on a series of learning activities that are complementary to the game, which include doing research on the Internet and with other documentary sources, classroom presentations, the preparation of multimedia assignments, and evaluations. Students worked in teams of four, and had to collaborate to solve the problems presented in the games' various activities.

To accompany the students' work, the teachers were trained through the use of b-learning methodology. The content of this training included issues related to problem solving, collaboration, MSG and the specific activities that the students had to develop with the video games.

The data was obtained through a survey applied to the five science classes that participated in the study. These classes were made up of 206 students. A control group of 167 students was selected from the same participating schools through the use of matching. The control group did not participate in any of the project's activities, except those related to the collection of data for the study. Other, complementary data was obtained by administering Focus Groups, ethnographic observation and skill testing.

The survey contained a scale of the students' perception of their own problem-solving skills and a separate scale dealing with the students' perception of their own collaborative skills. The problem solving scale was made up of 14 items and the collaboration scale consisted of 25 items, with each item in both scales measured within a range of 1 to 5 points. Both scales were developed by the research team and validated through a pretest. After calculating Cronbach's Alpha, the instruments to be applied in the study were refined. The problem solving scale obtained a Cronbach's Alpha of 0.88 and the collaboration scale obtained a 0.82.

The scores obtained were analyzed using mean differences and the Student t-test for independent samples.

2. Results

At the end of the experience, students from the experimental group were more willing to work collaboratively than students from the control group. The mean score on the collaboration scale for the experimental group was 3.86 points, while for the control

group it was 3.75 points. This difference is statistically significant (*Student's t-test* = 2.03, $p = 0.04$). In addition, the analysis of the five dimensions included in the scale (leadership, work responsibility, work objective, tutor's role, willingness to work in a group) revealed that the differences between both groups were significant in three of them: work responsibility (including the capacity for each member to take responsibility for the group work, and both collective and individual achievements and difficulties), in which the experimental group obtained 4.23 points, while the control group obtained 4.07 points (*Student's t-test* = 2.49, $p = 0.013$); work objectives (that they must be focused on finishing the task, but also on learning and allowing for the participation and collaboration of all group members), in which the experimental group obtained 4.22 points, while the control group obtained 3.86 points (*Student's t-test* = 5.31, $p < 0.01$); and leadership (which includes the need for the work to be regulated by shared leadership), in which the experimental group obtained 3.76 points and the control group obtained 3.95 points (*Student's t-test* = -2.58, $p = 0.01$).

Table 1. Mean differences between experimental and control groups for the five dimensions of collaboration and for the total scale

	Group	**N**	**Mean**	**Std. Dev.**	**Std. Error Mean**	**Mean Dif.**	**Std. Error Dif.**	**t-test for Equality of Means** t	df	Sig.
Leadership	Exp.	172	3.76	0.674	.0514	-0.19	0.074	-2.58#	332.8	0.010
	Control	164	3.95	0.681	.0532					
Work responsibility	Exp.	170	4.23	0.544	.0418	0.16	0.066	2.49*	332.0	0.013
	Control	164	4.07	0.652	.0509					
Work objective	Exp.	167	4.22	0.559	.0433	0.36	0.068	5.31*	326.0	0.000
	Control	161	3.86	0.675	.0532					
Tutor's role	Exp.	172	3.77	0.595	.0454	0.11	0.067	1.55#	315.3	0.123
	Control	156	3.66	0.649	.0520					
Willingness to work in a group	Exp.	170	3.26	0.601	.0461	0.08	0.075	1.13#	308.9	0.261
	Control	163	3.17	0.756	.0592					
Total scale	Exp.	158	3.86	0.393	.0313	0.10	0.513	2.03*	260.0	0.043
	Control	134	3.75	0.471	.0407					

* Equal variances assumed using Levene's Test for Equality of Variances
\# Equal variances not assumed using Levene's Test for Equality of Variances

Table 2. Mean differences between the experimental and control groups for the four dimensions of collaborative work and the total scale

	Group	**N**	**Mean**	**Std. Dev.**	**Std. Error Mean**	**Mean Dif.**	**Std. Error Dif.**	**t-test for Equality of Means** t	df	Sig.
Understanding the problem	Exp.	163	3.88	0.714	0.0560	0.05	0.0844	0.55#	309.4	0.580
	Control	155	3.83	0.786	0.0632					
Strategy design	Exp.	158	3.87	0.769	0.0612	0.09	0.0886	0.99*	313	0.322
	Control	157	3.78	0.804	0.0642					
Strategy execution	Exp.	162	3.90	0.745	0.0585	0.19	0.0858	2.17*	319	0.031
	Control	159	3.71	0.792	0.0628					
Strategy evaluation	Exp.	163	3.78	0.798	0.0625	0.08	0.0947	0.87*	313	0.387
	Control	152	3.69	0.882	0.0716					
Total scale	Exp.	140	3.91	0.619	0.0523	0.12	0.0800	1.51*	271	0.132
	Control	133	3.79	0.701	0.0608					

* Equal variances assumed using Levene's Test for Equality of Variances
\# Equal variances not assumed using Levene's Test for Equality of Variances

The problem-solving scale involved four dimensions: understanding the problem, designing, executing, and evaluating a strategy. On the global problem solving scale, the students from the experimental group obtained a better score than those from the control group (3.91 and 3.79 points respectively), although the differences were not statistically significant ($p > 0.05$). The Student's t-test analysis showed statistically significant differences in favor of the experimental group in the "plan execution" dimension, obtaining a mean score of 3.9 points, while the control group obtained 3.71 points (*Student's t-test* = 2.17, $p = 0.031$). For the other dimensions the differences were always in favor of the experimental group, although these were not statistically significant.

3. Conclusions

The results show that the methodology developed through the use of MSG contributes to the development of collaborative skills. The participants considered the work responsibility as shared between members of the team to be especially important, as well as focusing the work objectives not only on completing the task, but on learning and recognition in order to be able to express legitimate opinions as well. The leadership results are especially interesting. The control group had a higher score for the leadership subscale than the experimental group, which is related to the fact that for the latter the presence of a group member who regulated the work of the others was more necessary than in the control group. This was because among the participants in the study, the need for a group leader who would organize the set of tasks to be completed resisted the recommendations of the research team to organize the work through shared leadership. The students from the experimental group were more emphatic than their classmates in the control group in pointing to the need for a leader who would direct the rest. This is a point that must be analyzed in more detail in order to identify which factors influence this resistance. Such factors could include cultural or pedagogical elements, or a focus on the training provided to the teachers.

In problem solving, the students from the experimental group had a better perception of their own skills to execute their strategy than the control group. In executing their plans, they examined the details more and were more careful in making sure that the steps they made were correct. The results obtained for problem solving have been analyzed in previous versions of the study [27,28]. In these analyses results have been found that point to the development of some of the problem-solving dimensions. Although the experimental group has always performed better than the control group, we discovered statistically significant differences in favor of the experimental group regarding the students' perception of their own capacities for understanding and planning a strategy, as well as statistically significant differences in the students' capacities to complete the problem-solving cycle, including the evaluation of the strategy. The analysis of the set of results obtained indicates two alternative explanations. The first is that this is a skill that requires a lot of time to develop. A 3-month long project such as that described here contributes to the development of this skill, but a much longer, systematic intervention is required to obtain results on the set of dimensions that make up this skill. The second is that there are factors involving the context of application and/or the intervention itself that influence the results obtained. An in-depth qualitative analysis of these aspects must be developed in order to better interpret these results.

All in all, the results obtained allow us to contribute to progress on the empirical evidence available regarding the contribution of Mobile Serious Games to the development of collaborative problem solving skills in education. The connection between collaboration and problem solving in our study is only recent in the literature and supports the identification of the contribution of video games to the development of high-order skills. In addition, in our work we have emphasized the players' mobility, under the assumption that in order for the game to be natural, it must incorporate the learners' bodies; and that the learning can take place in various non-school spaces always when the activities are appropriately focused.

Acknowledgment

This report was funded by the Chilean Ministry of Education, Innovation Program, Project "Mobile Learning in Science" and Project CIE-05 Program Center Education PBCT-CONICYT.

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Treadmill Interface for Virtual Reality vs. Overground Walking: A Comparison of Gait in Individuals with and without Pain

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Abstract. A treadmill (TR) interfaced with a virtual reality (VR) system can provide an engaging environment that could improve activity adherence and walking function for individuals with pain. Furthermore, inclusion of discrete visual and auditory cues into the VR environment (e.g. manipulation of optic flow speed or audio beat frequency) could improve walking. This study compared gait characteristics (speed and cadence) of a baseline over ground walk (OVR) with a TR walk as part of a project to develop gait referenced visual and auditory frequency cues. Thirty-six participants aged between 22 and 80 years, with pain (n=19) and without pain (n=17) took part. A 2x2 MANOVA conducted on the speed and cadence for all participants showed a significant difference between pain and control groups for speed ($F_{1,34} = 9.56$, $p<0.01$) and cadence ($F_{1,34} = 5.75$, $p<0.05$), as well as a significant decrease from overground to treadmill conditions for both speed ($F_{1,34} = 81.39$, $p<0.01$) and cadence ($F_{1,34} = 25.46$, $p<0.01$). Differences between OVR and TR walking indicate that visual or auditory cues for VR walk training should be referenced according to TR baseline measures.

Keywords. Virtual reality, pain

Introduction

Virtual Reality (VR) displays, as a tool of rehabilitation, can help engage patients [1], improve movement [2,3] and potentially enhance adherence to activity based rehabilitation interventions. Preliminary studies have also shown that VR can decrease pain [4], and improve motor function [e.g. 5]. However, the ability of VR to simultaneously reduce pain and increase active movement has not been established.

This could be important for musculoskeletal problems such as osteoarthritis, which are major health problems, characterized by significant morbidity, mortality, and economic burden [6]. The numbers of those impacted and the associated medical and human costs will only increase as the projected rise in life expectancy develops and the proportion of elderly people increases [7]; currently over half of the older population has arthritis [6]. Historically, rest and avoidance of physical activity were the mainstays of treatment. However, it is now apparent that inactivity causes many of the same problems that were originally attributed to arthritis (e.g., muscle weakness, decreased flexibility) and obesity [8]. More recently, exercise and activity have played a changing role in the management of arthritis.

The beneficial effects of exercise on local joint structures, on physical function, and on psychological mood are all well established, and clinical guidelines now

recommend that the management of arthritis should be based on a combination of exercise/activity and education. Unfortunately, adherence to the recommended exercise and physical activity remains problematic, and there is a growing interest in the potential of Virtual Reality to address this issue, both to improve understanding of the factors, which influence movement, and to manipulate these to improve rehabilitation outcomes.

Previous studies have indicated that decreasing the rate of optic (visual) flow relative to normal walking speed is correlated with an increase in walk speed in healthy individuals [3], although this has not yet been investigated in individuals with musculoskeletal pain. In addition, the use of audio frequency cues ('beat') has been demonstrated to modulate movement speed in healthy individuals [9,10]. There is also some evidence that audio cues can improve walk speed in patients with Parkinson's disease [11] but there has been little investigation into the effects of audio cues on the rehabilitation outcomes in other clinical populations.

These findings suggest that the use of altered audio and visual cue frequencies in treadmill-mediated virtual rehabilitation may improve movement. However, such cues need to be referenced to the participant's baseline gait; specifically optic flow referenced to walk speed and audio beat referenced to cadence. Walk tests such as the 6-minute walk test are commonly used to assess walking ability [12], and are carried out overground, whilst interventions are commonly carried out on a treadmill [13]. However, it cannot be assumed that treadmill gait characteristics are the same as those during overground walking and thus, the baseline speed and cadence measures taken from such tests may be unsuitable for use as cue- references in treadmill-mediated VR interaction.

To further complicate the matter, there are three main categories of treadmill, each requiring a different approach to locomotion. The simplest are non-motorized treadmills ("self-driven"), which require the belt to be driven by the walking effort of the subject. These typically have fairly narrow and short walking surfaces and often are slightly inclined to facilitate belt movement. More commonly used are motor-driven treadmills, which can have a much wider and longer walking surface. Most of these motorized treadmills operate at "pre-set" speeds, which use non-natural (i.e. manually controlled) interfaces to alter the speed incrementally. This will not support any natural variation in walking speed. The third category of treadmill (self-paced), whilst also motorized, is coupled to the walk speed of the user (measured continuously whilst on the treadmill) updating the motor speed in real-time to accommodate natural fluctuations in gait [14]. These treadmills are thus well suited to traversal through virtual environments.

A number of studies have compared gait characteristics of overground and treadmill walking, for pre-set treadmills that have been set to the overground walking speed [e.g. 15,16]. However, if the development of treadmill interaction with VR for rehabilitation is to continue successfully, any potential differences between the walking modalities needs to be understood, and there are, to date, no studies which have compared overground walking with self-paced treadmill walking.

The purpose of this study was thus to compare gait characteristics during baseline assessment of an over ground (OVR) vs. a self-paced treadmill (TR) walk test in participants with and without pain during walking, in order to establish whether there are significant differences in speed and cadence.

1. Methods

Thirty-six participants, (21 females, 15 males aged 22-80 yrs, mean age 51 yrs) were assigned to one of two groups based on the presence (n=19) or absence (n=17) of musculoskeletal pain that compromised walking.

A static, high-contrast image of a linear walkway lined with pillars was back projected onto a 2.5m x 2m screen. The motorized self-paced treadmill was placed in front of the screen.

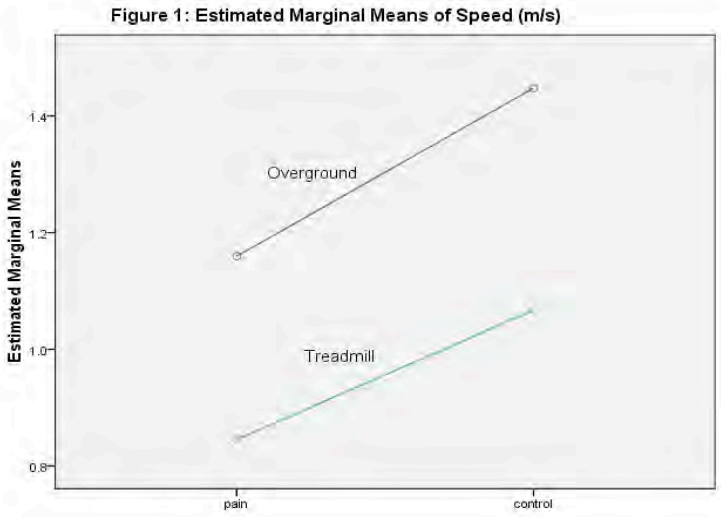
All participants completed a standard OVG walk test (6-min walk), with the average cadence being recorded across 10m sections of walkway. After a rest of approximately 30mins, the participants practiced on the treadmill system. When they were confident walking on the treadmill, a 2-minute trial was initiated, during which the speed was recorded to a computer. The total number of steps was counted in 30-second blocks (a random sample were cross checked against results from a motion capture system). The cadence (steps per second) was calculated from this.

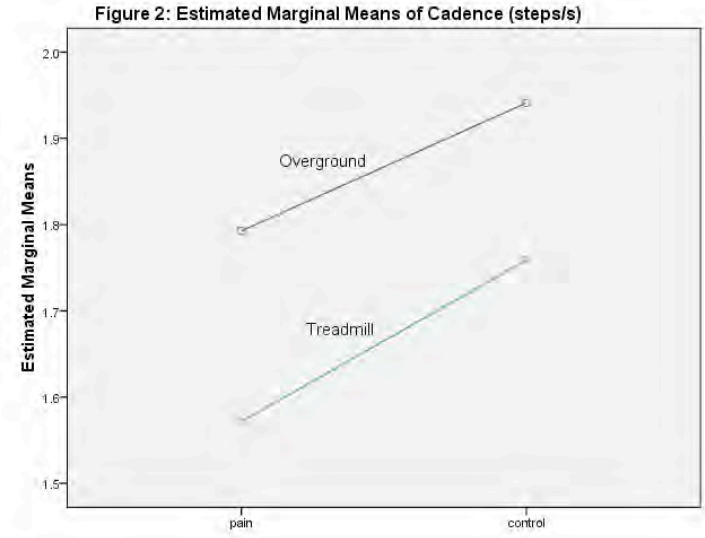
2. Results

A 2x2 MANOVA conducted on the speed and cadence for all participants (Table 1) showed a significant difference between pain and control groups for speed ($F_{1,34} = 9.56$, $p<0.01$) and cadence ($F_{1,34} = 5.75$, $p<0.05$), as well as a significant decrease from overground to treadmill conditions for both speed ($F_{1,34} = 81.39$, $p<0.01$) and cadence ($F_{1,34} = 25.46$, $p<0.01$).

Table 1. Mean speed (m/s) and cadence (steps/s) for group (pain or control) and condition (overground or treadmill)

		Pain (n = 19)		Control (n = 17)		
		Mean	**StDev**	**Mean**	**StDev**	
OVR	**Speed**	1.16	0.26	1.45	0.18	**OVR vs Treadmill** Speed ($F_{1,34} = 81.39$, $p<0.001$) Cadence ($F_{1,34} = 25.46$, $p<0.001$)
	Cadence	1.79	0.23	1.94	0.14	
TR	**Speed**	0.84	0.33	1.07	0.28	
	Cadence	1.57	0.32	1.76	0.23	
		Pain vs Control Speed ($F_{1,34} = 9.56$, $p<0.01$) Cadence ($F_{1,34} = 5.75$, $p<0.05$)				





However, there was no significant interaction effect ($F_{1,34} = 0.74$, $p = 0.4$) between pain and walk condition for speed (Figure 1) and no significant interaction ($F_{1,34} = 0.23$, $p = 0.63$) between pain and walk condition for cadence (Figure 2).

3. Discussion

Although a number of studies have compared overground and treadmill walking, they have generally pre-set the treadmill speed to match the preferred overground speed and then compared gait biomechanics between the two conditions [e.g. 15, 16]. Whilst useful in establishing that treadmill walking is biomechanically comparable to overground walking for therapeutic purposes, these studies fail to fully investigate

changes in temporal characteristics between the two walking modes, which can only become apparent if the participants are allowed to select their own pace on the treadmill in the same way as on the overground component. It has been suggested that fixed-speed treadmill walking can give rise to a "sense of urgency" to place the foot of the swing limb down because the supporting leg is moving backwards on the treadmill [15]. This is supported by the observation that stance time is decreased and cadence increased in these studies [15, 16]. In contrast, during self-paced treadmill walking an increase in stance time would not result in significant backward movement of the supporting leg.

Furthermore, it has also previously been noted that a given walking speed is perceived as faster on a treadmill when compared to overground walking [15]. This effect was evident, albeit in reverse, in this study, where participants generally walked at a slower speed on the self-paced treadmill. This slower speed was also associated with a slower cadence. This finding was independent of the presence of pain, although the mean speed and cadence of the control group was higher than the pain group across both conditions.

The present options for treadmill interaction require that either the treadmill speed is preset, which may decrease immersion and increase anxiety, or the treadmill can respond to the participants speed, which may result in slower walking speeds. As noted previously, modulation of audio and visual frequency cues may improve movement speed, and if these are correctly referenced to individual gait then this may compensate for the slower speeds noted on treadmill walking. Therefore, if studies are to be conducted using gait-referenced visual and audio frequency cues to improve movement speed in virtual reality, the baseline measures should be calibrated to treadmill walking and not to the standard overground walk tests.

4. Conclusion

This is the first study to demonstrate that gait characteristics of treadmill walking are significantly different to overground walking when participants are allowed to self-select their walking pace in both conditions. Given the magnitude of the decrease in gait velocity and cadence from OVR to TR walking, visual (optic flow) or auditory cues (stepping beats) included in a VR environment to improve walking must be calibrated to TR based walk assessment measures.

Further work is required to examine the gait characteristics of the remaining treadmill type (self-driven), and to develop a standardized treadmill assessment protocol comparable to the current overground tests.

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Behaviour of Motor Disabilities and Appearance of Visual Hallucinations in Patients with Parkinson's Disease in a Virtual Environment

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Abstract. We studied 23 Parkinson's disease (PD) non-demented patients and 15 controls in Virtual Reality (VR) environments reproducing usual daily living situations. In VR sessions, PD patients performed their actions worse than controls, in terms of time of execution in exploration and pointing, precision as objects avoiding, and in semantic incidental memory task. We observed clear differences of performances between on and off status medication, with a global worsening during off phase. Moreover, all six patients with motor fluctuations described visual hallucinations during off state, with occurrence of images not included in the virtual environment.

Keywords. Virtual Reality, Parkinson's disease, Visual Hallucinations

Introduction

In the rehabilitative field of Parkinson's disease (PD), it has been demonstrated that a virtual display superimposed over a user's visual filed, augmented reality, has been shown to initiate and sustain walking [1], in function of disease severity [2]. But, even if VR originates as an useful tool, providing within a motivating context, as an effective rehabilitation intervention, can potentially present opportunities to better understand the clinical view. In a preliminary study [3], we reported PD in two patients while in VR immersion such as in the reality, difficulty in speed of action, incidental memory, orientation, and a pointing task even- despite their normal neuropsychological tests.

Aim of the present study was to evaluate the behaviour of PD patients in different stages of the disease in order to evaluate the correlation between the ability of performing virtual tasks and the severity of extrapyramidal signs.

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1. Methods

We studied 23 non-demented patients affected by PD (mean age 65.3 years, standard deviation 7.7; education 8.40 years, standard deviation 4.6; mean score UPDRS, Unified Parkinson's disease Rating Scale, motor part 24) and 15 control subjects (mean age 62.9 years standard deviation 9.1; education 9.3 years; standard deviation 4.4).

The environments are implemented in an immersive system, including a head-mounted display subsystem, while the motion tracking is provided by a gyroscopic tracker. To provide an easy motion a two-button joystick-type input device: pressing the upper button the operator moves forward, pressing the lower button the operator moves backwards. The direction of the movement is given by the rotation of operator's head.

The environments reproduce usual daily living situations (supermarket, Gymnasium and Kitchen) where subjects can move around and interact with the objects. The VR research protocol includes 5 phases: learning, exploration, incidental memory tasks, denomination, and pointing. Time was recorded with an external device.

In six patients with motor fluctuations (3 men, mean age 63 years and 11.6 years of education, and 3 women, mean age 70.3 years and 7 years of education), the experimental protocol was repeated four times in four consecutive weeks, in the early morning, after the first administration of L-dopa ("medication on" week 1 and 3), and without ("medication off" week 2-4), then after 12 hours, in withdraw from L-dopa therapy.

In order to test cognitive abilities required for the tasks of the VR sessions, patients were evaluated by a dedicated neuropsychological assessment battery, including MMSE, Verbal Test (Command Comprehension Test; Phrase Construction Test), Memory Tests (Rey's auditory verbal learning test; Disillabic Span Test, Prose Memory, Corsi's Span, Visual Memory Test), Frontal abilities test (Clock Draw Test; Phonological Verbal Fluency; Raven's colored progressive matrices; copying drawings, Frontal Assessment Battery, Weigl' s Test; Trail Making Test A and B; Search and Attention Test; Ideomotor Apraxia Test), and Visual perception (Street Completion Test).

To compare the control's data with those of two groups of PD patients (with and without motor fluctuations), we used a Kruskal-Wallis' Anova, followed by a Mann-Whitney two-tailed U test. Furthermore, in order to assess the correlation between neuropsychological, clinical parameters and VR performances, a square matrix of Spearman was used. Finally, to study the differences in VR variations between medication on and off, we used a Wilcoxon's Test. All the continuous variables were dichotomized using the median as the cut-off value. The statistical analysis was conducted employing the STATISTICA program and the significant level was predetermined at $p<0.05$.

2. Results

In VR sessions, PD patients performed their actions worse than the control's, in terms of time of execution in exploration ($p < 0.004$) and pointing ($p < 0.00016$), precision as objects avoiding ($p < 0.0002$), ability of pointing ($p< 0.006$), and in semantic incidental memory task ($p <0.04$).

Table 1 Visual Hallucinations in six motor fluctuation patients during "off-medication" session

Patient 1	In Gymnasium: not well-defined animals on the wall
Patient 2	In Gymnasium: a nest of bees with bees flying around
Patient 3	In Gymnasium: children sitting in desks
Patient 4	In Kitchen: a petrol pump
Patient 5	In Gymnasium: a woman is mistaken as a policeman
Patient 6	In Gymnasium: undefined animals on the wall and on the floor

No significant differences were founded in the VR's scores between the six patients with motor fluctuations and with the other patients, although those without fluctuations showed better global performances.

Inside the group of patients with motor fluctuations, we observed clear differences in the same individual between the on and off phase during VR performances, with a worsening "during off" phase in time of exploration ($p<0.02$), in pointing time ($p<o.o2$), and in the ability of pointing ($p<0.04$). The denomination tasks scores, as well as the incidental memory task, are better during the "on" phase.

The VR scores of PD patients resulted "not correlated" with neuropsychological findings, or clinical variables.

Much more, all six patients with motor fluctuations, in both "off- medications" sessions, described visual hallucinations (Table 1), with occurrence of images not included in the virtual environment. The "object" of the visual hallucination was never the same, in the same patient, in the same environment, or in the same location. In these patients, visual dysperceptions were never experienced in the real life.

3. Discussion

We have investigated the quality of performances of PD patients during various VR tasks session, such as environment exploration or pointing at virtual objects.

The time of execution and accuracy were the parameters of reference in the evaluation. Patients were slower and more inaccurate in all tasks, compared to the controls.

Also, even if in while performing the virtual task, it is necessary to involve the "real motor system", such as moving the hand to command the joystick, it is reasonable to hypothesize an independent contribute of the virtual immersion "*in se*," in the altered findings of PD patients. In this view, these results can be consequent of the well-known alterations of the visual-motor system.

We also found a statistically significant difference between "on-off" medication, indicating that the system principally evaluated in VR, and, not easily correlatable with the clinical view, it includes a dopaminergic function, as does the retinal visual system.

Our study has shown, therefore, that a VR environment can induce the appearance of visual hallucinations in PD patients who had never previously complained of such symptoms.

Visual hallucinations (VH) are one of the most typical symptoms among the behavioral disturbances observed in PD, affecting about one-quarter of all patients.

Various pathogenetic models have been considered to explain VH in PD, recently focusing on dyregulation of external perception and internal image production secondary to dysfunctions of the ponto-genicolo system, implicated in the control of rapid eye movement during sleep [4].

4. Conclusions

Also in VR, where real motor disabilities should be less relevant, PD patients showed significantly abnormal performances comparing with the controls. These alterations can be attributed to the bradiphrenia as well as to an altered function of a dopaminergic system, not correlatable with clinical scales, such as the retina.

This system is probably implicated in the genesis of VH as well, referred by our patients during off-medication VR immersion as a behavioral manifestation of a hypodopaminergic status, supporting an integrative model of VH, which includes the retinal dopaminergic system and the REM sleep regulatory system [5].

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Reactive Ocular and Balance Control in Immersive Visual Flows: 2D vs. 3D Virtual Stimuli

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Abstract. The control of gaze and balance strongly depend on the processing of visual cues. The aim of this study is to assess the effects of the dynamic 2D and 3D visual inputs on the oculomotor and balance reactive control. Thirteen subjects were immersed in a virtual environment using 10 different 2D/3D visual flow conditions. Analysis of eye movement and postural adjustments shows that 2D and 3D flows induce specific measurable behavioral responses.

Keywords. Reactive control, oculomotor, balance, virtual immersion, visual flow, performance measurement, adaptation.

Introduction

The balance adaptation mainly depends on the efficient visual information processing during postural mechanisms. The visuo-postural control quickly integrates dynamic visual cues extracted from images properties to adapt oculomotor and balance commands in order to quickly react to the visual environment. Our previous works have shown the ability to adapt movement and posture to visual changes [1] or visuomotor discordance [2] in virtual visual environments (VEs) with similar neuromotor processes as those use in natural visual environment. However, despite the fact that the automatic oculomotor reaction (*optokinetic nystagmus)* to large 2D visual flow is well established [3], the question of how the automatic ocular and balance strategy use the spatial characteristics of dynamic visual cues is still unclear, mainly concerning the specific effects of moving 2D vs. 3D visual stimuli. The goal of this study is to determine the effects these visual inputs on ocular and balance responses.

By analyzing the effects of the moving visual stimulation on motor adjustments, it also questions the sensorimotor flexibility of the initial postural and the online balance adaptation in VEs.

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1. Methods

Thirteen subjects aged from 22 to 42 participated in the study. The experiment lasted 1 hour per subject. All subjects had normal or corrected vision and were naive to the purpose of the study. Subjects stood within an immersive VE displayed on a 180 degrees curved screen (12x2 meters). They wear stereo-shutter glasses. Virtual visual stimulus consisted in randomly displayed circle-like flow patterns (multi-color patterns on a gray-light background). Ten conditions of stimuli were proposed: right, left, up and down (both in 2D and 3D), forward and backward (in 3D only). Each stimulus was presented during 20 seconds, and was preceded by a preparatory period of 4 seconds without visual stimuli (gray-light full screen). The subject was instructed to keep a comfortable stabilized upright posture during this preparatory period. No instruction was given about the way to behave during the stimulus, except to stand up and keep the arms crossed on the chest. Two randomized sessions of 10 trials per stimulus was performed, corresponding to 100 trials for each subject. A 10-minute rest period occurred between sessions. Eye movements were recorded using an electrooculographic system (EOG at 500Hz) to analyze both the horizontal and vertical *optokinetic nystagmus (OKN*) frequency. Postural adjustments were evaluated using a force platform to record (at 500Hz) the ground reaction forces around the medio-lateral (x), antero-posterior (y) and vertical (z) axes at the feet center of pressure. Data processing and analysis focused on the ocular and postural adjustments parameters. A multi-factorial statistical design between *2D/3D* and the visual flow *Directions* conditions was applied to data.

2. Results

General comment. No subject mentioned immersive discomfort or motion sickness during or after the experiment. This indicates that neither maladaptive transfer nor after effects was observed despite the one-hour VEs exposure. No unbalance imposing a footstep or to go down from the force platform was observed.

Eye movement. EOG results show that the optokinetic responses to virtual flows are dependent of the visual flow *Direction* in both *2D* and *3D* (figure 2 left). This OKN is automatically triggered from the first flows motions and persists during all the trial. For all *Direction* conditions, the frequency of the ocular responses decreased for 3D-flow stimulus, and is balanced in forward/backward directions.

Postural adjustment. Force platform results show an initial reactive postural adjustment to counteract the sudden unbalance when the visual flow begins. This starting reaction is followed by online postural corrections *Direction*-dependent, to compensate for the balance automatic deviation due to the visual flow. This is clearly visible for antero-posterior postural correction in Up/Down directions in figure 2 (right).

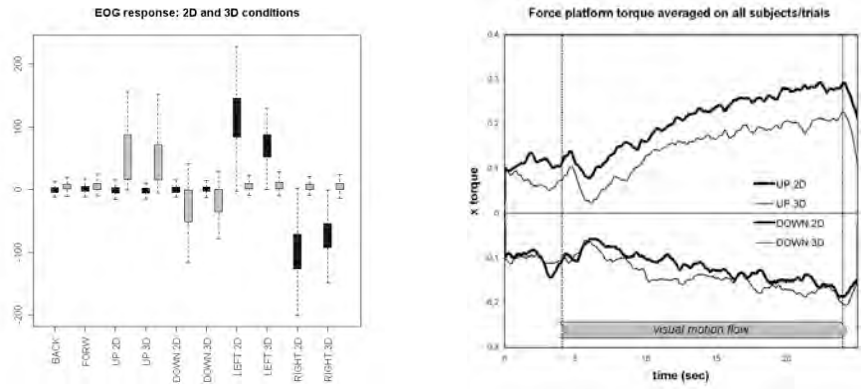

Figure 2. Left: Opto-kinetic nystagmus frequency signed from [left – right] and [up – down] calculation. Boxes represent central quartiles (50%) for horizontal (black) and vertical (grey) visual flows, for *2D* and *3D Direction* conditions. Right: X-axis torque for Up/Down *Directions* for 2D/3D flows (in thick and thin line).

3. Discussion and conclusion

The study shows the oculomotor and balance reactivity to both vertical and horizontal 2D and 3D visual flows. The decrease of optokinetic nystagmus frequency for 3D visual flows could be due to the non-uniform motion and depth-dependant perception for the 3D cues, moving slower for farthest ones. Comparatively, the motion uniformity and the absence of depth ambiguity in 2D visual flows overdrive the optokinetic and visuo-postural behaviors in a more repetitive and predictive way.

For 3D flows, cues velocity is not uniform because of parallax. We suggest that higher complexity of the visual stimuli explain an increased cognitive load and the observed modification of balance control and oculomotor characteristics.

This study proves that 3D flows, closer to natural visual stimulation than 2D ones, induce measurable specific behavioral responses. Finally, we propose that virtual immersion is an appropriate tool for richer immersive protocols in clinical assessment of the visuo-vestibular disorder, and in functional rehabilitation based on visuo-motor and cognitive reactivity.

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The Co-Definition of Self: Conversations in Virtual Reality

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Abstract. Conversation analysis can take the form of a qualitative methodology for the exploration of discursive productions, whose main goal is the formulation of hypotheses for reading psychosocial interaction through descriptive models of interlocution. Therefore, in this study, conversations in a shared Virtual Environment have been analyzed in order to understand the specific structure, dynamics, and phenomenology of Virtual Reality effects on the "interactive micro-chains" that constitute the communicative thread of daily experience.

Keywords. Presence, Self, Social Interaction, CyberTherapy, Social Presence

Introduction

In recent years, the wide diffusion of multi-user Virtual Environment (VE), on-line games, and other artifacts shaped the research on collaboration in Virtual Reality (VR). There is a large interest on the study of social interaction per se, as noted by Schroeder [1]: a small or large group behavior, social conventions, and trust dynamics are just few example of themes investigated by the means of shared Virtual Environment.

Understanding how to use virtual reality to support collaborative interaction presents a substantial challenge for the designers and users of this emerging technology [2]. First, Virtual Environments (VEs) are created to serve a purpose, so they must be designed by explicitly considering intended users' tasks and goals [3]. Second, the possibility of negotiation, both of actions and of their meaning, plays a key role in providing a satisfactory sense of cooperation. This is even truer for networked VEs, where cooperation and collaboration are the key features of the experience [4].

Particularly, there are two basic difficulties in studying VR-mediated interaction. The first difficulty lies in daily situations' ambiguity and unpredictableness: considering the world of experience as an open system, it is not possible to plan and design every type of situation which could be generated while carrying out a series of tasks, as required in order to build a suitable cooperation environment [2]. Another issue is the fundamental diversity from the points of view of actors implied in the interaction: as noted by Gasser "two agents cannot have identical representations […] shared knowledge is impossible" [5]. Cooperation, according to Gasser, is simply a moment of practical understanding, because the actors are good at pragmatically tuning their own activities 'as if' they had common knowledge with other actors [2]. According to Galimberti and colleagues [4], for these reasons, the only way to

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understand interaction in VE is by analyzing the subjects involved in the environment in which they operate, and the new processes and activities developed during interactions. A major difficulty in studying interaction can be identified in the respect of the ecological situation in which the interaction takes place.

A possible solution could be to use the method called analysis of conversations, a qualitative methodology for the exploration of discursive productions, whose main goal is the formulation of hypotheses for reading psychosocial interaction through descriptive models of interlocution [6-8]. Therefore, in this study we will examine conversations to understand their specific structure, dynamics, and phenomenology in order to understand the effect of Virtual Reality on the "interactive micro-chains" [9] that constitute the communicative thread of daily experience.

1. Method

In order to compare conversational dynamics in real life and in virtual reality, we created two experimental conditions during which couples of participants negotiated a narration using some Peanuts® cartoons. First condition was based on a CVE (Collaborative Virtual Environment) and the second condition took place inside the laboratory room. During their interaction participant were requested to choose 6 cartoons out of 46 and to create a story using them. Cartoons were randomly chosen from the Peanuts official website archive, and were reproduced on paper boxes or on virtual boxes inside the CVE.

A total of 48 participants (24 male and 24 female) were recruited for the experiment via e-mail, newsgroup, and poster announcements in Milan, Italy. Participants' ages ranged from 18 to 29 (M= 23.30, SD= 3.13). Participants were divided by sex and randomly assigned to two groups: the Virtual Reality group (VR) and the Real Life group (RL), resulting in 12 males and 12 females for each group. They were then divided in couples, balanced for sex, resulting in 12 couples for group, 4 constituted only by females, 4 mixed, and 4 constituted by males. Since any level of acquaintanceship can have an effect on conversational dynamics, we paid particular attention in order to create couples with participants reciprocally unknown to each other.

The virtual environment was constituted by three rooms and two corridors, each linked by doors. Participants started in two separated rooms connected to the main space by two corridors divided by a window. The main room contained two sets of boxes (textured with Peanuts® comics) and a table. In order to obtain a high perceptual realism, several elements have been manipulated, according to Rademacher [10]: the used VE was characterized by high shadow softness, a wide variety of shape and number of objects, an average of 5 light sources in each room, a detailed sound environments, and coherent physics behaviors.

Participants were represented with a 3D human-like avatar of the same sex of the participant who controlled its movements using the mouse and the right-button for walking forward; the actions (opening the door, picking up a box, dropping it) were performed by using the mouse left button.

The VR software engine adopted offers two opportunities to show the action of object grasping: representing a gripping tool or representing objects as floating in front of the participant holding it. In order to increase the self perception [11], the gripping solution was preferred. To evaluate the impact of this solution on the perception of the

realism during the VR experience, a survey has been conducted: 43 participants (20 male, 23 female; age M= 29.23, SD= 4.21) were asked to describe a picture, randomly selected between two screenshots out of the different points of view. Only 8 of them described the "strange tool." As noted by Hoorn [12], VR experience is not based only on the realism, but also on the relevance of its elements, dynamics, and actions allowed. In the VE used in this study, the grasping tool was relevant for the action, and its appearance, although not realistic, was not in contrast with its function. Considering the survey results, and the relevance of the experience, the grasping tool solution has been adopted in the VE.

2. Analysis

The research questions posed by presence in VR required an integrated approach, as suggested by Riva [13] and Galimberti [4]: the Complementary Explorative Multilevel Data Analysis (CEMDA) integrates qualitative and quantitative procedures, therefore it has been used as a framework for this analysis. CEMDA incorporates complementary use of both methods, depending on the particular research stage or the initial assumptions that need to be taken in consideration.

Conversation analysis usually does not require quantitative information of interactions analyzed, but the greater differences between conditions shall be reported: VR conversations' average number of utterance is 178.2 per actor, while face-to-face average length is 97.4 utterance per actor. This mere information tells us something about the complexity characterizing VR-based conversations and the effort required of the actors in order to accomplish the same task as in face-to-face. The general structure of interaction underlines the co-definition of meanings and actions, but a deeper investigation highlights some recurrent processes characterizing the action of doing something with someone else in a collaboratively constructed context, specifically in VR.

In order to understand how Virtual Reality experience can shape the inter-subjectivity in interaction, the relative position that speakers took during interaction has been analyzed. While interacting, each actor can direct the other to do something, or could ask for help: each turn [14] has been coded as "+-" if the speaker directly assumed a "high" position , and as "-+" if the speaker accepted and adopted the "low position" casted by the previous turn [7, 15]. An iterative coding procedure has been adopted. After defining the rules for the two categories, 6 transcripts have been coded independently by two coders. The results of their coding have been compared for consistency of code application for both categories. According to Carey [16], a 2-by-2 contingency table has been constructed, reporting the absence or presence of each node by both coders across all the utterances coded. Such table was constituted by two agreement and two disagreement cells and Cohen's Kappa [17, 18] had been calculated. The code "+-" scored .93, while the "-+" code scored .89. A Mann-Whitney test has been conducted on frequencies and a significant difference has been found for the +- code ($Z=-5.78$; $p<.001$) and for the -+ code ($Z=-4.57$; $p<.001$), with the VR condition scoring higher than the f2f condition for both. But a Mann-Whitney test on proportional frequencies showed a significant difference only for the -+ code ($Z=-2.22$; $p<.05$) with the VR condition scoring higher than the f2f condition, and no significant difference has been found for the +- code. This difference can indicate that VR

conversations require "interactants" to continuously define and affirm their role, but that there is no difference on the interactive position taking and casting pattern.

3. Discussion

The first quantitative analysis of conversations produced in this study shows that interaction in VR requires quite the double of turns than interaction in face-to-face conditions, in order to perform the same task. This information tells little about interactive characteristics of a dialogical sequence, but is a confirmation of the greater complexness and articulation of VR interaction. We found that conversations in virtual reality are usually composed by 7 different phases, while face-to-face ones only by 3. If we look at the common phases, we can see that they are all about the task: in details, there is a Task defining sequence, very common in RV conversation and far less in F2F ones; the Task sequence, composed by every exchange finalized at completing the task assigned, and the Closure, when subjects reported the story they created.

But differences are far more interesting: VR conversations are characterized by two opening sequences devoted to the negotiation of the environment, of the actors themselves, and of the action. The first sequence, that we called "tuning", is similar to the summon/answer" sequence identified in phone conversation by Schegloff [19], but there is a difference, due to the specific media involved: while by phone the "summon" action is performed by calling, here it should be explicitly performed by the speaker. But the significance for the overall conversational sequence is the same: it starts the interaction. Sometimes the tuning sequence is followed by a salutation form, completely absent from the real life situation. Immediately after that, actors in VR performed what we called a Co-defining sequence, finalized at the negotiation of self, and three sub-sequences emerged: the self-affirmation, the reciprocal affirmation and the agnition of the other. This sub-sequence is in relation to the existence of the speaker in VR, the existence of the other, and their shared reciprocal recognition, and it supports the inter-comprehension process by creating a conversational device helping each actor to:

- ensure the intelligibility by the other of his own utterance;
- be sure of his own comprehension of other's utterance;
- identify the environment and his relative position and make it identifiable by the other;
- identify the actions performed and objects involved and make them identifiable by the other.

These are the basis of any successful conversational interaction, as noted by Galimberti [6]: what changes here is that they are explicitly faced and solved by each actor.

Allport defined social psychology as "an attempt to understand and explain how the thought, feeling, and behavior of individuals are influenced by the actual, imagined, or implied presence of others" [20]: by exploring the reciprocal affirmation sequence in its dialogical structure we can see that there are two symmetrical adiacency pairs, showing that for an actor is not enough to see the other, but he also need to be sure that the other sees him. A deep analysis of the conversational interplay highlights that actors not only co-define the virtual environment, but also their representations of it: when they don't share their relative positions, or their mutual understanding of the situation, the interaction needs to be continuously tuned, they stop doing the task to fall

back on the description of the environment around there, and their position in it, their actions, and their intentions. From a psychosocial point of view, the sense of being in the VE can be defined as the result of the reciprocal confirmation, and can be defined as the reciprocal presence of self and the actual, imagined, and implied other.

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Mixed Reality for PTSD/TBI Assessment

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Abstract. Mixed Reality (MR) refers to the blending of virtual content into the real world. Using MR, we create contextually meaningful scenarios in which users carry out tasks encountered in the presence of visual and aural distracters. Visual distracters can include subtle ones – people walking; and more abrupt ones – cartons falling. Aural distracters can include gentle ones – fans whirring; and more aggressive ones – automobiles backfiring. The intensity of these distracters can be dynamically controlled by a therapist or software that takes into account the patient's perceived level of stress. Intensity can also be controlled between experiences. For example, one may increase the stress level in a subsequent session, attempting to improve a person's tolerance. Assessment of progress includes psychophysical metrics (stress indicators) and the performance of tasks (accuracy and adherence to time constraints). By accurately capturing a patient's interaction with the environment in the context of simulation events, we can use MR as a tool for assessment and rehabilitation planning for individuals with stress-related injuries. This paper reports on the MR environment we have developed and its efficacy (realized and potential) for the assessment of post-traumatic stress disorder (PTSD) with or without traumatic brain injury (TBI).

Keywords. Mixed reality, post-traumatic stress disorder, psychophysical metrics, traumatic brain injury

Introduction

Virtual reality (VR) technologies afford the therapist an ecologically valid research environment while still maintaining therapeutic benefit and have fostered over fifteen years of research supporting these assets [1-2]. The flexibility of VR to deliver both safe and programmable rehabilitation protocols allows for more personalized environments that can match the disability level of the patient. From a basic research perspective VR-based rehabilitation also has the potential to advance our understanding of how the brain functions when persons perform real-world tasks [3]. These advances are major steps forward in creating standardized efficacy measures and designing successful rehabilitation protocols [4].

For some rehabilitation applications, VR's intentional attribute of isolating participants from the real world is inappropriate. Specifically, our goal is to use Mixed Reality (MR), the blending of virtual content into the real world [5], as a way to create

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contextually meaningful scenarios that can trigger responses indicative of subjects suffering from post-traumatic stress disorder (PTSD). The study on which we report was carried out with a group of healthy controls, with the objectives of testing the system's ability to capture baselines, stress indicators and performance data, and of the scenario's ability to induce levels of stress and distraction found in a chaotic work environment.

1. Determining MR Efficacy using Psychophysiological Measures

An MR-based experience refers to one that occurs in the context of virtual objects that are integrated into the real world. At a minimum, this involves the user's visual sense, and commonly includes mixed synthetic/real aural content. Other senses (touch, smell and taste) are often provided by the real world only. This combination of real and virtual content can create a very intense, personalized experience. For instance, an MR-enabled rehabilitation experience could take place in a transitional learning center, where MR is used to give a patient the sense of being in his or her own home [6]. Here, physical objects required for the patient to carry out desired tasks are real. Thus, in a kitchen, objects like the counters, cabinets, utensils, dinnerware, refrigerator, required food items, microwave and coffee maker may be real. Some of these real objects would be augmented by virtual textures that simulate the appearances of the patient's actual kitchen, e.g., the cabinets, counters and floor. Moreover, objects with which the patient never interacts, like a stove or a dining area, could be entirely virtual. The expected sense of touch is provided by real components, e.g., one can put coffee grounds into the real coffee maker. The smell of food, e.g., the coffee brewing, and its taste are real.

Figure 1 provides a visual tour of the MR Kitchen referenced in [6]. The left column shows three instances of the subject with his therapist. On the top, we see them standing in front of a real refrigerator, with a virtual counter and virtual cabinets; in the middle pane, we see them talking in front of a portion of the physical space containing a real coffee maker and real cabinets; in the lower pane, we see his therapist watching him make coffee in view of a virtual version of his dinette set in the background (demonstrating the immersion of a participant into a much larger environment than the physical space he or she is in.). The large right pane shows some of our staff testing the system. The top part shows the real setting. The bottom presents three monitors. The left monitor displays the scene as observed through a video see-through head-mounted display (VST-HMD). The middle monitor displays the output from a program that records the participant's movements. The right monitor is running a video of the patient in his home kitchen.

This combination of real and virtual content makes for a rich experience that can trigger old memories, and build multiple pathways to new and existing ones. When coupled with portable, noninvasive, unobtrusive neurosensing devices (e.g., encephalography, EEG), MR-based rehabilitation provides a means to study the brain in action. Uncovering the retuning and the reorganizing properties of the human brain is necessary for determining therapeutic efficacy, appropriate prognoses, and long-term care needs. In previous work, the UCF team has shown that EEG measures of engagement and workload can assist in determining the efficacy of an MR-based rehabilitation environment within the feasibility stage [7].

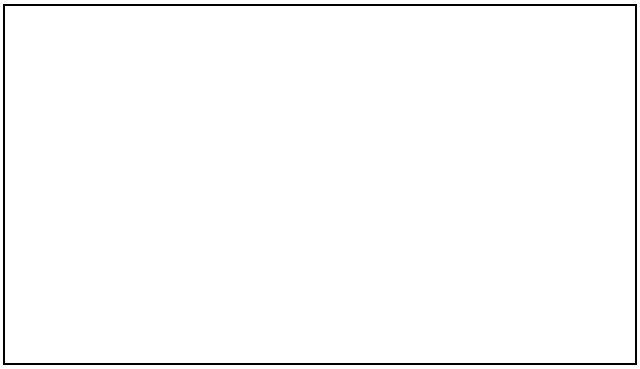

Figure 1. MR-enabled rehabilitation for relearning how to make breakfast.

To obtain these classifications, 20-minute baseline tasks consisting of a 3-choice vigilance task, eyes open rest task, and eyes closed task are performed. The results of these tests were used to fit an attention and distraction algorithm to obtain the proper classifications for each construct during data collection. The strength of this approach is that data from each participant can then be processed per individual or in aggregate, thus maintaining the individual effects while highlighting overall sample trends. More importantly, therapists can obtain objective, quantitative response variables instead of potentially unreliable after-the-fact surveys or patient reports.

2. Multiple Distracter Study Overview

The goal of this feasibility study was to measure the amount of distraction a healthy participant would experience while performing a multi-task occupation as follows. The primary task was to scan warehouse items. The worker also performed two secondary tasks, filling incoming orders and alerting the manager when a truck entered the bay. The scenario we developed (Figure 2, left side) shows a participant in a virtual warehouse setting, involving a real counter with printer, order forms and a parts tray; an open cabinet with parts trays containing a variety of small parts; and a surrounding area with boxes. In addition to the virtual surround, the counter has a virtual texture associated with it. Virtual sounds are added to those associated with the real printer in order to increase the participant's awareness of new orders arriving. Additional audio enhancements include the sounds of a fan, trucks arriving, doors opening/closing, a supervisor giving out orders and the forklift moving around the warehouse in order to stack newly arriving palettes.

Figure 2. Warehouse worker performing sequencing tasks: Real setting on left; Mixed Reality on right.

The worker is wearing a VST-HMD [8] that has stereo cameras on the outside to capture the real world and a pair of LCD displays on the inside to present the visual component of the MR world (Figure 2, right side). The participant is also wearing a wireless B-Alert EEG cap and a vest that contains sensors for respiration and electrodermal response (galvanic skin response) [7]. The baseline tasks were performed in a quiet room outside of the scenario presentation area before the participant entered the mixed reality setting. The participant was then escorted to the experiment site still wearing the cap and performed the experiment overview and baseline for the other physiological measures. Separate EEG data files were created for each of these stages of the experimental procedure.

Twelve healthy participants (6 males and 6 females) performed the mixed reality warehouse tasking. Data analysis performed for this paper was on data collected during the participant's performance within the mixed reality scenario only. While analysis for the full EEG dataset is ongoing, we report results for 5 participants (3 females and 2 males) for which there is a full EEG dataset of high data quality.

3. Results

Overall, participants showed a mix of high and low EEG engagement with frequent distraction. Distraction was mostly associated with the audio stimuli from the printer. Spikes ranging from 50 to 70% distraction were classified within 10 seconds of one or more printer audio cues. Some participants were so distracted by the secondary task of filling orders that they did not respond to the trucks entering the bay after the first observation. Figure 3 displays the means for % Engagement 30 seconds prior to the truck entering the bay area. When the truck entered the bay, the worker needed to alert the manager by pressing a button on the wall. The high percentage of low engagement and distraction suggests that the participants were not able to sustain attention or maintain vigilance when performing this task.

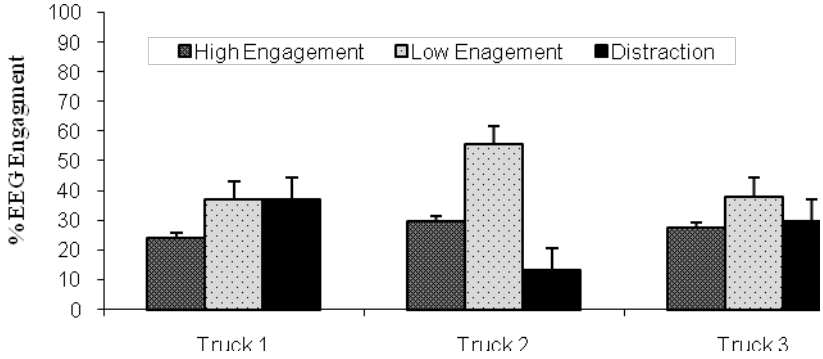

Figure 3. Average % EEG Engagement 30 seconds prior to the truck entering bay

Additionally, participants demonstrated phases of high and low workload levels. Figure 4 shows the % EEG Workload changes 30 seconds prior to the truck entering the bay. The high workload percentages suggest that the warehouse tasking is cognitively demanding during periods where the worker may have to shift their attention to another task. The Workload measures coupled with the Engagement measures suggest that the warehouse tasking is challenging even for healthy controls. Further analysis of individual performance, including task strategy, may show distinct associations

between tasks that demand more cognitive resources than others. Based on the outcomes described here, we believe that this EEG-based workload and engagement assessments have promise as comparators between healthy controls and their head-injured counterparts.

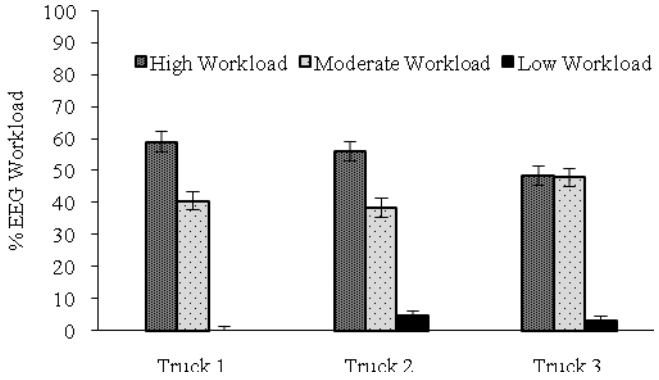

Figure 4. Average % EEG Workload 30 seconds prior to the truck entering the bay

4. Conclusions

The results show that EEG measures of Engagement and Workload are good indicators of how the tasks affected the healthy participants. A person with head trauma would not be able to complete these vocational tasks as scripted. However, the EEG measures allow for a means to modify the environment to support successful use of the mixed reality scenario as a rehabilitation tool. More specifically, EEG data can be analyzed individually and in aggregate to obtain an understanding of cognitive aspects of the task that may pose challenges to head injured patients. The EEG measures also show how distracters within the scenario affected performance from a cognitive processing perspective. This information is critical for virtual rehabilitation therapy protocols.

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SECTION IV

CLINICAL OBSERVATIONS

Cybertherapy is a field that is growing rapidly due to today's technology and information boom.

Virtual reality and advanced technologies have been used successfully to in a variety of healthcare issues, including treatment of anxiety disorders and phobias, treatment of eating and body dysmorphic disorders, neuropsychological assessment and rehabilitation and distraction during painful or unpleasant medical procedures.

The novel applications of these technologies yield many advantages over traditional treatment modalities, and the disadvantages that accompanied the first trials of virtual reality are quickly being addressed and eliminated.

Virtual reality peripherals such as data gloves, physiological monitoring and Internet worlds are swiftly demonstrating their usefulness in cybertherapy applications.

Wiederhold & Wiederhold, 2004

Cost Effectiveness of Virtual Reality Graded Exposure Therapy with Physiological Monitoring for the Treatment of Combat Related Post Traumatic Stress Disorder

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Abstract. Virtual Reality Graded Exposure Therapy (VRGET) is an effective treatment for combat-related PTSD. We summarize the outcomes of a VRGET pilot study with 12 participants who completed one to multiple combat tours in support of the War on Terrorism and who were subsequently diagnosed with combat-related PTSD. Details of the collaborative program amongst the Virtual Reality Medical Center (VRMC), Office of Naval Research, the Naval Medical Center San Diego (NMCSD) and the Navy Hospital Camp Pendleton are discussed as is the VRGET outcomes of significant reductions in PTSD symptoms severity. We also described the estimated cost-effectiveness of VRGET for the treatment of combat-related PTSD, as contrasted to Treatment as Usual (TAU) for combat-related PTSD.

Keywords. Virtual Reality Graded Exposure Therapy (VRGET), physiological monitoring, Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), Post-Traumatic Stress Disorder (PTSD)

The opinions expressed are the private ones of the authors and should not be considered approved or representative of the Navy Medical Department, the Office of Naval Research or the Department of Defense.

Introduction

In the face of mounting public concern over post-deployment health care issues confronting Operation Iraqi Freedom (OIF) or Operation Enduring Freedom (OEF) veterans, a Department of Defense (DOD) Task Force [1] a Presidential Commission [2] and an independent review group [3] were convened to examine the care of the war wounded. Both the DOD Task Force Report and the Report of the President's Commission discovered that 11-25% of OIF and/or OEF veterans have been diagnosed with PTSD and both of these reports recommended that VA and DOD should aggressively prevent, develop early intervention strategies and treat PTSD [1-3]. Early treatment intervention for PTSD has been endorsed in other reports as well [4,5]. Disappointedly, several studied have documented that the rate of PTSD would be higher among troops who have been to Iraq more than once [5,6] and that PTSD, secondary to combat tours in Iraq, has been rated as the second leading cause of combat injury [1-3].

Because the PTSD diagnosis comprised a complex of symptoms, a combination of treatments is recommended [7]. A meta-analysis review of traditional PTSD psychotherapy (i.e., various forms of cognitive Behavioral Therapy, Stress Inoculation Training, Prolonged Exposures, EMDR and Reprocessing, etc.) reported only 44% of all those who entered treatment were classified as improved at the end of the treatment [8]. Milliken et al. [4] reported that soldiers, who were diagnosed with PTSD, and who received 3 or more sessions of mental health treatment had a 37% improvement rate; this 37% treatment response was not inconsistent with the response rate documented in other PTSD treatment studies [9,10]. Milliken et al. [4] concluded that, "in the context of the recent DOD task force finding, the 37% treatment response rate for PTSD is not optimal in military health clinics because soldiers are either not receiving a sufficient number of sessions or the treatment provided is ineffective." PTSD treatment with anti-depressant medications, such as selective serotonin reuptake inhibitors, infrequently results in patients achieving more than a 40% reduction in their Clinician Administered PTSD Scale (CAPS) scores, and most patients will still meet criteria for PTSD at the end of an adequate treatment trial [11]. In terms of treatment efficacy, some studies have suggested that combat-related PTSD may be more refractory than PTSD secondary to other traumas [12].

Recently, The Institute of Medicine concluded that only exposure therapy was recommended as the treatment for PTSD [13]. Virtual Reality Graded Exposure Therapy, with Physiological Monitoring (VRGET) is a promising exposure therapy that has been documented as an exceptional treatment for anxiety disorders and specifically for PTSD [7,14-18]. Wood et al. [17] utilized VRGET with participants diagnosed with PTSD secondary to their combat tour or tours due to the War on Terrorism. All warriors completed 10 sessions of VRGET and by the end of treatment, measurable reductions in PTSD, depression and anxiety were documented. Recently, Wood & Wiederhold [18] reported the treatment outcomes of 12 male participants, diagnosed with combat-related PTSD, who completed the 10 week VRGET Pilot study at Naval Medical Center San Diego (NMCSD) and Navy Hospital Camp Pendleton (NHCP). By the end of 10 sessions of VRGET, these participants experienced significant reductions in PTSD and depression and measurable reductions in anxiety.

Using previously published studies that have documented the effectiveness of traditional psychotherapy or Treatment as Usual (TAU) to treat combat-related PTSD [4,7-11] and the report [18] of the effectiveness of VRGET in successfully treating

combat-related PTSD, this study was designed to report the estimated cost effectiveness of VRGET versus TAU care for participants diagnosed with combat related PTSD. The VRGET participants received their VRGET mental health care at either NMCSD or NHCP.

1. Method

1.1 Participants

Twelve male volunteers met the DSM-IV-TR criteria for chronic PTSD [19] and these participants also met the study requirements for enrollment in the pilot phase of the VRGET study (see Table 1). All of these participants were members of the United States Navy or United States Naval Reserve. All but one of our participants were prescribed and were actively taking psychotropic medication prior to and following their enrollment in the Pilot VRGET study; all of our participants consulted with their Navy psychiatrist at least twice during the study period.

These 12 participants were originally diagnosed with PTSD, by a Navy psychiatrist, between January 2004 and August 2008; all of our participants initiated VRGET since March 2006. As part of the treatment protocol, VRGET was typically delivered over a 10 week period and treatment sessions each lasted 90 – 100 minutes. Each VRGET session was typically conducted one to two times each week by one of the authors (DPW) or by another civilian clinical psychologist.

Following the completion of their VRGET, three of our participants received a Medical Discharge secondary to their PTSD and co-morbid medical diagnoses, one participant received an Honorable Discharge due to his retirement from the Navy following 20 years of active service, one active duty and three Navy Reserve participants received Honorable Discharges upon their having reached the end of

RANK (a)	Military Specialty	AGE	Combat Tours	mTBI (b)	PSYCH MEDS	MED BOARD	STATUS (c)
04 - USN	Medical Officer	49	multiple	No	Yes	No	Active Duty/Deployed: Iraq
E-7 -USN	Corpsman	41	1	No	Yes	No	Retired/H.D./working
E-7- USNR	Seabee	45	2	No	Yes	No	HD/EOS/working
E-7 - USNR	Seabee	44	1	No	Yes	No	HD/EOS/working
E-7 - USN	SEAL	28	4	Yes	No	No	Active Duty/Naval Station
E-6 - USNR	Seabee	47	1 year	No	Yes	Yes	HD/working
E-6 - USNR	Seabee	40	1	No	Yes	Yes	HD/working
E-5 - USNR	Seabee	37	2	No	Yes	Yes	HD/working
E-5 - USN	Corpsman	32	1	Yes	Yes	Yes	HD/college
E-5 - USN	Corpsman	31	1	Yes	Yes	No	HD/EOS/working
E-4 - USN	Corpsman	25	1	Yes	Yes	No	Active Duty/Navy Hospital
E-4 - USN	Corpsman	29	2	Yes	Yes	No	Active Duty/Deployed: Iraq

Table 1. Demographic, 10 VRGET sessions completed and current status of the VRGET pilot participants (N = 12); (a) USN: United States Navy; USNR: United States Naval Reserve; (b) mTBI: mild Traumatic Brain Injury; (c) HD: Honorable Discharge; EOS: end of obligated service

enlistment or at the end of their recall to active duty and four of our participants have continued on active duty. Two of the participants, who remained on active duty, were subsequently re-deployed to Iraq and both have recently returned from their respective deployments.

1.2. Procedure

The Procedure has been previously described [16,17].

1.3. Clinical Measurement Instruments

The Clinical Measurement Instruments have been previously described [16,17].

1.4. Equipment

The equipment has been previously described [16, 17].

1.5. Treatment

The Virtual Reality Graded Exposure Therapy (VRGET) has been previously described [16,17].

1.6. Training Cost Assessment

The estimated cost of providing 10 VRGET sessions (i.e., approximately 15 hours of VRGET) to a participant, diagnosed with PTSD, and 4 hours of pre- and post-treatment assessment, involved approximately 19 hours of a clinical psychologist's time is assessed at $2,100.00[1]. For the purpose of this study, the cost of the VRGET 3-computer system, the VRMC software and the cost of training a clinical psychologist in Exposure Therapy and VRGET were not factored in as treatment costs.

Levy, Rattelman, Grefer et al [20] reported that Hospital Corpsman/Dental Corpsman (HMs/DTs) training represents a significant investment for the Navy. In terms of student costs alone[2], the Navy spends about $20,000 to train a general duty Hospital Corpsman. Further, Levy et al [20] assumed the following: (a) that all HMs/DTs attended boot camp and Basic Corpsman Training (i.e., A-school); (b) all HMs/DTs attend Field Medical Service School/Combat Medic Training (FMSS); and (c) the cost of recruiting a sailor was fixed at $1,000 per recruit. Hence, the minimal cost of training this Hospital Corpsman is $21,000. According to Levy et al [20], the cost of graduate medical education (GME) for a physician resident is $104,000 per year; two years of GME equals a training cost, to the Navy, of $208,000.

Even though all of the VRGET participants were not Corpsmen, we have assumed that the basic training costs for the eleven enlisted participants were similar and

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1 personal communication from Dr. Mark Wiederhold, February 13, 2009

2 Student cost is estimated to be compensation and PCS (moving costs associated with a change in duty station), calculated at the average student's Paygrade and prorated for the course length.

equaled a training cost of $231,000 (11 X $21,000). Combining the enlisted training cost of $231,000 with the GME training cost of $208,000, for the Medical Officer who completed VRGET, the total estimated training cost, to the Navy for the 12 participants who successfully completed VRGET (see Table 2), is $439,000.00.

ETC for 12 VRGET Participants	ETC Savings with TAU with 44% Treatment Effectiveness	ETC Savings with VRGET with 75% Treatment Effectiveness	ETC Savings: VRGET vs. TAU	ETC Savings of VRGET vs. TAU minus Cost of Clinical Psychologist (i.e., $21,600.00)
$439,000.00	$193,160.00	$329,250.00	$136,090.00	**$114,490.00**

Table 2. Estimated Training Cost (ETC) Savings due to VRGET at NMCSD and NHCP versus Treatment As Usual (TAU) for combat-related PTSD (N = 12) and ETC Savings for 5 Clinical Psychologists to treat 200 warriors with VRGET.

2. Results

The VRGET participants' clinical levels of PTSD and Depression significantly reduced and their level of anxiety measurable reduced from their pre-treatment assessment to their post-treatment assessment (18, see Figure 1). More specifically, at the end of 10 sessions of VRGET, 75% of the participants' PCL-M scores had reduced, with 75% of our participants' PCL-M scores equaled 49 or lower and/or they were assessed, by the evaluating psychiatrist (RLM), as not any longer meeting the DSM-4 [19] criteria for PTSD. Referencing the Estimated Training Costs for the 12 VRGET participants, the 75% VRGET effectiveness level equals an estimated training cost savings of $329,250.00 versus the estimated training cost savings of $193,160.00 for PTSD TAU (see Table 2). Hence, the estimated training cost savings of VRGET versus TAU, for PTSD, minus the cost of the clinical psychologist, is estimated to be $114,490.00 (See Table 2).

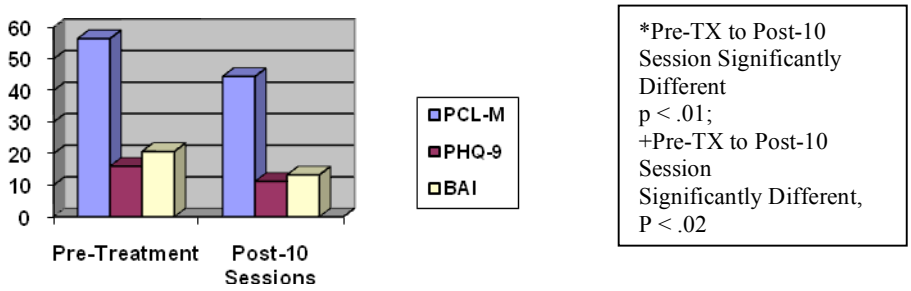

Figure 1. Results of Pre-TX and Post-TX PCL-M*, PHQ-9* and BAI Assessments (N = 12).

3. Discussion

In this era of reduced DOD mental health care resources and increased mental health care demand, secondary to the increasing number of warriors diagnosed with combat-related PTSD, there is an increasing emphasis on effective psychotherapeutic treatment that is cost effective.

The process of care for the combat warrior, diagnosed with PTSD, is being scrutinized in terms of the effectiveness of mental health care and the empirical support for the treatment that is being used [4,6–12]. The cost of mental health care for PTSD is high because of the long duration of care, the fact that less than 44% of those treated experience a measurable reduction in their PTSD severity and there is a lack of trained clinicians [1–3,6-12]. It is hoped that efforts to develop more effective PTSD treatments, such as VRGET, would ultimately result in more effective standardized clinical pathways and the development of guidelines for the appropriate use of the more effective standardized clinical pathways.

This study matched the clinical outcome of 12 volunteer participants, who received VRGET for combat-related PTSD at two Navy Hospitals (NMCSD & NHCP), with their estimated training cost data. A cost simulation analysis showed that the estimated measurable reductions in training costs, as a result of VRGET, could lead to substantial estimated training cost savings as compared to replacing those warriors who would otherwise have been medically discharged from the Navy due to the severity of their PTSD. With this study's VRGET pilot participants, after subtracting the cost of the treating clinical psychologists, an overall savings of $114,490.00 for VRGET vs. TAU was documented.

Importantly, the estimated cost savings of training, due to VRGET, did not include the recruiting costs, the actual cost of a recruit completing recruit training, the cost of housing allowances, medical care costs, advanced training costs or the inherent costs secondary to attrition (i.e., how many individuals have to enter recruit training, graduate from recruit training, start and complete "A" school in order to have a qualified Corpsman, Seabee or SEAL). Lastly, the cost of the VRGET hardware and computers and the cost for a clinical psychologist to receive VRGET training were not factored into the cost simulation.

Caution needs to be exercised in considering the results of this cost simulation analysis due to the small number of the VRGET pilot participants, the fact that these pilot participants were treated at two Navy Hospitals by two clinical psychologists and the fact that the TAU studies referenced [6,8-12] were not exhaustive. Further, the absence of a randomized VRGET study and the inherent possibility that our 12 volunteer participants' positive VRGET response was the result of a self-selection bias and this selection bias could be a reason for the reported therapeutic outcomes need to be considered. Hence, as recommended by Milliken et al [4], randomized trials need to be conducted evaluating treatment of warriors diagnosed with combat-related PTSD. Such a randomized study, comparing VRGET to TAU, is currently underway at NMCSD and NHCP. We must also caution that there are obvious limitations to the generalizability of these results to other PTSD treatment populations at other medical centers, military, Veterans Administration or civilian.

Acknowledgment

This study was sponsored by the Office of Naval Research (ONR) Contract (#N00014-05-C-0136) to the Virtual Reality Medical Center San Diego, CA.

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Neuropsychological and Virtual Reality Assessment in Topographical Disorientation

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Abstract. Although literature does not provide a unique explanation, the importance of hippocampus for human topographical learning and orientation is assumed to be relevant by most of the authors. There is considerable evidence that the hippocampus is necessary for acquiring cognitive maps of allocentric space, which includes topographical knowledge of large-scale real environments.
This study aimed to investigate neuropsychological and behavioral characteristics of topographical disorientation in a 71 years old patient, affected by an ischemic bilateral occipital lesion involving the hippocampus. Several assessment methods have been involved: neuropsychological test, paper and pencil test for the evaluation of topographical abilities, and a Virtual Reality tool. Experimental evidences for the value of an integrated evaluation approach in underlying spatial orientation difficulties are provided.

Keywords. Topographical Disorientation, Hippocampus, Neuropsychological Assessment, Virtual Reality.

Introduction

Topographical Disorientation (TD) refers to the inability to find the way into familiar or unfamiliar environments [1,2].

There are relatively few studies including a comprehensive and situated assessment of the topographical abilities in patients with TD.

A number of cognitive dissociations within this disorder, involving the relative preservation or impairment of topographical and spatial abilities sub-components, has been found between retrograde and anterograde memory, egocentric and allocentric perspectives, visual imagery, and geographical abilities**.**

An exhaustive investigation of orientation abilities can be useful in order to identify specific disorders in patients affected by TD and to define focused and effective rehabilitation programs [3]. Virtual reality (VR) environments, in particular, constitute an interesting opportunity for the evaluation of topographical disorientation, providing a representation of a dynamic nature and interactive environments [4].

1. Case History

L.M. (71 years old, man) suffered from a cortico-subcortical bilateral ischemic lesion into occipito-temporal lobe involving bilateral hippocampus. Soon after the hospital discharging the patient referred the presence of topographical disorientation (TD): he was unable to find the right way into both familiar and novel environments.

After a two-month rehabilitation training focused on topographical abilities and the education of compensatory strategies, several improvements in functional aspects of daily living were observed, although topographical disorientation did not ameliorate.

2. Methods

Visuo-spatial and orientation abilities of L.M. were tested employing several approaches: typical neuropsychological tests, an assessment of topographical abilities by paper and pencil test and a virtual version of mazes.

2.1 Neuropsychological evaluation

A comprehensive neuropsychological evaluation assessing general cognitive abilities, verbal and visuo-spatial memory, language, praxic, attentional, perceptive and planning abilities, *geographical abilities, Right-left orientation, forward and backward word spelling* has been administered. The evaluation of topographical abilities consists of:

- *Ecological evaluation of retrograde/anterograde topographical memory:* the patient was asked to describe 32 of familiar and unfamiliar routes, starting from home, going to a certain place, and starting from a certain place going back home. Routes were temporally graded according to the life period they were learned and experienced (childhood, adolescence, adult life, late life).
- *Learning of subsequent paper and pencil mazes*: 8 mazes were presented three times each. The decrease in execution time during the successive presentations was calculated and conceived as due to implicit learning.
- *Map reading and route learning into a written map:* a written map, enriched with landmarks and labels, was presented, asking the patient to follow a spoken route. In a subsequent step, patient was asked to trace from memory the same route in a map without labels.

2.2 Virtual reality

The VR-Maze test was based on the Wisc-R Maze subtest [5]. Patient was requested to first perform the allocentric paper and pencil version of eight mazes (see figure 1), and after to use them in order to find the right way into the equivalent egocentric VR version of the maze (see figure 2). Execution times were recorded for each of the eight mazes

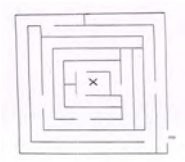

Figure 1. A picture of a paper and pencil maze

Figure 2. A screenshot of a virtual maze

3. Results

Not regarding standardized tests (manikin test, backward and forward word spelling, VR task, learning of paper and pencil mazes), a patient's performance was compared to that of a 10-subject control group, matched for age and schooling.

L.M. showed impairment in visuo-spatial (Corsi Supra Span, Rey's Figure Copy and Recall and Trail Making Test) and executive functions (Tower of London).

Deficits were more evident in the recovery of geographical information, in learning of new topographical information (learning of paper and pencil maze and route following/learning into the map), in spatial working memory abilities (backward spelling). In the VR task, a deficitary transfer of allocentric information to an egocentric perspective was found. The patient was able to perform the paper and pencil version, while he managed to complete only one virtual maze. Besides, execution times for both versions were slower with respect to control subjects.

The description of known and un-known routes was unimpaired.

4. Conclusions

Patient's performance showed a clear dissociation between verbal learning abilities (preserved) and visuo-spatial and topographical memory capacities (severely impaired). This represents an unintuitive result, considering the bilateral hippocampal damage, which usually does not reveal a lateralization in the cognitive impairment.

TD resulted to be more evident in the recovery of geographical (Italy map test) information; in the learning of new topographical information (learning of paper and pencil maze and performance into the VR mazes task); in spatial working memory abilities (backward spelling) and in the map reading/route-learning task.

The unimpaired description of known and un-known routes can be due to the major involving of verbal memory abilities in this task, and only a minor role of spatial and topographical ones.

The integrated assessment approach allowed us to highlight patient's everyday spatial disorientation and to contribute to the debate of the role of hippocampus in a selective impairment of visuo-spatial learning in TD [6].

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A Rehabilitation Protocol for Empowering Spatial Orientation in MCI. A Pilot Study.

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Abstract. Spatial navigation is among the first cognitive functions to be impaired in Alzheimer's disease [1] and deficit in this domain is detectable earlier in patients with Mild Cognitive Impairment [2]. Since efficacy of cognitive training in persons with MCI was successfully assessed [3], we developed a multitasking training protocol using virtual environments for stimulating attention, perception and visuo-spatial cognition in order to empower spatial orientation in MCI. Two healthy elders were exposed to the training over a period of four weeks and both showed improved performances in attention and orientation after the end of the intervention.

Keywords. Mild Cognitive Impairment, Visuo-spatial Cognition, Spatial Orientation, Virtual Reality

Introduction

Mild Cognitive Impairment (MCI) is a syndrome that is currently thought of as a transition phase between cognitive ageing and dementia [4]. Cognitive performance in individuals diagnosed with MCI is deficient relative to that of age- and education-matched control subjects [5], but it does not meet the criteria for dementia yet. 20-50% of patients with MCI will develop dementia over a period of 2-3 years, but whether or not a case converts to AD, MCI in and of itself may be a cause of disability in frail elders and thus may be an important target for screening and possible intervention [6].

Previous research suggests that plasticity still exists in patients with MCI [7] and that they can improve their performance (for example on episodic memory and/or attention) when provided with cognitive training [3]. Spatial navigation has shown to be early impaired in MCI, potentially leading to limitation in independent living. Nonetheless, there is no record of any program of intervention addressing spatial orientation in MCI.

1. Methods

We designed a training protocol aimed to stimulate and improve attention, perception and visuo-spatial cognition in persons diagnosed with MCI. The program is highly individualized and is divided into two main units, each one composed by six one-hour-

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sessions. It covers a period of eight weeks. Six different virtual environments were adapted for the protocol, using the open-source software NeuroVR. Every session takes place in an environment close to the everyday experience of the patient, such as a flat, a supermarket, an office or a park, the city-centre. The subject is required to walk and execute several tasks on the base of a narrative plot.

The protocol includes over 80 different exercises referred to following cognitive functions: spread and divided attention (through visual and/or acoustic cues and distractors), visuo-spatial perception (location of points in the space, appreciation of dimensions, orientation or distance of an object, etc), spatial cognition (recognition of shapes, mental rotation, etc), navigation (way-finding and cognitive mapping). Each cognitive function is stimulated by a specific group of exercises.

Neuropsychological performance and psychological status are assessed for each patient at baseline, at the end of the first unit, at the end of the whole program and after two months. The test battery includes among others MMSE, GDS, Trail Making Test part A and B, Stroop Effect Test, Standardized Money Road-Map-Test. Furthermore, attention and orientation are evaluated at the beginning and at the end of every single session.

The training is individualized by varying the levels of difficulty in visuo-spatial attention and/or spatial orientation tasks. Entry level of each patient is determined by the neuropsychological results at the baseline and may change during the training according to the performance in the visuo-spatial attention and orientation tasks of every session.

2. Results

A pilot trial of the protocol was conducted on two healthy elders (F, 65 and 73) over a period of four weeks. Their performance was assessed at the beginning (T_0) and at the end of the training time (T_2). Both individuals have obtained improved achievement in attention and especially in orientation. As far as attention is concerned, mean scores improved of 10 percent at Stroop Effect Test and at TMT part A, and of 5 percent at TMT part B. Referred to orientation, the performance at the Standardized Money Road-Map-Test improved for both subjects with a 50 percent decrease of errors (see Table 1).

This trend is similar to the one we observed inside the virtual environments, where visuo-spatial attention and orientation were measured. In order to assess the performance, several different parameters were considered: number of errors and/or omissions committed across the virtual environment, efficiency with which the subject fulfilled the intended purpose, time required to execute all the tasks foreseen for the session, number of times the subject asked the researcher for help (in case of confusion, disorientation or trouble). Orientation was the function showing the biggest improvement (see Figure 1).

Table 1. Performances of the 2 subjects (mean scores): baseline vs end of training program.

Test	T0	T2
TMT-A (sec)	84,0	75,5
TMT-B (sec)	202,0	189,5
STROOP (sec)	128,0	111,0
ROAD MAP (errors)	10,0	5,0

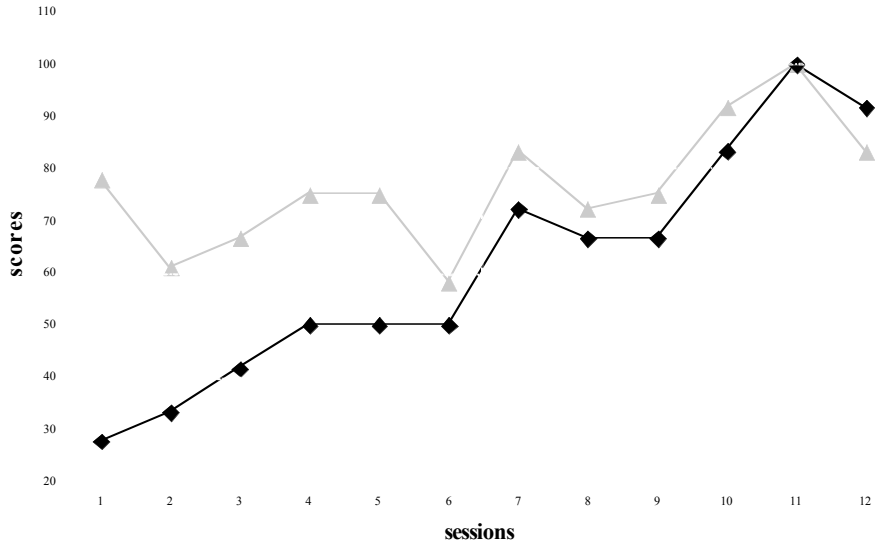

Figure 1. Evolution of the performance produced by the two subjects inside the virtual environments (scores at orientation tasks, sessions 1 to 12). ▲ = subject 1 (F, 65) ◆ = subject 2 (F, 73).

3. Conclusion

The pilot study suggests that the training protocol was able to produce improvement in targeted areas (orientation and attention) in two healthy elders. Our aim is to exploit the protocol on a sample of individuals diagnosed with MCI and early Alzheimer's disease during the second semester of 2009.

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Semantic and Gender Priming in Frontotemporal Dementia

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Abstract. Modifications of language processing can be observed both in normal aging and in the most common forms of degenerative dementia, such as Alzheimer's disease and the spectrum of frontotemporal dementias. The present experiment tests at the same time semantic and syntactic aspects of language processing in patients with frontotemporal dementia, using an online paradigm that allows researchers to evaluate the real linguistic competence of the patients.

Keywords. Semantics, gender, priming, frontotemporal dementia

Introduction

Priming is largely based on automatic processes, that enable to bypass execution deficits, such as slowed motor response, proper to healthy older people and patients suffering from cognitive deterioration. Semantic priming is the facilitation induced by a prior activation of items semantically related to the target, and results in faster responses to the target if compared to a baseline condition. In gender priming, the facilitation is due to the gender agreement between the prime and the target. Semantic and gender priming have been studied on young people by Bentrovato [1]: they found a large, additive facilitation effect of both gender and semantics. These results were taken to indicate that normal subjects could take advantage of both source of information, with no significant interference when they are both discordant. The same procedure, then, has been applied in a sample of patients with diagnosis of Alzheimer's Disease (AD), compared with a sample of normal aging subjects [2]. Researchers found effects of facilitation due to the concomitant congruence of both gender and semantics in both the groups; by opposite, a striking difference between controls and patients was discovered, when both information (semantic and gender prime) were discordant. An interference effect appeared, suggesting that AD patients could feel the effect of difficulties in inhibiting irrelevant information. The present study aimed to test

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gender and semantic priming in a sample of patients suffering from different variants of frontotemporal dementia.

1. Methods

Twentyfour patients with diagnosis of frontotemporal dementia, who received a complete neurological and neuropsychological evaluation, entered this study. The test used was the Italian Word Reading Test [1]: it is featured by brief two-sentences stimuli, orally presented, with a visually presented target word. Auditory sentences provide the semantic and gender context and represent the primes. The sentence context ends with an article, that provides gender cue and precedes the target word. Different priming conditions have been created manipulating semantic and gender agreement. Table 1 illustrates examples of the sentences used in each condition.

Subjects were seated in front of a computer screen, wearing headphones with a microphone, that were connected to the sound amplifier port of the computer. Response times were collected in milliseconds through the Carnegie Mellon Button Box. Experimental design was implemented on Psyscope [3].

Subjects were instructed to listen carefully the auditory sentence context looking at the fixation point (++) on the screen and, when the sentence was halted, to read as quickly as possible the word appeared in the place of the fixation point.

Table 1. Examples of prime-target pairs for each condition

Prime		Target	Prime	Condition
Quando vado a letto prima di addormentarmi leggo sempre (*when I go to bed before falling asleep I always read)*	UN (masc) UN (masc) UNA (fem) UNA (fem)	LIBRO *(book)* TOPO *(mouse)* LIBRO *(book)* TOPO *(mouse*)	per questo mia mamma mi ha regalato una collezione di romanzi gialli	**G+S+** **G+S-** **G-S+** **G-S-**
Silvia ha fatto un test in inglese: doveva ripetere *(Silvia took a test in English: she had to repeat)*		LIBRO *(book)*	per 5 volte. L'insegnante ha detto che è l'unico modo per migliorare la pronuncia (*five times. The teacher said that was the only way to improve her pronunciation)*	**NN**

2. Results

In order to assess the effect of gender and semantic congruence, a 2X2 Anova within-subjects was conducted. The results indicated an effect of gender [$F(1,23) = 5,608$; $p = 0,023$] and semantics [$F(1,23) = 14,567$; $p = 0,001$], while the interaction gender X

semantics was not significant [F(1,23) = 3,810; p = 0,063]. At this point it was important to determine the direction of priming; to do that, we compared reaction times of each condition with the ones of the neutral baseline. Four independent sample t-tests were conducted: a significant facilitation was observed for the G+S+ condition [t (23)= 3,706; p= 0,001]; no other condition reached significance, even if G-S+ and G-S- showed a trend close to significance in opposite effect direction (respectively facilitation and interference) [G-S+: t (23)= 1,913; p=0,068], [G-S-: t (23)= -1,900; p=0,069].

3. Conclusion

The present findings indicate that frontotemporal patients behave similarly to AD patients for what concern language processing: in fact in both groups, a significant facilitation due to concomitant congruence of gender and semantics was found. The lack of interference effect in FTD when there is a complete incongruence (G-S-) is in contradiction with one of the main feature of frontal lobe disease, that is the difficulty to inhibit irrelevant information; this result could be explained considering the small size of sample.

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Assessment of Inhibition Deficits with the Virtual Classroom in Children with Traumatic Brain Injury: A Pilot-Study

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Abstract. This study compared the performance of 8 children who have sustained a traumatic brain injury on the traditional VIGIL Continuous Performance Test and the Continuous Performance Test included in the Virtual Classroom. Results supported the hypothesis, showing that the Continuous Performance Test from the Virtual Classroom showed more sensitivity concerning inhibition deficits. More precisely, children showed more commission errors and longer reaction time. These results can be explained by the ecological character of the Virtual Classroom, meaning that this instrument is close to real-life experiences and requires more attention and inhibition resources.

Keywords. Virtual Reality, Virtual Classroom, Children, Traumatic Brain Injury, Inhibition Deficit

Introduction

Traumatic brain injury (TBI) represents the most reported neurological injury in children. It generally involves attention, inhibition, working memory, and processing speed deficits [1]. It is expected that attention deficits are closely related to learning and school performances. Furthermore, attention assessments must be sensible, complex and cognitively demanding, so subtle deficits can be identified with neuropsychological evaluations.

Traditional neuropsychological assessment makes it possible to represent cognitive impairment, but many doubts remain concerning the representativeness of the actual functioning in everyday life. Virtual Reality (VR) brings a plus to current neuropsychological instruments and answers criticisms raised, mainly because it invites the user to interact in real-time three-dimensional environment equivalent to normal daily situations, with no risk of harm, all simulated by a computer. The participant therefore goes in immersion with the help of a visor on which the virtual environment is projected. This technique has many advantages of which the most outstanding are the improvement of the sensibility and ecological validity of the instrument. This particular

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context of evaluation makes it possible to seize the child's real potential and functioning since he is left by himself to behave naturally.

In 2000, Rizzo et al. [2] developed the Virtual Classroom to evaluate attention in ADHD children. This particular virtual environment includes a Continuous Performance Test into a Virtual Classroom. The child must carryout the task, presented on the chalkboard of the classroom, while resisting distractions similar to a real classroom. The environment has been completely redesigned by Digital Mediaworks [3]. Although initially developed for children with ADHD, the Virtual Classroom is an interesting instrument for the assessment of attention with children who have undergone a traumatic brain injury.Objective: the objective of this study was to compare the performance given by children with a Traumatic brain injury (TBI), which generally involves attention deficits, on the traditional VIGIL Continuous Performance Test to the Continuous Performance Test included in the Virtual Classroom.Hypothesis: it is expected that the Virtual Classroom will show more sensitivity concerning attention and inhibition deficits than the traditional VIGIL Continuous Performance Test because of its ecological nature.

1. Method

1.1 Subjects

The sample is composed of 8 children from 8 to 12 years with a TBI.

1.2 Tests

- The Virtual Classroom [2] [3];
- VIGIL Continuous Performance Test [4].

Variables drawn from these tests: total of omissions, total of commissions, and reaction time.

2. Results

Mean comparison tests with repeated measures were used to compare the output of children with a TBI concerning the number of omissions, the number of commissions and the reaction time, on the traditional VIGIL Continuous Performance Test and the one from the Virtual Classroom (VIGIL CPT vs. CPT from the Virtual Classroom). Table 1 shows the children's mean for each of the variables: total of omissions, total of commissions, and reaction time.

There was no difference between the two kinds of CPT on the total of omissions. However, paired t-tests showed that children made significantly more errors of commission and that their reaction times were significantly longer in the CPT of the virtual classroom compared to the traditional CPT.

Table 1. Means and standard deviations for the group on the standard VIGIL CPT and the CPT from the Virtual Classroom and results for the paired t-tests (*N = 8*)

	VIGIL CPT		Virtual Classroom CPT		Paired t-test
Variable	Mean	SD	Mean	SD	
Omission (total)	6.8	5.1	6.6	3.0	0,06
Commission (total)	3.6	3.7	10.5	6.8	-3.56**
Reaction Time (msec, mean)	319.1	38.9	449.4	72.7	7.67***

** p < .01, *** p < .001

3. Discussion

Using a virtual environment as an assessment tool represents a revolutionary practice and little is explored in this field in neuropsychology, especially in children with TBI.

Results from this study support the hypothesis, showing that inhibition problems in children with a TBI are more important in the Virtual Classroom CPT that the VIGIL CPT. Thus, the evaluation approach based on Virtual Reality is more sensible to the repercussions of a TBI than the VIGL CPT. These conclusions can be explained by the ecological character of the Virtual Classroom, meaning that this instrument is close to real-life experiences and requires more attention and inhibition resources.

Errors of commission are associated with a deficit of inhibition. It is particularly interesting to demonstrate this kind of deficit in children who have sustained a traumatic brain injury as the impact of frontal areas are associated with such deficits.

However, it is important to be careful in the interpretation of these results because of the few TBI participants and the absence of a control group. Others aspects than the ecological characteristics of the Virtual Classroom could explain these results. It seems important to pursue this type of work.

Acknowledgment

The authors would like to thank Mr Roman Mitura from Digital Mediaworks (Canada), and Dr. Rizzo from University of Southern California (USA), for their authorization to use the Virtual Classroom.

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A NeuroVR based tool for cognitive assessment and rehabilitation of post-stroke patients: two case studies

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Abstract. Neuropsychological disorders are common in stroke patients, ranging from an isolated impairment to impairment in multiple cognitive functions. The cognitive domains affected are in particular executive functions. These comprise planning, organising, conducting, assessing and controlling actions. Dual task abilities, that is the ability to perform successive or simultaneous tasks, are not easy to be evaluated and recovered by traditional paper and pencil methods, due to their ecological and contextual nature. NeuroVR 1.5 is a cost-free virtual reality platform based on open-source software, allowing professionals to easily modify a virtual world, to best suit the needs of the clinical setting.The present study was designed to develop and test a NeuroVR based tool for the rehabilitation of shifting of attention and action planning functions using tasks reminiscent of daily life tasks. We present the virtual environment and the cognitive procedure we developed, discussing two stroke patients case studies, which underwent an integrated neuropsychological and VR assessment.

Keywords. stroke, executive functions, NeuroVR 1.5, virtual reality, daily life tasks.

Introduction

An incidence of stroke is often followed by cognitive impairment [1]. The affected cognitive domains are in particular executive functions, psychomotor abilities and attention. Executive function comprises planning, organising and controlling actions. They also involve the ability to perform successive or simultaneous tasks, which is a necessary everyday life ability, not easy to be evaluated and recovered by traditional paper and pencil methods [2].

Starting from these observations, we developed a Virtual Reality (VR) task for the cognitive assessment and treatment of people with focal brain lesions due to stroke.

1. The virtual supermarket

A cognitive procedure, conceived as a hierarchical sequence of tasks, starting from a single-task condition and ending with successive multiple tasks, has been implemented in a virtual supermarket.

The virtual environment is a supermarket developed via the NeuroVR software [3] and displayed on a desktop monitor. It consists of a Blender based application enabling the active exploration of a virtual supermarket where users are requested to select and buy various products presented on shelves (see Fig. 1). The user enters the supermarket where he is presented with icons of the various items to be purchased. With the aid of a joypad, the participant is able to freely navigate in the various aisles (using the up-down joypad arrows), and to collect products (by pressing a button placed on the right side of the joypad), after having selected them with the viewfinder. Audio announcements are available and can be used to introduce additional tasks while the user is engaged in the primary task (shopping).

For the attention shifting procedure we established two main rules that subjects have to satisfy: (1) a primary rule according to which participants have to purchase a list of four supermarket products in a pre-set order and (2) a secondary rule, which increases in its difficulty with respect to the collection order and number of items. Thus 4 different conditions were created. The first condition was composed of the initial three trials (1 to 3) which consisted of a simple collection task, while the following trials involved a change to the primary rule, in terms of the order of items to be collected (condition 2; trials 4 to 6), the number of items to be collected (condition 3; trials 7 to 9), and combinations of order and number (condition 4; trials 10 to 12). A final trial (number 13) was added, constituted by the same combination of order and number, with more than two objects involved in the change. It represents a higher level of complexity, introduced in order to investigate participant performances in a more complex situation, providing interesting information to be used for further investigation.

A trial is considered correct only when no errors are committed by the subject; a maximum of three attempts for each trial are allowed, represented by same trial, but with different objects.

Execution times and errors are recorded for each trial or attempt (when subjects need more than an attempt to complete a trial) and condition, together with the complexity level reached by each subject.

Figure 1. A screenshots of the virtual supermarket.

2. Two case studies results: a neuropsychological and VR evaluation

Two patients, suffering from an ischemic brain lesion and referring to our Institute Stroke Unit, were enrolled, in order to evaluate the virtual shopping task feasibility.

A clinical and neuropsychological evaluation was conducted, both for inclusion criteria and data collecting referred to patients cognitive profile.

The Mini Mental State Evaluation was used to assess the general cognitive level, the Behavioural Inattention Test was used for visuo-spatial assessment. For memory evaluation we used the Corsi's memory span and supra-span, the Digit span, the Short Story recall and the word recall test. Executive functions and attention abilities were assessed by the Tower of London Test, the Frontal Assessment Battery, the Trial Making Test (form A and B), the Stroop test. For object recognition and denomination we used the Street Completion Test, the phonemic and semantic and fluencies and the Token test.

Two sessions were scheduled for each patient: during a first session they underwent the complete neuropsychological assessment, while in the second one (one week later maximum) the virtual reality task was administered.

A training period was first provided in a smaller version of the virtual supermarket environment in order to familiarize participants with both the navigation and shopping tasks. The assessments and training session took about 75 minutes. If the subject was unable to achieve success in a trial after three attempts, the dual task procedure was stopped.

2.1 Case Study 1

DS, a female patient aged 59 years, was recruited for the study. She was admitted in the Stroke Unit after a transient ischemic attack (TIA), and left the hospital one week later.

At the neuropsychological evaluation (see tab. 1) the patient performed above average on most of tests, showing a low (at inferior limits of average) score at Short story recall test and Trial Making Test, part (B-A). These tests respectively measure episodic memory and divided attention abilities. She also obtained a low, but not deficitary, score at the Token test and Street completion test.

When presented with the VR task, DS easily learned to use the joypad and was able to navigate and collect objects into the virtual food-market, developed for the training. On the contrary, her behaviour during the progressive collection task highlighted the presence of severe memory and attention deficits. She managed to correctly complete the first condition (simple collection task), and the second one (change in the order of items to be collected). When she entered the third condition, which requires participants to keep in mind and later retrieve the right number of items to be collected, she hasn't been able to perform the task. She needed more than one attempt to complete the trials, for both this and the successive condition (combination of products order and number change). Finally, she hasn't been able to complete the last trial, constituted by the same combination of order and number, with more than two objects involved in the change. After three attempts to perform this trail, the task was stopped; DS managed to reach the last level of complexity, but she didn't complete it, making 7 errors totally. She took about 40 minutes to perform the virtual shopping task.

Since no evident cognitive impairment emerged at the neuropsychological evaluation, the patient poor performance on the VR shopping task seems to have

highlighted her difficulties. This can suggest that the procedure we developed represents a higher and more sensitive level of difficulty with respect to traditional evaluations.

2.2 Case Study 2

CM, a female patient aged 72 years, was recruited for the study. She was admitted in the Stroke Unit in July 2008, after an ischemic stroke in the right hemisphere, and left the hospital one week later.

At the neuropsychological evaluation the patient showed the presence of poor attention and memory difficulties (see tab.1). She obtained deficitary scores at the Stroop test (a selective attention measure) and Short Story recall. She also performed at the average inferior limits at Trial Making Test, a divided attention measure, Frontal Assessment Battery, evaluating executive functions, and Corsi Supra Span, evaluating visuo-spatial learning abilities.

Since CM cognitive difficulties affected several cognitive functions, we expected to observe a clear impaired performance on the VR task, since it simulates an ecological and complex real life situation.

When presented with the VR task, CM employed much time and effort to learn using the joypad and navigating into the virtual environment. Even if she managed to move into the virtual supermarket, a lack of fluidity was evident during the task execution.

CM correctly completed the trials composing the first condition (simple collection task), while she had many difficulties in performing the second one (change in the order of items to be collected). She wasn't able to remember the information provided by mean of the audio announcement, even after the same piece of advice was repeated more times. Since neuropsychological evaluation showed both memory and attention difficulties, probably the problem was not only in encoding, but also in the retrieval process. Since also executive functions resulted impaired, an effective action strategy has not been implemented.

She didn't manage to complete the trial number 5 with less of three attempts and, 25 minutes after the beginning, the task was stopped.

Tab. 1 CM and DS Neuropsychological tests scores

NEUROPSYCHOLOGICAL TESTS	CORRECT SCORES		EQUIVALENT SCORES	
	CM	DS	CM	DS
MINI MENTAL	24,7	27,74	Normal	Normal
STROOP TEST colour naming	28	38,7	0	2
STROOP TEST interference	13,2	19,4	1	3
BIT	141/146	144/146	Normal	Normal
FAB	14,3	15,8	1	3
TMT Part A	34	46	4	3
TMT Part B	155	172	2	2

TMT Part (B-A)	122	126	1	1
PHONEMIC FLUENCY	35	30	4	3
SEMANTIC FLUENCY	31	44	2	4
DIGIT SPAN	4,5	24	2	Normal
PAIRED WORS	7,5	5,5	1	4
CORSI SPAN	4,5	12,5	3	4
CORSI SUPRA SPAN	6,24	4,5	1	3
SHORT STORY REC	7,5	18,67	0	3
TOKEN TEST	31,75	9,5	3	1
STREET C. TEST	5,75	29,25	3	1

Equivalent score: 1 (deficitary); 2 (average inferior limits); 3 (above average); 4 (fully above average)

3. Conclusions

The two described case studies show that our VR task can integrate the traditional neuropsychological evaluation of patient, adding relevant behavioural and functional information. This information is in particular important for rehabilitation purposes, since it ecologically reflects patient behaviour in complex real life situations.

In such a way, NeuroVR 1.5 allows to build person-oriented interventions, since it provides information about both cognitive/behavioural difficulties, and alternative cognitive resources which can be employed to achieve a desired outcome.

The possibility to choose between several scenes and customize them by adding audio, videos and objects makes easy to re-create meaningful situations for the subject, augmenting the sense of presence and facilitating the rehabilitation effectiveness and generalization to the real world.

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Designing an Ecological and Adaptable Virtual Task in the Context of Executive Functions

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Abstract. Brain damage is a major cause of disability that often leads to deficits in Executive Functions (EF) with dramatic consequences on activities of daily living. While rehabilitation approaches of the dysexecutive syndrome are still limited, Virtual Reality (VR) has shown its potential to propose innovative intervention strategies based on ecologically valid functional tasks. The purpose of this paper is to present the design process of the Therapeutic Virtual Kitchen (TVK) in which ecological and adaptable virtual tasks may be configured by the therapists for patients' assessment and rehabilitation. The outcomes of a preliminary test of feasibility among members of our laboratory and Kerpape Rehabilitation Center are reported and discussed.

Keywords. Brain damage, Executive Functions (EF), Virtual Reality (VR), Ecological task, Adaptable task

Introduction

Executive functions (EF) are the high-level cognitive processes that are required to perform complex or non-routine tasks [1]. Deficits in EF, known as the dysexecutive syndrome, may be the consequence of brain damage, such as stroke or traumatic brain injury [2]. They refer to a collection of impairments in the sequencing and organization of behavior, and include other problems in attention, planning, or multi-tasking [3-5]. People with EF evince handicaps in performing complex daily living activities, known as Instrumental Activities of Daily Living (IADL) [6,7]. Many tests have been developed to assess different aspects of EF [8]. The use of functional tasks, like the Multiple Errand Test (MET) [9], is the preferred method, as they have ecological validity. But they are often time consuming, expensive to perform and must be carried out outside the clinic.

Virtual Reality (VR) has now emerged as a promising tool in the therapeutic field and a wide range of studies has shown the feasibility of using VR for cognitive care [10,11]. Brooks et al. [12,13] reported its use in memory assessment and rehabilitation. Rizzo et al. [14] designed a virtual classroom and a virtual office for attention and memory evaluation. Recently researchers have investigated the potential of virtual

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supermarkets [15-17] or virtual kitchens [18-20] to evaluate and train executive functions during IADLs. For example, the SOFTHAVEN™ system was designed by Christiansen et al. [21] to teach and assess basic life skill performance (e.g., meal preparations) to persons with traumatic brain injury (TBI). Zhang et al. [19] found that this VR environment was a good predictor for the actual kitchen performance.

In the context of our collaboration with Kerpape Rehabilitation Center and in order to provide the patients with dysexecutive syndrome more opportunities of training, we developed the Therapeutic Virtual Kitchen (TVK) in which we implemented an ecological and adaptable VR-based task. The purpose of this paper is to present the design process of the TVK project and its preliminary evaluation among our laboratory members and Kerpape Rehabilitation Center members.

1. Method

1.1. Participants

Three women and 3 men – either graduate students or laboratory staff members, and 3 persons from Kerpape Center – 2 female therapists who work with brain injury patients on a daily basis and 1 male computer scientist, participated in the experiments. All of them had computer experience. Since the intention was to gather experiences and show the potential of the TVK, it was considered too early to include patients.

1.2. Instrumentation

The first step of the design process was to collect the clinical habits and the needs of the therapists related to EF exploration, and then to design the Therapeutic Virtual Kitchen (TVK) that is graphically very close to the kitchen of the Center, with its standard objects and appliances (Figure 1). The TVK is also functional since most of the 3D objects needed in meal preparation are endowed with behaviors, and ensure interaction of the participant within the virtual environment. Real sounds are provided according to the activated 3D objects, in order to increase the feeling of immersion within the virtual kitchen. According to our objective of low cost devices use, participants navigate and interact using respectively the keyboard arrows and the mouse.

The general virtual task, initially selected by the therapists, is related to the preparation of a coffee. Both planning of all the steps of this "complex" task and spatio-temporal organization are required so that the participant carries out the task. The TVK offers the therapist various possibilities to individualize the task (e.g., time constraint) and to adapt it to the capacities of the participant (e.g., number of cups to prepare) or to the therapeutic purpose (assessment or rehabilitation). According to the configuration of the task, help can be provided to the participant via visual or auditory cues. One of our challenges is to design the assessment of the participant's performance according to the practice of Kerpape therapists (e.g., action omission, action addition) in order to provide the therapists a VR-based assessment template. We used the Virtools™ Life Platform (www.virtools.com) to integrate the scenario and the interactivity as well as to ensure participant's immersion.

Figure 1. Kerpape real kitchen and the TVK

1.3. Design issues

While designing the TVK and the "coffee task", we had to address some basic issues related to the primary tasks, to the graduation of the task and to the modalities of interaction (Figure 2).

Primitive tasks are available in the TVK to insure the familiarization of the participant to the system and tools, but also to provide simple tasks, which can be proposed before engaging the patient in the complex "coffee task". Visual cues are given to facilitate the understanding of the interaction opportunities, like the modification of the mouse cursor when an item is "pickable."

In the TVK, graduation of the "coffee task" is ensured by various parameters, like: 1) number of cups to prepare (from 1 to six), for counting requirements; 2) time's constraint, for time organization and stress induction; and 3) position of the required items (easy: all are ready at the right place; medium: all are on the table; hard: necessity to fetch all the items in the cupboards).

Due to the various items positions, we worked on interaction metaphors to represent the action "take and put". We proposed various solutions: 1) use of an inventory, like in video games (with one item or two items); 2) use of "Drag and drop", like on PC desktop; and 3) stick of the item on the mouse cursor after its selection ("Stick on mouse").

1.4. Procedure

The participants were made aware that the purpose of the experiments was to assess the functioning of the VR-based system and the feasibility of the tasks. During a training session, they were asked to perform some primitive tasks (e.g., search of a utensil), and then during a second step to carry out the "coffee task" for two persons within 20 minutes, all this by using the keyboard arrows to navigate and mouse clicks to interact. All their actions and time were recorded. They were then asked for criticism about the system as well as to give suggestions about further developments.

Figure 2. Water measurement and "Stick on mouse" interaction

2. Results

This first study allowed us to assess various conditions of experimentation within the TVK. At first, the participants succeeded in the configuration of the task that allows an adaptation of the task according to various parameters, like time constraint or items position.

If the Lab members appreciated the inventory with two items and so the possibility to anticipate actions, it was considered too difficult by the therapists for TBI patients. They preferred what we called the "Stick on mouse" way of interaction.

The "primary" tasks were considered useful for familiarization with the system, the spatial context and the metaphors of interaction. The therapists made suggestions for new developments in order to propose various possibilities of training, notably with objects, which are not related to the "coffee task".

All the participants succeeded to perform the "coffee task", with or without the helping cues. It appears that the manual helping cues provided by the therapist seem better than temporal helping cues delivered by the system because of the difficulty to sometimes understand the intention of the participant. The results show that an average time of 9.2 ± 3.9 minutes is required to complete the task, from 5.4 minutes when the items are on the table to 15.7 minutes when it is necessary to look for them.

The "coffee task" is a complex task with at least 16 steps. If the chronology of some steps is obvious (you have to put a filter before putting the spoonful of coffee), no chronology is required for other ones (you may put the cups on the table before or after having prepared the coffee). Due to this issue of chronology, the suggestions of the participants (sometimes related to their habits) will be useful to improve the management of the unfolding of the task.

3. Conclusion and Novelty

We reported the design process of an ecological and adaptable VR-based task in the TVK whose final objective is to address EF rehabilitation and to explore the capacities of transfer from virtual world to real world. Results of our preliminary study highlighted some forces and weaknesses of the TVK, the feasibility with control subjects, and showed the way for further developments.

Since, we improved the system and we worked on the addition of new components such as the delivery of a final virtual scale of evaluation based on the traditional scale used in Kerpape Rehabilitation Center. An analysis of the recorded data will be provided as well as an assessment of the unfolding of the task performed by the participant in order to provide a performance indicator and to follow the progress of the participant along the interventions. A clinical trial among patients with TBI is scheduled in April 2009.

The achievement of these developments will provide effective observation of the patient's activity, and will lead our clinical partners to novel therapeutic practices.

Acknowledgments

We thank Laval authorities (Laval Agglomération and Conseil Général de la Mayenne) for their support and Emissive company for the 3D modeling of the TVK.

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Cognitive Therapy Using Mixed Reality for Those Impaired by a Cerebrovascular Accident (CVA)

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Abstract. There is new research showing that interactive multimodal rehabilitation may enhance cognitive therapy after cerebrovascular accident. A well-designed Mixed Reality system provides a diverse, controllable and versatile therapeutic environment to help promote neural plasticity during recovery. In addition to stroke patients, there are other groups, such as those with traumatic brain injury (TBI) that could benefit from the system. Initial results, both paper-and-pencil measures and physiological measures, in a trial with fourteen participants are discussed.

Keywords. stroke, traumatic brain injury, cerebrovascular accident, rehabilitation, mixed reality, cognitive rehabilitation, physical rehabilitation.

Introduction

For over a decade, researchers have used virtual reality (VR) as a useful tool in therapy for a wide variety of applications, including treatment of anxiety disorders and pain distraction. One of the newest and most exciting applications of VR is in the field of rehabilitation. Research in VR applications for stroke patients in particular has made considerable progress.

Approximately 700,000 Americans are affected by stroke annually, costing an estimated $62 billion in 2008. At the age of 55, the risk of having a stroke is one out of every six. This risk doubles for every decade after 55. Once the Baby Boomer generation starts turning 65 in 2011, the risk will exceed the growth rate of the total population. More than 50% of stroke victims suffer from impairment of the upper limb, hindering their ability to carry out simple tasks such as dressing, picking up objects, and preparing meals. Recent evidence shows that intensive and repetitive rehabilitation, even a year after the cerebrovascular accident (CVA), can improve patient functionality. One challenge to all rehabilitation is that after an initial period of recovery, patients prematurely plateau in their recovery. Related challenges include limited rehabilitation resources and low levels of interest and participation.

The Mixed Reality Rehabilitation System (MRRS) was developed to overcome these deficits in traditional therapy by providing an interactive, engaging rehabilitation

tool that patients want to use. Mixed Reality (MR) is a parallel technology to VR with many possibilities in the area of healthcare. MR is generally viewed as being along a continuum from VR to physical reality and extends VR by blending real and virtual into a seamless landscape. Wearing a visual see through head-mounted display (VST-HMD), a user can see a virtual environment blended into their view of the real environment, which effectively "mixes" the two realities. The paramount advantage of MR is that it creates an altered or augmented reality without losing the benefits of the physical setting—touch, smell, hearing, taste, and visual contact with other humans.

In addition to stroke patients, there are other groups, such as people with traumatic brain injury (TBI) who could benefit from the system. A recent RAND survey found that 19.5% (over 320,000) of service members may have experienced at least a mild traumatic brain injury (mTBI) while deployed. Multiple re-deployments, unprecedented in this all-volunteer U.S. military, may compound the risk for physical and psychological injuries potentially resulting in more severe and chronic difficulties.

Cognitive assessment for TBI as well as assessment for stress injuries such as Post Traumatic Stress Disorder (PTSD) could be achieved in MR by capturing and analyzing a user's reaction while experiencing the environment.

Initial MR scenarios were developed to increase stroke patients' rate of physical and cognitive recovery and also increase their activities of daily living, enable at-home physical therapy, relieve some of the burden of caregivers, and decrease costs in lost productivity and hospital length of stay.

1. Methods

A prototype system of MRRS was designed, and the system has been used in two trials in the context of both physical and cognitive rehabilitation. Initial MR scenarios were developed to increase stroke patients' rate of physical and cognitive recovery and also increase their activities of daily living, enable at-home physical therapy, relieve some of the burden of caregivers, and decrease costs in lost productivity and hospital length of stay.

Therapy programs and protocols were developed within the context of the virtual worlds. Patients were evaluated prior to being considered candidates for MRRS. The therapist subjectively evaluates the patient's performance during a therapeutic activity while the MRRS monitors the patient's motion and evaluates the patient's performance relative to the prescribed motions and tasks. Patients were immersed in interesting environments and assigned entertaining and interactive tasks relevant to the virtual environment while still addressing their physical and cognitive therapeutic goals.

2. Results

Fourteen participants were enrolled in the cognitive rehabilitation study. Participants ranged from 18 years of age to 63 years of age. They varied in their experience and familiarity with video games and Mixed Reality.

The B-Alert EEG was used to acquire 6 channels of high-quality electroencephalographic (EEG) signals 30 feet from the computer data collection station - allowing for mobility. Engagement, workload, and distraction levels of healthy participants were measured while they performed tasks in the MR environment.

Distracters within the scenario demonstrated affected performance from a cognitive processing perspective.

Physiological measures were collected from all study participants, displaying higher overall readings for heart rate, skin conductance, and breaths per minute when comparing the scenario readings to baseline.

Based on subjective user feedback, participants found the MR scenarios engaging. Tasks provided during the scenarios were sufficient to maintain the interactive experience.

3. Conclusions

Initial trials with MRRS seem to indicate that it has many capabilities and great potential to extend the services offered in the rehabilitation field. Other scenarios for additional task training and varied levels of difficulty are being developed and testing is ongoing.

Study results concluded that a uniform standard for developing software is required as is a universal platform for delivering worlds. Given the amount of physiological data collected during each scenario, it would be ideal to integrate physiology into the MRRS such that the VR world and associated scenarios are dynamically controlled by the patient's physiology. Clinically, we aim to improve the ability to objectify presence and immersion. Additionally, it would be ideal to individualize the virtual world for each patient.

There are some basic reasons to believe that MR applications may be effective for rehabilitation. First, MR, like VR, engages the user. It is unlike watching a video, in that the user must interact, and experience, the world first hand. MR users report direct engagement with the experience. MR also creates a safe environment [1] where users may explore without feeling as though they are threatened. In addition, the computer is infinitely patient, unlike a "human trainer". The patient may feel less fear in "pushing the envelope" in this setting, since mistakes are not dangerous, humiliating, or "real".

In both cognitive and physical rehabilitation, an advantage over the real world includes the fact that the MR can be manipulated in ways extending beyond the real world. This allows for overlearning to occur and for abstract concepts and rules to be conveyed without the need for language. This is important when supporting the skill development of those with intellectual difficulties [2].

MR offers a significant opportunity to test new treatment paradigms for a wide variety of physical and cognitive rehabilitation tasks.

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Virtual Reality for the Upper Limb Motor Training in Stroke: A Case Report

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Abstract. In this report we describe the effects of a virtual reality (VR) training addressed to the upper limb of a stroke patient. After 20 days of rehabilitation sessions consisting of physical therapy and VR rehabilitation, the subject was evaluated by means of kinematics and clinical scales. Results showed the improvement of paretic arm mobility, in terms of quantitative parameters and clinical scales, suggesting that VR training could represent a valuable tool to supplement the traditional rehabilitation provided by the physical therapist.

Keywords. Rehabilitation, virtual reality, upper limbs, stroke, kinematics

Introduction

Stroke disease impairs motor functions of survivors and it is estimated that 50% to 75% of individuals who experienced a stroke have persistent impairment of the affected upper limb (UL). Rehabilitation intervention is a critical part of the recovery and recent studies reported that intensive repeated practice might be necessary to modify neural organization [1,2] and to effectively favor recovery of functional motor skills [3].

Virtual Reality (VR) is a promising rehabilitation technique even though until now evidence about its effectiveness in UL rehabilitation of stroke patients is very limited [4]. Moreover, to evaluate the real efficacy of motor training in a virtual environment, it is important to determine whether the skills gained in that environment transfer to real-world conditions. Thus, in our opinion, before recommending the use of VR rehabilitation techniques in clinical practice, it is mandatory to assess its effectiveness not only in VR environment but also in real-world conditions. In this report we describe a rehabilitation protocol integrating standard physiotherapy and VR training, aimed to treat right upper limb paresis in a stroke patient. The results of this treatment were evaluated in the real world using a quantitative kinematic analysis and by means of clinical scales. To our knowledge this is the first study integrating VR rehabilitation and quantitative biomechanical evaluation of the obtained results.

1. Materials and Methods

BA was a 35-year old man with right hemiparesis following an ischemic stroke. Clinical picture included: preserved cognitive functions, ability to stay in standing position without any assistive device, ability to perform postural transfers, and spastic muscle hypertone on the right upper limb.

The treatment consisted of 1 daily session, 5 days a week, for 4 consecutive weeks. Each therapeutic session included 30 minutes of standard therapeutic physiotherapy plus 30 minutes of selective treatment for the upper limb: patient was asked to grasp and throw virtual targets (Fig. 1) that appeared randomly on the computer screen using P5 virtual glove (Essential Reality, U.S.).

Quantitative kinematic analysis of pointing task (Fig. 2) was performed according to Menegoni et al., [5], before and after treatment, using an optoelectronic system (Vicon, UK). Specifically, we focused on the following kinematic parameters to characterize the functional limitation of the paretic arm: movement execution time and precision parameters (adjustments performed in the last phase of pointing and minimum distance from target).

The following validated clinical scales were administered before and after treatment: Nine-Hole Peg Test (NHPT) a quantitative test for upper extremity fine coordination [6], Frenchay Arm Test (FAT) [7], Medical Research Council (MRC) [8], Motricity Index (MI) [9], and the Motor Evaluation Scale for Upper Extremity in Stroke Patients (MESUPES) [10].

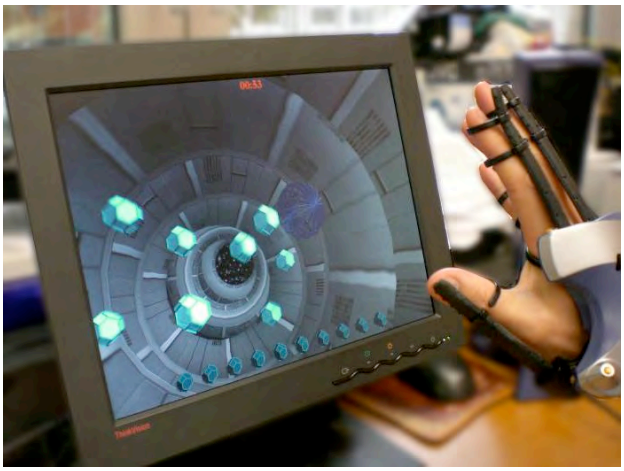

Figure 1. VR treatment unit.

Figure 2. Quantitative evaluation of pointing task in real-world conditions.

2. Results

After the treatment, the kinematic analysis of the paretic arm, showed a diminished time of movement execution (-11%), more pronounced in the last part of pointing (-20,8%), together with accuracy improvements: less finger excursions (-10%) and more precision (-13% error) in target localization (Fig. 3). Clinical scales confirmed quantitative improvements: MRC of fingers (pre: 4; post: 5), MESUPES - orientation part (pre: 2/6; post: 3/6), and NHPT time (pre: 25 s; post: 21 s). No significant changes were recorded in MI (pre: 76/100, post: 76/100) and FAT (pre: 5/5, post: 5/5).

3. Discussion and Conclusion

The effectiveness of the proposed rehabilitation protocol, integrating VR treatment and standard rehabilitation therapy, was demonstrated by a careful quantitative analysis in real world. Furthermore the treatment was well tolerated and

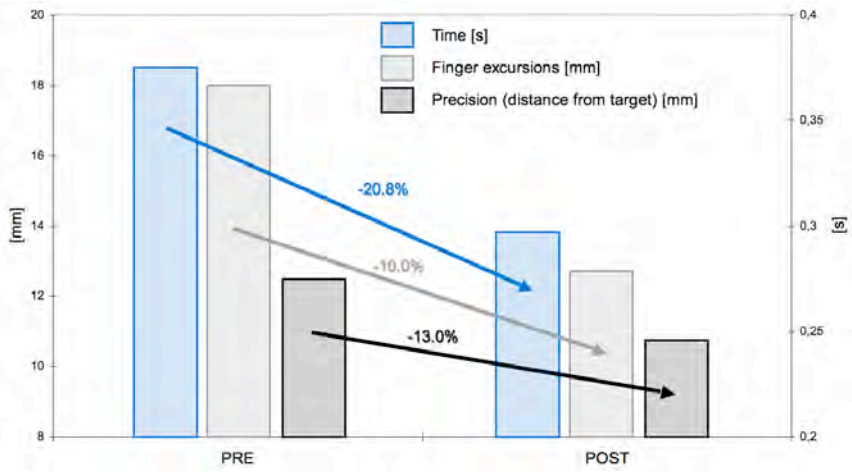

Figure 3. Quantitative kinematic parameters before and after treatment.

allowed the administration of intensive training without need to increase allocation of human resources.

Improvements were assessed by clinical scales in terms of enhanced arm mobility (MESUPES), in terms of dexterity and movement velocity (NHPT), and in terms of muscle power (MRC). Conversely no effects were found in terms of MI, and FAT. While the latter was suffering of ceiling effect, the unchanged MI could depend on the scale itself, not specifically designed to take into account arm-hand improvements.

The implicit limitations affecting clinical scales (e.g.: semi-quantitative, operator dependent) lead us to assess upper extremity movement by quantitative methods. The quantitative kinematic analysis, which represents a valuable and sensitive tool to detail different aspects of improvements, confirmed the results provided from clinical scales. Specifically, after treatment, our patient showed a clear improvement in terms of movement time together with better precision and less finger excursion in the last phase of the movement. The diminished time can be associated to the better values of MRC, i.e.: having more muscle power it is easier to perform the movement in less time. In addition, precision and finger excursions can be associated to movement control: the rehabilitation treatment could have caused a better organization of the movement, thus providing the right path and direction to the target, decreasing finger displacements in the last phase of the movement (i.e.: diminishing movement corrections), and augmenting the final precision. It is clear that better movement control can also influence the movement time, since less trajectory corrections means less time spent in performing them.

This study suggests that VR training could represent a useful tool to integrate and complete the traditional rehabilitation provided by the physical therapist.

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A Multimedia Holistic Rehabilitation Method for Patients after Stroke

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Abstract. The rehabilitation of patients after a stroke must provide polisensoric cognitive therapy. A specially designed computer/information system suits well to these requirements and offers a complementary and holistic treatment, which can be used in a rehabilitation center and later at the patient's home.

Keywords. stroke, aphasia, rehabilitation, multimedia rehabilitation, cognitive function, cognitive rehabilitation

Introduction

Special care is needed for patients who have experienced a stroke. Rehabilitation procedures must improve the patient's cognitive functions, reduce somatic influence of paresis, and often provide a kind of logopaedic help for people suffering from aphasia or dysarthria. Dedicated computer systems equipped with proper software to support rehabilitation process are very helpful in a cognitive rehabilitation, which requires the polisensoric stimulation of a patient's brain. Research in this field is still in progress [1,2] including implementations of virtual reality environment [3,4].

In this paper we describe a multimedia rehabilitation method developed in our medical center, exercises implemented in the computer system (equipped with special devices) and their application in stroke patients. Preliminary results obtained by using standard tests are presented as well.

1. Multimedia rehabilitation method

The proposed multimedia rehabilitation method consists of:

1. diagnostic phase,
2. main rehabilitation process and intermediate results assessment phase (this phase uses a specially developed multimedia computer system),
3. final result assessment phase,
4. and optionally – remote patient rehabilitation.

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During the first phase each patient follows an individual diagnostics process. Its results inform about nature and depth of cognitive dysfunctions. It helps to choose exercises best suited to patient's needs.

Several exercises are designed and implemented which are targeted at different types of disabilities:

1. logopaedic exercises for patients with aphasia,
2. exercises improving the dexterity of a hand,
3. cognitive exercises.

Additionally, many exercises are designed to allow simultaneous rehabilitation of more than one dysfunction. Every patient can have an individually chosen set of exercises (so called "training") where interleaving exercises assure improvement in brain functions**.**

In the second phase a patient is trained by prescribed complementary exercises. The results of exercises are stored in a central computer database. This data is analyzed to assess patient's progress and to alter exercises.

In the third phase, an individual and general rehabilitation score of a patient is obtained using a computer program and the standard methods of measuring the rehabilitation results.

The optional fourth phase allows for extending the patient's rehabilitation at home. This phase is proposed for selected patients only, based on the results achieved in the previous phase [2].

2. Results

In Table 1 we present some preliminary results obtained with the standard psychological tests, prior to and after the rehabilitation process.

The results of rehabilitation of the patients with concentration and memory dysfunction are presented in the upper part of Table 1. Tests were conducted on a group of twelve persons with left and right-sided stroke, six men and six women with average age of 51. The standard medical test MMSE (Mini Mental State Examination) was used to grade the effect of rehabilitation. The MMSE attempts to quantify the patients' capabilities in five fields: orientation, registration, attention and calculation, recall, and language. The maximum score in this test is 30 points. The results below 23 indicate the disturbance of cognition. We observed a two point (7.6% of initial value) improvement in the general score and a one point (18%) in the attention field.

Table 1. Effects of rehabilitation

Patients with concentration and memory dysfunctions (before/after)				
Mini Mental State Examination		Memory (W. Lucki set)		Learning curve (max 10)
general score (max 30)	attention (max 5)	visual memory (max 15)	auditory memory (max 16)	
23.6/25.4	2.75/3.25	8.25/10.6	5.0/5.6	2.4/3.75
Aphasic patients (before/after)				
motor aphasia (Broca)		mixed aphasia sensorimotor		
expression (max 106)	understanding (max 71)	expression (max 106)	understanding (max 71)	
73.0/94.3	59.6/67.2	42.8/62.6	33.0/47.75	

To examine the cognitive processes of the patients with brain damages, selected parts (visual and auditory memory) of Wlodzimierz Lucki's package [5] were used. The two point (28%) improvement regarding visual memory and the 0.6 point (12%) one regarding auditory memory were observed. Alexander Luria's learning curve indicates one point (56%) recovery.

In the lower part of Table 1, the results of rehabilitation of the aphasic patients are shown. The tests were conducted on a group of twenty-one persons with left-sided stroke, thirteen with motor aphasia and eight with mixed aphasia, seven women and fourteen men with average age of 59. In this case of Wlodzimierz Lucki's package of tests in two main categories: language expression and understanding was used. The patients with Broca's aphasia demonstrated a twenty-one point (29%) improvement in expression and about seven (7%) in understanding. The sensorimotor aphasia patients achieved a twenty-point (46%) recovery in expression and the ca. fifteen one (44%) in understanding.

3. Conclusions

A polisensoric rehabilitation performed with the aid of the specially designed computer system offers a complementary and holistic treatment of patients after stroke. It better stimulates the brain plasticity and speeds up the regeneration after injury.

The average results of rehabilitation of the patients with concentration and memory dysfunctions are not very satisfying due to the severity and location of stroke**,** character of dysfunction, and weak motivation for performing exercises. The results of rehabilitation of the aphasic patients are quite good and stable.

The results presented are preliminary. We plan to continue the tests and to compare the proposed rehabilitation methods with the traditional ones. We also are going to introduce new exercises to amplify the holistic rehabilitation process.

Acknowledgements

This research is financed by Polish Ministry of Education and Science, project No. N N519 315435 and partially by AGH grant 11.11.120.777.

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Optimizing Clinical Training for the Treatment of PTSD Using Virtual Patients

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Abstract. Adequate treatment of PTSD is a growing concern for the military. However, there is a shortage of qualified personnel available to apply this treatment. Virtual patient systems offer a novel technology to enhance the training needs of such health providers. This pilot project builds on previous work done with virtual patients and describes a novel scenario wherein a virtual patient is immersed within an exposure therapy simulation while a clinician interacts and guides the virtual patient through the recovery process using exposure therapy for PTSD. While this work is ongoing, preliminary results will be presented.

Keywords. Virtual Reality, PTSD, Exposure Therapy, Training, Virtual Humans

Introduction

In recent years, the US Department of Defense has made a rapid and intense effort to fund the development, documentation, and dissemination of efficacious treatment methodologies for posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI). During the past decade, approximately 1.64 million U.S. troops have been deployed for Operations Enduring Freedom and Iraqi Freedom (OEF/OIF) in Afghanistan and Iraq. A recent RAND report discusses the psychological impacts resulting from these deployments, in which many soldiers experience prolonged exposure to combat-related stress over multiple rotations [1]. Unfortunately, the effective deployment of evidenced-based clinical treatment has been limited by a shortage of properly trained clinicians. This shortage is particularly notable for exposure therapy as expert consensus guidelines recommend it as the first line treatment for PTSD. Exposure to emotional situations and prolonged rehearsal result in the regular activation of cerebral metabolism in brain areas associated with inhibition of maladaptive associative processes [3]. Identical neural circuits have been found to be involved in affective regulation across affective disorders [4]. Systematic and controlled therapeutic exposure to phobic stimuli may enhance emotional regulation through adjustments of inhibitory processes on the amygdala by the medial prefrontal

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cortex during exposure and structural changes in the hippocampus after successful therapy [5].

A novel tool for conducting exposure therapy is virtual reality exposure therapy (VRET), in which users are immersed within a computer-generated simulation or virtual environment (VE) that updates in a natural way to the users head and/or body motion. When a user is immersed in a VE, they can be systematically exposed to specific feared stimuli within a contextually relevant setting. VRET comports well with the emotion-processing model, which holds that the fear network must be activated through confrontation with threatening stimuli and that new, incompatible information must be added into the emotional network [6].

The University of Southern California's Institute for Creative Technologies (ICT) has created an immersive virtual reality system for exposure therapy with combat-related PTSD. The treatment environment is based on a creative approach to recycling virtual assets that were initially built for the commercially successful X-Box game and tactical training simulation scenario, Full Spectrum Warrior. As well, other existing and newly created assets available to ICT have been integrated into this rapidly evolving application. The Virtual Iraq application (and the new Virtual Afghanistan scenario) consists of a series of virtual scenarios designed to represent relevant contexts for VR exposure therapy, including middle-eastern themed city and desert road environments (See Figures 1). In addition to the visual stimuli presented in the VR HMD, directional 3D audio, vibrotactile and olfactory stimuli of relevance can be delivered.

The presentation of additive, combat-relevant stimuli in the VR scenarios can be controlled by a therapist via a separate "wizard of oz" Clinical Interface, while in full audio contact with the patient. The clinical interface is a key feature in that it provides a clinician with the capacity to customize the therapy experience to the individual needs of the patient. The clinician can place the patient in VR scenario locations that resemble the setting in which the traumatic events initially occurred and can gradually introduce and control real time "trigger" stimuli (visual, auditory, olfactory, and tactile) as is required to foster the anxiety modulation needed for therapeutic habituation. More system details can be found in Rizzo et al. [7]

Training in exposure therapy typically requires multi-day workshops with corresponding time and resource demands to send government mental health providers to trainings that are often geographically distant from their place of duty. This may result in some facilities possessing fewer trained providers than the patient demand. Once trained, providers need resource intensive supervision with several cases in order

Figure 1. The *Virtual Iraq* Simulation

to ensure adequate learning and utilization of key skills. These challenges are the same for innovative exposure methodologies utilizing virtual reality. New more efficient yet effective training methodologies are required to address this problem and produce clinicians with the necessary therapeutic expertise.

A potential option for addressing this clinical training challenge is in the use of Virtual Human agents to serve as digital standardized virtual patients (VP). Such VP technology is now poised to create new options for clinical training in interviewing, assessment, and therapy. Early efforts in this area [8] produced virtual patients for medical examination training with a virtual examination room where a virtual patient could be interviewed verbally. The USC ICT has been conducting similar virtual human research as part of its primary mission over the past decade years to create highly interactive artificially intelligent embodied conversational agents to be used for VR military leadership and negotiation training, tactical question/answering, leadership training and in the creation of immersive environments where interactive characters are essential to meet training objectives [9].

1. Methods

Our early work with natural language-capable virtual patients involved the development of "Justin", a 16-year old male with a conduct disorder, as a virtual therapy patient for training novice clinicians in the art of clinical interviewing with a resistant teenage client [10]. The system used a sophisticated natural language interface that allowed novice clinicians to practice asking interview questions in an effort to create a positive therapeutic alliance with this very challenging virtual client. From this pilot work, we created "Justina" as a VP representation of a female sexual assault victim with PTSD [11, 12]. The emphasis of this work was two-fold: 1) Explore the potential of this system for use as a clinical interview trainer for promoting sensitive and effective clinical interviewing skills in clinicians in training; and 2) Test whether novice clinicians ask the appropriate questions needed to determine if the patient reports symptoms that meet the criteria for the DSM-4 diagnosis of Posttraumatic Stress Disorder.

The Justina domain was modified for this project to include a military version of a female assaulted within a military base. Domain building for the VP consisted of role-playing sessions to gather the verbal and non-verbal behavior for the patient along with the set of questions typically asked by a clinician. Additionally, iterative discussions with psychiatry faculty from the Keck School of medicine at USC were performed to enhance the corpus of questions and responses. The goal was to build enough of the domain to cover the six categories in the PTSD DSM criteria and cover the kinds of questions people would ask a patient.

The corpus was used for the statistically natural language question/response system. The natural language system works by selecting responses based on input questions. A domain expert manually maps the set of questions and responses. The aim was to build the domain corpus with what we could anticipate and then elicit questions from the user that s/he may ask of the VP for the specific traumatic experience and use those questions in an iterative process to further build the corpus. Since PTSD falls in the diagnostic category of anxiety disorders, rather than assessing for all of the specific criteria, we initially focused at a high level upon the six major clusters of symptoms

following a traumatic event. While this did not give the character depth but breadth, for initial testing this seemed prudent.

2. Results

While this work is ongoing, the current paper discusses the novel developments in this research program that aim to better assist the US military in clinical training for the assessment and treatment of PTSD. One aspect focuses on the creation of a military version of Justina with the aim to develop a training tool that clinicians can practice therapeutic skills for addressing the growing problem of sexual assault within military ranks. The system can also be used by command staff to foster better skills for recognizing the signs of sexual assault in subordinates under their command and for improving the provision of support and care.

The second aspect involves the use of both male and female VP's in the role of a patient who is undergoing Virtual Reality exposure therapy. The VP is in a simulation of a VR therapy room wearing a HMD (Figure 1), while the therapist practices the skills that are required for appropriately fostering emotional engagement with the trauma narrative as is needed for optimal therapeutic exposure.

This simulation of a patient experiencing VR exposure therapy uses the *Virtual Iraq/Afghanistan* PTSD system [7] as the VR *context*, and the training methodology is based on the Therapist's Manual created for that VR application [14]. We believe the "simulation of an activity that occurs within a simulation" is a novel concept that has not been reported previously in the VR literature.

Figure 2. Virtual Justina Interacting in the *Virtual Iraq* Simulation

3. Conclusions

Herein we presented an approach that allows novice mental health clinicians to conduct an interview with a virtual character that emulates an adolescent female with trauma exposure. The work presented here builds on previous initial pilot testing of virtual patients and is a more rigorous attempt to understand how to build and use virtual humans as virtual patients and the many issues involved in building domains, speech, and language models and working with domain experts. The lessons learned here can be applied across any domain that needs to build large integrated systems for virtual

humans. We believe this is a large and needed application area, but it's a small enough domain that we can perform some serious evaluations on using virtual humans in real settings.

It is our belief that with more questions covered in the domain the accuracy of the system will increase along with the depth of the conversions, which will further enhance the virtual patient system. In order to be effective virtual humans must be able to interact in a 3D virtual world, must have the ability to react to dialogues with human-like emotions, and be able to converse in a realistic manner with behaviors and facial expressions. The combination of these capabilities allows them to serve as unique training and learning tools whose special knowledge and reactions can be continually fed back to trainees.

While this work is ongoing, the current paper discusses the novel developments in this research program that aim to better assist the US military in clinical training for the assessment and treatment of PTSD. One aspect focuses on the creation of a military version of Justina with the aim to develop a training tool that clinicians can practice therapeutic skills for addressing the growing problem of sexual assault within military ranks. The system can also be used by command staff to foster better skills for recognizing the signs of sexual assault in subordinates under their command and for improving the provision of support and care.

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Virtual Reality Therapy Contolled Study for War Veterans with PTSD. Preliminary Results

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Abstract. More than 30 years after signing truces, there are still around 20,000 Portuguese war veterans that fill PTSD (Posttraumatic Stress Disorder) diagnose criteria. Despite many of them attending therapy, the outcome is not cheerful. In this way, a research protocol was devised to investigate the opportunity of adopting virtual reality exposure therapy (VRET) to reduce PTSD symptomathology. This protocol consists on a controlled study (VRET vs. traditional psychotherapy vs. waiting list), where in the VRET condition patients will be graded by being exposed to a virtual reality jungle scenario. The activating episodes, that are comprised of three cues (ambush, mortar blasting and waiting for injured rescue), are repeated 3 times each session. The cues' intensity and frequency increase from session to session. Patients are exposed to the VR world through a HMD (Head Mounted Display). This paper reports on the ongoing research where 4 VRET patients that filled CAPS DSM-IV PTSD criteria were assessed at pretreatment and at the middle of treatment (5th session). Results from IES and SCL-90R dimensions showed no statistical significant differences between assessments, with exception to obsession-compulsion dimension of SCL-90R ($F(1; 3) = 21.235$; $p < .05$), indicating a decrease in obsessive thoughts. However, through descriptive analysis, it was observed a reduction in all IES and SCL-90R dimensions, except for hostility and psychoticism of SCL-90R.

Keywords. PTSD, war veterans, VRET

Introduction

More than 30 years after signing truces, there are still around 20,000 Portuguese war veterans that fill PTSD (Posttraumatic Stress Disorder) diagnosis criteria. Despite many of them attended to therapy, the outcome is not cheerful.

Within the psychotherapy scope of action, exposure *in vivo* or in imagination is often the elected technique to treat anxiety disorders. The information and technology era brought about new possibilities. Accordingly, an alternative to *in vivo* and to imagination exposure may reside on Virtual Reality Exposure Therapy (VRET). The

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use VRET, despite being on its infancy, is not a novel technique within the anxiety disorder therapies milieu. In fact, for more than a decade, VR is being used to treat patients with several anxiety disorders. Numerous studies revealed that VRET can be an alternative to *in vivo* and in imagination exposure [1-4]. VRET enables patients to be immersed in the VR world creating the so-called "sense of being there" [5].

VRET seems to deliver better results than the classical imagination exposure. More often than not, patients with severe anxiety disorders are not willing to cooperate with the therapist when asked to imagine the situation that induced the trauma. By itself, the avoidance of recalling the traumatic experience is a PTSD symptom. On the other hand, some of them are not able or not willing to engage emotionally, which may reduce therapy success [6].

As far as the use for VR exposure protocols for PTSD pathology is concerned, the last five years have produced some insight on this subject. [7] Studied patients with PTSD from World Trade Center attacks, [8] patients with PTSD from suicide bomb attacks in Israel and [9] studied soldiers that returned from Iraq.

Concerning war veterans, a decrease of 34% and of between 15% and 67% on PTSD symptoms, was, respectively, found in two studies with American Vietnam combatants by [10].

However, for the Portuguese war veterans population there are no controlled studies that evidences that VRET may be a treatment option [11]. In this way, a research protocol was devised to investigate the opportunity of adopting VRET to reduce PTSD symptomathology.

1. Method

This protocol consists on a controlled study (VRET vs. traditional psychotherapy vs. waiting list), where in the VRET condition 5 patients with PTSD (CAPS – Clinical Administered PTSD Scale) were graded expose to a virtual reality jungle 5 sessions scenario. The activating episodes that comprised three cues (ambush, mortar blasting and waiting for injured rescue) were repeated 3 times each session. Cues' intensity and frequency increase from session to session. Patients are exposed to the VR world through a HMD (Head Mounted Display). Assessment took place before 1st and after 5th session.

2. Results

ANOVAs for related samples were executed in order to evaluate IES-R (Impact of Event Scale-Revised) and SCL-90R (The Symptoms Check List-Revised) dimensions between assessments and showed no statistical significant differences between assessments, with exception to obsession-compulsion dimension of SCL-90R ($F(1; 3) = 21.235$; $p < .05$), indicating less obsessive thoughts between these two assessments. However, through descriptive analysis, it was observed a reduction in all IES-R and SCL-90R dimensions, except for hostility and psychoticism of SCL-90R. Presence (ITC-SOPI) was evaluated only after the VRET session. 65% of the patients agreed, or strongly agreed, that they were present on the VR world. 62% reported no negative effects after exposure.

Table 1. PTSD (IES-R) and Psychopathology (SCL_90R) scores

	Pre-treatment		During treatment		
	M	SD	M	SD	F
IES-R					
Avoidance	15.75	6.70	15.00	7.83	.36
Intrusion	19.75	5.68	18.25	7.80	.73
Hyper arousal	17,75	7.37	16.25	7.68	5.40
Total Score	53.25	15.69	49.50	19.01	1.86
SCL-90R					
Somatization	1.39	.61	1.25	.67	9.91
Obsession	2.45	.58	1.98	.57	21.24*
Interpersonal	1.41	.46	1.11	.45	1.44
Depression	2.00	.49	1.96	.32	.01
Anxiety	1.67	.53	1.40	.35	2.77
Hostility	1.25	.91	1.62	.71	1.43
Phobic anxiety	1.11	.49	.08	.56	.514
Paranoid ideation	1.08	.52	1.00	.34	.089
Psychoticism	1.00	.45	1.03	.45	.018

* $p < .05$

3. Conclusion

This paper reports on an ongoing controlled study of a sample of Portuguese war veterans that fill DSM-IV PTSD criteria. The preliminary results showed a decrease from pre to during treatment, on avoidance, intrusion and hyper arousal, as well as, on several psychopathological symptoms.

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Virtual Worlds as a Healing Modality for Returning Soldiers and Veterans

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Abstract. Those who have served in recent conflicts face many challenges as they reintegrate into society. In addition to recovering from physical wounds, traumatic brain injury, and post-traumatic stress disorders, many soldiers also face basic psychological issues about who they are and how to find their place in a society that has not shared their experiences. To address these challenges, we have created a space that provides ongoing opportunities for healing activities, personal exploration and social camaraderie in an online virtual world, Second Life. In such worlds, where each avatar is controlled by a live individual, experiences can be unintuitive, uninviting, considered boring, or difficult to control. To counter this, we are implementing autonomous intelligent agent avatars that can be "on duty" 24/7, serving as guides and information repositories, making the space and activities easy to find and even personalized to the visitor's needs. We report the results of usability testing with an in-world veterans' group. Tests comparing soldiers who use this space as part of their reintegration regimen compared to those who do not are being scheduled as part of the Army's Warriors in Transition program.

Keywords. Virtual worlds for healing, PTSD, TBI, Complementary and Alternative Medicine, immersion, interactive agents, agent avatars

Introduction

Veterans of recent conflicts and soldiers who have temporarily returned from deployment face many challenges when they come home. Not only are they often recovering from physical wounds, they also face psychological issues that may be debilitating. Many of these conditions, such as Traumatic Brain Injury (TBI) and Post-traumatic Stress Disorder (PTSD) may take months to manifest fully, according to recent studies by the Walter Reed Army Medical Center. [1] The Army's Post-Deployment Health Assessment (PDHA) and reassessment (PDHRA) tests, given to soldiers at the beginning and end of a six month period after their return, show that a soldier's health actually is worse after the six month interval. Yet most soldiers are sent home as soon as their physical injuries have healed.

Many factors inhibit their getting the ongoing help they need, including lack of resources at their home location, perceived stigma for requesting help, and failure to recognize warning signs. What is needed is continued intervention in a form that is safe, enjoyable, and always available.

The rapid explosion of online virtual worlds, such as Second Life® by San Francisco-based Linden Lab, points to a possible solution that can address many of the issues returning soldiers face. Such worlds are persistent and available from the

comfort and privacy of one's home. They can unite geographically dispersed people in a common space, such as unit buddies, or a veteran and a therapist in different cities. They can provide enjoyable activities for those who cannot get out or move about normally. These activities can be both entertaining and healing in nature.

As many virtual worlds are considered overwhelming or boring, a key aspect of this project is providing autonomous virtual avatar agents to assist in the soldiers' successful experience within the space. These avatar agents look and act like knowledgeable guides who can provide information as well as customize the experience for the individual. For example, our first avatar agent walks a visitor through the labyrinth, explaining how it can be used to address issues that person may be experiencing.

1. Methods and Tools

To test the efficacy of a virtual world as part of a veterans' reintegration package, we have built a private space in Second Life for this population that focuses on both social aspects of healing and therapeutic activities from the Complementary and Alternative Medicine (CAM) arena. [2] A group of 700 veterans, already formed within Second Life, are serving as our primary usability testers, providing valuable input to the design process. Activities are divided into three categories: social, enrichment and therapeutic.

The center of our social space is *Chicoma Lodge* – specifically designed to be warm and inviting, with comfortable seating areas around fireplaces, and two wings with activities such as pool, arm wrestling, and darts. There is an autonomous greeting avatar that is available to the visitors when they first arrive, or that can be approached at any time. This agent can conversationally provide information about what is available in the area.

Enrichment activities include a labyrinth [Figure 2], with an autonomous guide that can be summoned to enable a visitor assistance in the many ways in which the labyrinth can we walked. Among the other enrichment activities planned, we have designed a Warrior's Journey space where a veteran can travel in the shoes of worthy historical warriors, such as the Samurai, or the Cheyenne Dog warriors. This journey takes place within the tower structure pictured in Figure 3. Scenes from the warrior's life are visible along the walls of the curving path inside the tower, with sounds and voice-overs describing the ideals these brave men valued and lived by. At the end of the path is a full sized 3D model depicting a scene from the warrior's reintegration into society, with an autonomous agent avatar that is able to complete the story by talking directly to the participant. We plan to add a question answer function for this avatar in the future.

For the therapeutic aspects, there are areas where veterans can find information and resources on available therapies (in both the virtual and the real world) in a way that is private and therefore mitigates the stigma associated with getting help. For example, through the use of a Second Life HUD (heads up display), data accessed is kept private, with only the individual able to see which topics are being accessed. Two of the initial therapies implemented include Mindfulness Based Stress Reduction (MBSR) and the use of sound and music for healing. These were chosen because the scientific community has validated that these techniques are effective both physically and psychologically. [3,4,5,6,7] We have engaged experts in these disciplines to assist in a design that will be effective within the virtual world space.

Figure 1. Inside the central lodge

Figure 2. Labyrinth with one form the guide could take

Figure 3. The Warrior's Journey tower

2. Results

The first usability testing with our in-world veterans' group is providing positive feedback. We are currently setting up further testing at two Army bases involved in the Army's Warriors in Transition program. We expect to yield positive results in the reintegration process for the soldiers who use the space when compared to a control group of soldiers without access. Results will be verified by comparing the scores on the Army's Post-Deployment Health Assessment (PDHA) and reassessment (PDHRA) tests at the beginning and end of a six-month period. It is our hope that this will prove to be a useful tool that aids in the veterans' successful reintegration to the civilian world.

Acnowledgement

The project or effort described here has been sponsored by the U.S. Army Research, Development, and Engineering Command (RDECOM). Statements and opinions expressed do not necessarily reflect the position or the policy of the United States Government, and no official endorsement should be inferred.

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Psychopathological Issues of Technological Addiction: New Diagnostic Criteria for Addiction

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Abstract. All forms of addiction (drug addiction, food addiction, sexual addiction, technological addiction, work addiction) are syndromic conditions characterized by a recurrent and reiterated search for pleasure derived from a specific dependence behavior, associated with abuse, craving, clinically significant stress, and compulsive dependence actions despite the possible negative consequences. The purpose of this article is to propose a new diagnostic criteria of addiction.

Keywords. Addiction, diagnostic criteria, dissociation, affect dysregulation.

Introduction

In post-modern society, technology created a fundamental change in the communications and in the interpersonal relationship; new forms of self-with-other representation; new possibilities to freely access to informations regardless of age, sex, race, culture, or religion. But the technology also changed the relationship between means and ends.

Langdon Winner described this swap between means and ends as a reverse adaptation: human ends are adapted to the characteristics of the available means [1]. The goals, purposes, needs, and decisions that are supposed to determine what technologies do are in important instances no longer the true source of their direction. Technical systems become severed from the ends originally set for them and, in effect, reprogram themselves and their environments to suit the special conditions of their own operation. The artificial slave gradually subverts the rule of its master (p. 227).

When the technology becomes an end, there's the risk that it could be used as a necessary instrument for self-expression.

That's the way it is in the Technological addiction, in which the use of personal computer, television, video games is a psychic retreat [2] alternative to the ordinary conscience. It is a dissociative mental state that excludes emotions and feelings characterized by internal and external pain from the field of conscience, and deals with a mechanism of segregation sheltering the ordinary conscience from an excessive flood of painful stimuli.

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1. Internet Addiction: a form of Technological Addiction

Griffiths [3] defined the technological addiction as "nonchemical (behavioral) addictions, which involve human-machine interaction" (p. 471)

The author distinguishes between two types of technological addictions: passive (e.g., television); and active (e.g., computer games); both of which are hypothesised to promote addictive tendencies via a process of inducement and reward. Under this framework, Internet addiction is interpreted as an active technological addiction that develops as the user interacts with the addicted behavior, in this case the intangible entity of cyberspace.

"Internet addiction" is a specific type of Technological addiction. It is a broad term covering a wide-variety of maladaptive behaviors: online compulsive gambling, cybersexual addiction, cyber-relationship addiction, online role-playing addiction, information overload, online compulsive trading, and online shopping addiction.

Goldberg was the first to coin the term of Internet Addiction Disorder, borrowing from DSM-IV the criteria for substance abuse/dependence and pathological gambling.

Adopting the criteria for pathological gambling, Kimberley Young [4] defined the pathological use of Internet as Problematic Internet Use.

The diagnosis of PIU is indicated by five or more of the following symptoms: 1. preoccupation with the Internet; 2. increased amounts of time needed on the Internet to achieve satisfaction; 3. repeated unsuccessful attempts to control, cut back, or stop Internet use; 4. feeling restless, moody, depressed or irritable when attempting to cut down/control use; 5. staying online for longer than originally intended; 6. jeopardizing or risking the loss of a significant relationship, job, education, or career opportunity because of the Internet; 7. lying to conceal the extent of involvement with the Internet; 8. using the Internet as a means of escaping problems or relieving dysphoric mood.

In the diagnostic criteria of Kimberley Young, Internet addiction is considered an impulse-control disorder, which doesn't involve a drug abuse.

But these diagnostic criteria do not consider the last studies about the difficulty for the addicted to regulate the affects [5].

In a previous study [6], we found a correlation between Technological addiction, affect dysregolation, and dissociation.

In addicts the dissociation has the purpose to modulate unbearable and traumatic affective states. Through the dissociation, the subject may build up a parallel and more favorable reality- an easy shelter.

The relief coming from a temporary withdrawn inside, this retreat is not pathological by itself and can be at service of the personal energy, the creativeness, and the object relationships. When the withdrawal extends to an excessive reiteration and a morbid addiction, instead, it involves the risk of coercion, isolation, and distortion of the sense of Self and relationships, causing the loss of the vital contact with reality, a series of compulsive activities, and various forms of addiction- up to DSM-IV dissociative disorders.

From a trauma perspective, the dissociation, in addicts, is correlated to childhood traumatic experiences (neglect, sexual, psychological, and/or physical abuse).

During the last 20 years, the presence of the association between relational traumas, affect dysregulation and dissociation in people suffering from addiction (drug addiction, sexual addiction, food addiction, gambling addiction, alcohol addiction, technological addiction), has been confirmed by several researches [5-15].

2. New rationale for the diagnosis of addiction

On the basis of the presence of these common features, we consider the addiction as a syndromic condition characterized by a recurrent and reiterated search for pleasure derived from a specific dependence behavior, associated with abuse, craving, clinically significant stress, and compulsive dependence actions, despite the possible negative consequences. We also proposed the following new diagnostic criteria for addiction:

A. Persistent and recurrent behaviors of addiction. The behaviors are maladaptive and lead to clinically significant impairment or distress, as manifested by five (or more) of the following, occurring at any time in the same 12-month period: with at least two by (1), who one is (c), two by (2) and one by (3).

1) Obsessivity
   a) recurrent thoughts and images about the experience of dependence, or ideas related to dependence (e.g. being totally absorbed in mentally reliving experiences of dependence happened in the past, fantasizing or planning about the future behaviors and experiences of dependence);
   b) the dependence thoughts or the images are intrusive and cause inappropriate tension and arousal, as well as clinically significant anxiety and discomfort;
   c) the subject is aware that dependence thoughts and images are produced by the mind, and they are not provoked by external stimuli.

2) Impulsivity
   a) restlessness, anxiety, irritability, or distress when it is not possible to enact the dependence behavior;
   b) recurrent failure in resisting the inappropriate desires of dependence and self-regulating the impulses to enact the behavior of dependence.

3) Compulsivity
   a) the person feels obliged to repeatedly enact the dependence behavior, even against his or her own will, despite of the negative consequences.
   b) the coercive addictive behaviors and actions are finalized to avoid or prevent states of mental and physic pain, or to alleviate a disphoric mood (e.g. feelings of irritability, impotence, guilt or shame).

B. Thoughts or behaviors related to the addiction occur frequently and repeatedlyduring the day, and significantly interfere with normal habits, social functioning, activities, and relationships.

C. Thoughts and behaviors of addiction do not occur only during a maniac episode or because of a general medical condition.

The three factors of addiction (obsessivity, impulsivity, and compulsivity) explain the craving as an “uncontrollable desire toward a rewarding stimulus, intended as an environment element able to activate a behavioral approach toward the stimulus” [16].

The construct of craving assumes the characteristics of urgency and the compulsivity, especially in presence of specific internal or external stimuli; the strong, both impulsive and compulsive, attraction toward the addictive behavior goes really

beyond the drug-object by itself. The craving is activated in presence of environmental stimuli recalling the drug or the behavior, but also in answer to stressful events or particular emotional situations. The withdrawal inside-mental dissociated states in the addictive behavior in this way strengthen the mechanism of craving [17].

If we consider the pathological addiction as a disorder based on dissociation, originating from childhood traumatic experiences, it is easy to understand that the physiological effects produced by a drug-object (internet, substance, food etc.) is not the exclusive factor inducing the addiction, but there is a previous psychopathological predisposition, and the craving is its own natural epiphenomenon.

The craving is pre-existing to the addiction, it belongs to the sphere of aware and unconscious motivations that push the subject to seek a behavior, which puts aside the traumatic memories and the anguishes of fragmentation.

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A New Protocol Test For Physical Activity Research In Obese Children (Etiobe Project)

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Abstract. A new protocol is presented to validate TIPS (portable physiological monitoring device designed by I3BH that can get respiration, ecg and activity of the patient) for physical habits detection. Physiological and activity parameters and data from questionnaires have been acquired from a group of obese & non-obese children (n=20). Children completed activities from sedentary level to vigorous level. Preliminary results show variability on the response of children's effort and feasibility of TIPS platform as an ambulatory tool.

Keywords. Children Obesity, Physical Activity Detection, E-therapy, Wireless Monitoring

Introduction

TIN (Therapy Intelligent Network) is an open platform that tries to establish a sensor network where the focus is the patient, which captures information in real time, is so much of physiological-like contextual data. In this first phase, TIPS shows the personal platform (Personal Therapy Intelligent Sensor) that the patient will carry. This tool will be validated with a protocol test. The objectives of this work are:

- Research about predominant factors for estimating Energy Expenditure in obese children
- Facilitate physicians & psychologists with a new evaluation tool for the treatment
- Validate a new ambulatory tool for the detection of physical activity habits.

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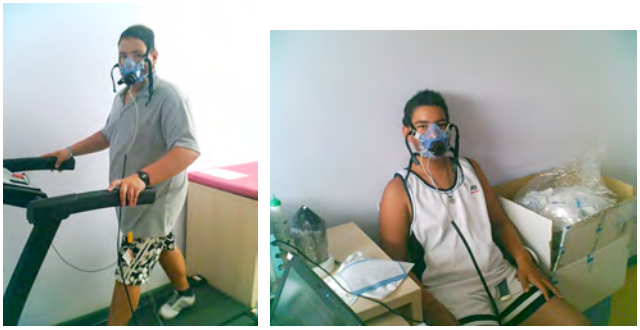

Figure1. The boy on the left is performing the walking stage. Boy on the right is sitting while the Fitmate Mask is collecting the VO2 consumed

1. Method

After analyzing certain studies and articles applied to physical activity estimation [1-3] has been designed a proprietary protocol. It has been correlated the activity registered at the TIPS with a portable indirect calorimeter (FITMATE PRO) that measures the O2 consumption during the physical activity [4,5].

It has been designed as a clinic protocol for testing TIPS in obese children:

- Two groups (non obese & obese group) of 20 children (male/female subjects 10±4 years).
- First phase, the patient is measured lyed during 20 minutes to get the resting metabolic rate
- Afterwards, patient must complete 8 activity stages during 45 minutes from sedentary level to vigorous level.
- During the protocol Respiration Rate, RR interval, Accelerometer against O2 consumption is measured. All the signals are synchronized for their processing stage.
- Questionnaires for detecting physical activity (3-Day Physical Activity Recall; 3DPAR), diet habits (a food frequency questionnaire), and ergonomy are completed at the end by the child.
- A Statistical ANOVA 2x2 (obese x non obese vs. high x low energy expenditure) analysis will be done in order to analyze the data.

2. Results

The preliminary results show two first conclusions:

1. *A variability on the response of children's effort.* The necessities of developed algorithms take variability into account. The combination model (Heart Rate+ Accelerometer) seems to have the strongest relation to Physical Activity Energy Expenditure. At sedentary stages, accelerometer overestimates energy consumption. At moderate and vigorous stages, the physiological response is a key point because it reflects the aerobic effort of the patient. The variability at this relation depends on the fitness and healthy level of the patient, a key point at the obese therapy.

2. *The feasibility of TIPS platform as an ambulatory tool*. The protocol showed good acceptability between children, and users reported that it was not aversively difficult. This factor is fundamental in order to know that the measures are stable and the children are able to stay with them for long time periods.

3. Discussion

Our first hypothesis:

- It is necessary to develop an exclusive estimation technique for the obese child population and assign special weight for each anthropometric, physiological, and movement parameter.
- It is necessary to have a direct measuring of the resting metabolic rate for a good evaluation.
- A good measuring of physical activity is important in order to prescribe the best physical activity tasks.
- A new protocol test using a standard effort-test (Bruce Protocol) must be made to compare this study with other children tests.

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