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Evidence-Based Clinical Applications of Information Technology

Editors:

Brenda K. Wiederhold, Ph.D., MBA, BCIA

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Evidence-Based Clinical Applications of Information Technology

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CONTENTS

INTRODUCTION

A shift is slowly and surely occurring in the realm of healthcare – the field of cybertherapy is becoming more commonly recognized and its wide array of innovative technologies is becoming more widely accepted and implemented throughout the world. Although small-scale projects may be more common than wide-scale adoption of new, cutting-edge technologies, trends are repeatedly pointing to the fact that the advantages that telehealth and mobile health, for example, have to offer – more readily accessible medical records, user friendly, reliable health advice at your fingertips, "patient-centric" care – are undeniable and work to meet the needs of all those involved in healthcare.

The growth of cybertherapy is resulting in exciting advancements in the ways in which healthcare addresses patient and caregivers' needs alike. The resulting flexibility and innovative options mean that patients are becoming more educated, more responsible, and more proactive in taking charge of their own health. This, in turn, leads to adopting and *adhering to* healthier lifestyle choices. The end goal of healthier bodies, healthier minds, and more efficient, effective healthcare is becoming more real and attainable each and every day.

Although the task of fully adopting and integrating these new types of healthcare into existing healthcare systems may seem a daunting task, we aim to increase awareness on a basic level. In light of the proactive nature encouraged by cybertherapy and its components, we work to provide informative research and ongoing studies of innovative teams of researchers from around the globe. We hope that this volume helps to increase awareness of developing projects, and to identify fields which are in need of further attention.

We have put a great deal of effort into 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 into four main sections:

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

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 available, as well as a fair understanding of the context of interaction in which they operate.

In conclusion, this volume underlines how cybertherapy has made initial progress in treating a variety of disorders. However, 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 need to address potential side effects, and the implementation of more controlled studies to evaluate the strength of cybertherapy in comparison to traditional therapies.

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 *Stéphane Bouchard* *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

Presence, Actions and Emotions: A Theoretical Framework

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Abstract. As commented by Biocca [1], and agreed by most researchers in the area, "while the design of Virtual Reality (VR) technology has brought the theoretical issue of presence to the fore, few theorists argue that the experience of presence suddenly emerged with the arrival of VR" (p. 121). So, what is presence? And what is its possible impact in cybertherapy? For instance, does a strong sense of presence cause patients to better engage and modify emotions and cognitive processes they have already developed in a real environment? Will the skills and the competences acquired in the virtual world transfer to a corresponding real experience? This chapter will try to provide some answers to these questions using the following definition of presence: presence is the non-mediated (prereflexive) perception of using the body/a medium to successfully transform intentions in action (enaction).

Keywords. Virtual Reality, assessment, therapy, NeuroVR, open source

Introduction

The term "presence" entered in the wide scientific debate in 1992 when Sheridan and Furness used it in the title of a new journal dedicated to the study of Virtual Reality (VR) systems and teleoperations: Presence, Teleoperators and Virtual Environments.

In the first issue, Sheridan [2] clearly refers to presence as an experience elicited by technology: the effect felt when controlling real world objects remotely as well as the effect people feel when they interact with and immerse themselves in virtual environments.

However, as commented by Biocca [1], and agreed by most researchers in the area, "while the design of VR technology has brought the theoretical issue of presence to the fore, few theorists argue that the experience of presence suddenly emerged with the arrival of VR" (p. 121). So, what is presence? And what is its possible impact in cybertherapy?

1. Presence as a Cognitive Process

To address these questions, a growing group of researchers is considering presence as "Inner Presence," the feeling of being located in a perceived external world around the self [3-6]. In this view, presence is a broad psychological phenomenon, not necessarily linked to the experience of a medium, whose goal is the control of the individual and social activity. The main outcome of this approach is the "*perceptual illusion of non-mediation"* [7] definition of presence. Following it, presence is produced by means of the disappearance of the medium from the conscious attention of the subject. The main advantage of this approach is its predictive value: the level of presence is reduced by the experience of mediation during the action. The main limitation of this vision is what is not said. What is presence for? Is it a specific cognitive process? What is its role in our daily experience?

To address these questions, a second group of researchers considers presence as "Inner Presence," the feeling of being located in a perceived external world around the self. In this view, presence is a broad psychological phenomenon, not necessarily linked to the experience of a medium, whose goal is the control of the individual and

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social activity.

This vision is supported by the outcome of many recent neurological studies that demonstrated that tool-mediated actions modify the multisensory coding of near peripersonal space [8, 9]: the active use of a tool to physically and effectively interact with objects in the distant space appears to produce a spatial extension of the multisensory peri-hand space corresponding to the whole length of the tool. *In other words, through the successful enaction of the subject's intentions using the tool, he/she becomes physically present in the tool [4]*. These studies suggest that the subject locates himself/herself in an external space according to the action he can do in it. As suggested by Zahoric and Jenison [10]: *"presence is tantamount to successfully supported action in the environment"* (p. 87, italics in the original).

In other words, the subject is "*present*" in a space if he/she can act in it. Moreover, the subject is "*present*" in the space – real or virtual – where he/she can act in. Interestingly, what we need for presence are both the affordance for action (the possibility of acting) and its enaction (the possibility of successfully acting).

An important consequence of this vision is the need to understand more what "acting successfully" means. We can start from the definition of "Agency": "the power to alter at will one's perceptual inputs" [11]. But how can we define our will? A simple answer to this question is: through intentions. Following this line of reasoning *"Presence" can be defined as "the non mediated (prereflexive) perception of using the body/a medium to successfully transform intentions in action (enaction).*"

A possible criticism to this definition is the following: *"I may be asked to repair a computer, and I may be unable to fix it. This does not mean that I am not present in the environment (real or virtual) where the computer and I are."*

This objection makes sense if we use the folk psychology definition of intention: the intention of an agent performing an action is his/her specific purpose in doing so. However, the latest cognitive studies clearly show that *any behavior is the result of a complex intentional chain that cannot be analyzed at a single level* [12, 13].

According to the *Dynamic Theory of Intentions* presented by Pacherie [13, 14] and to the *Activity Theory* introduced by Leontjev and disseminated by Kaptelinin and Nardi [15, 16], repairing a computer is driven by an above objective (e.g., obtaining the money to pay for a new car) and is the result of lower-level operations (e.g., removing the hard disk or the CPU, cleaning them, etc.) each driven by specific purposes. So, for an intention that failed (repairing the computer) many others were successful (removing the hard disk, cleaning it, etc.) inducing presence [4, 17].

This view suggests that the ability to feel "present" in a VR system – a medium – basically does not differ from the ability to feel "present" in our body. When the subject is present during agency – he/she is able to successfully enact his/her intentions – he/she locates himself/herself in the physical and cultural space in which the action occurs.

It also suggests that even in the real world the feeling of presence will be different according to the ability of the subject to enact his/her intentions within an external environment. For instance, I'm in a Korean restaurant for a formal dinner with some colleagues, but I don't know how to use the chopsticks I have nearby my dish. In this situation I'm physically there, but the lack of knowledge puts me outside, at least partially, from the social and cultural space of the "formal Korean dinner." The result is a reduced presence and a limitation in my agency: I'm not able to enact my intention (pick up some rice) using the chopsticks, so I don't use them to avoid mistakes.

Finally, in this view, presence can be described as a sophisticated but unconscious form of monitoring action and experience: the self perceives the variations in the feeling of presence and tunes its activity accordingly. From a computational viewpoint, the experience of presence is achieved through a forward-inverse model [18] (Figure 1):

- First, the agent produces the motor command for achieving a desired state given the current state of the system and the current state of the environment;
- Second, an efference copy of the motor command is fed to a forward dynamic model that generates a prediction of the consequences of performing this motor command;
- Third, the predicted state is compared with the actual sensory feedback. Errors derived from the difference between the desired state and the actual state can be used to update the model and improve performance.

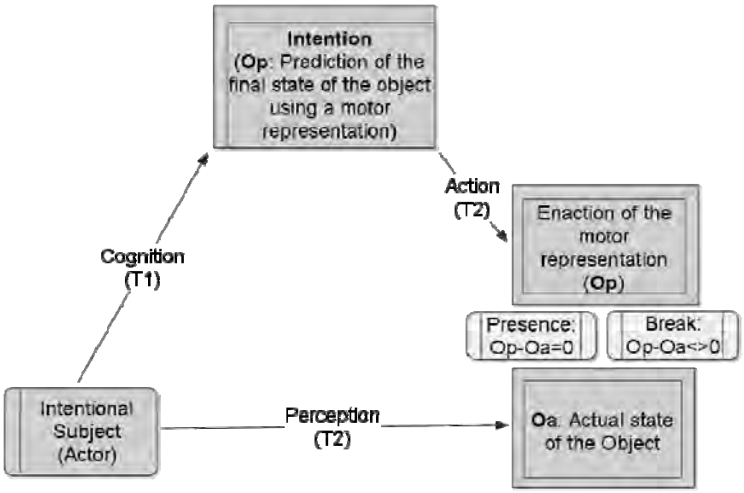

Figure 1: The feeling of presence.

The results of the comparison (which occurs at a sub-personal level) between the sensory prediction and the sensory consequences of the act can then be utilized to determine both the agent of the action and to track any possible variation in its course. If no variations are perceived, the self is able to concentrate on the action and not on its monitoring. As suggested by *the simulation theorists* [19, 20], the brain instantiates a sophisticated simulation, based on motor codes, of the outcome of an action and uses this to evaluate its course.

For this reason, the feeling of presence − *the prereflexive perception that the agent's intentions are successfully enacted* − is not separated by the experience of the subject but *is directly related to it*. It corresponds to what Heidegger [21] defined as "the interrupted moment of our habitual standard, comfortable *being-in-the-world.*" A higher feeling of presence is experienced by the self as a better quality of action and experience [10]. In fact, the subject perceives consciously only *significant variations* in the feeling of presence: *breakdowns* and *optimal experiences* [22].

2. Presence and Emotions

One of the most important effects of presence for clinical practice is that a virtual experience may evoke the same reactions and emotions as a real experience. But what is the link between presence and emotions? The outcome of different clinical trials and experiments underline the existence of a bi-directional relationship between presence and emotions.

On one side, the higher the presence, the higher the intensity of emotions the user experiences. Therefore, if the focus is on designing applications capable of eliciting emotions with the goal of reducing or modifying them (for example in psychological therapy), the environments must be able to induce a substantial feeling of presence while supporting the user's intentions. However, the opposite could also be claimed: the higher the intensity of the emotions and feelings, the higher the presence and reality judgment.

In sum, because individual patients exhibit wide variations in their responses to virtual environments, presence alone is not enough to guarantee a positive clinical outcome in VR exposure therapy: the technology behind the virtual stimuli has to be "transparent" enough to enable the activation of the fear structure. Once this threshold is passed, there is no direct effect of the level of presence on the efficacy of desensitization.

3. Conclusions

In this paper we introduced a cognitive vision of presence – "inner presence" – defined as *the non-mediated (prereflexive) perception of using the body/a medium to successfully transform intentions in action (enaction).* This

vision, that works both in the virtual and real world, is based on the following broad statements:

- *The content of consciousness is the content of a simulated world in our brain*;
- *Presence refers to the part of the contents of consciousness that relate to the current time and place in which the body is located*;
- *The psychology of presence is related to human action and its organization in the environment*;
- *The feeling of presence is not the same in all situations (virtual or real) but can be different in relation to the characteristics of the physical, social and cultural space the subject is in*;
- *A circular interaction exists between presence and emotions*;
- *Presence alone is not enough to guarantee a positive clinical outcome in VR exposure therapy*.

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Effectiveness of Cybertherapy in Mental Health: A Critical Appraisal

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Abstract. Although Virtual Reality (VR) treatment and Internet-based cognitive behavior therapy (CBT) have been found to be effective in a large series of studies, dissemination of these therapies in the community at large is still in its infancy. A number of reasons for the lack of dissemination are discussed, including clinicians' resistance, lack of representation of samples studied, and lack of cost-effectiveness studies. Challenges for further studies are pointed out.

Keywords. Virtual Reality Exposure Therapy, Internet-based therapy, Second Life

1. Introduction

Cognitive behavior therapy (CBT) has been shown to be effective in numerous randomized clinical trials for anxiety disorders, depression and eating disorders and CBT is now recommended as the treatment of choice in a number of clinical guidelines around the world. In spite of its efficacy, CBT is not free of limitations: the therapist has to be present during the whole therapeutic process; there is a lack of trained therapists; there are generally long waiting lists for treatment, and there is a lack of access to face-to-face therapy in rural areas.

Since 2000, a number of controlled clinical studies have shown that Internet-based CBT is more effective than a no-treatment control and may be as effective as face-to-face therapy in anxiety disorders and depressive disorders [1]. Numerous studies have also investigated Virtual Reality Exposure Therapy (VRET) in the last decade. The effectiveness of VRET has now firmly been established for a few specific phobias, such as fear of heights and fear of flying [2, 3], but very few well-controlled studies have been conducted in clinically more disabling anxiety disorders, such as panic disorder and agoraphobia, social anxiety disorder and obsessive-compulsive disorder. One of the advantages of computer-assisted delivery of treatments is that such treatments are usually more standardized than treatments conducted in routine clinical practice and may enhance treatment adherence [4]. However, dissemination of VRET and Internet-based therapies in the community at large is still in its infancy.

2. Future Applications: What Needs to be Done

Some of the barriers for the clinicians' resistance are fear of being replaced by the computer, lack of knowledge about the application of new technologies in the field of clinical psychology, and a lack of training on how to use VRET and Internet-based treatment programs. These barriers can be dealt with by informing clinicians about results achieved and by providing adequate training and supervision. It is important to create user-friendly and attractive VR treatments and Internet-based treatments in order to be well received not only by the patient, but by the therapist as well. Other concerns of therapists relate to patient confidentiality on the World Wide Web and a number of therapists are afraid of taking clinical responsibility of patients who they do not see face-to-face. With regard to confidentiality, the use of safe servers and access to the treatment using a login and a password could guarantee privacy. The clinical responsibility of the therapist is a more serious problem, but can be handled by adequate measures such as using well-validated measures, strict exclusion criteria, and, where needed, clinical interview by phone [1].

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2.1. Therapeutic Relationship

Other clinician's worries concern the influence that such technology-driven treatments could have on the development of a productive participant-clinician relationship. In addition, there is some concern that Internet-based cognitive and behavioral treatments for anxiety and depression are characterized by poor adherence. Each limitation is a challenge that researchers have to try to surpass in future studies before broad scale implementation will be feasible. For example, research has already shown that the role of the therapeutic alliance might be as important in technology-driven treatment as in face-to-face therapy. Knaevelsrud et al. [5] examined the quality of the working alliance, its development through the course of Internet-based therapy, and whether it moderates the impact of the observed change in posttraumatic stress symptoms. They found a growth in the quality of the therapeutic alliance over the course of the Internet-based therapy and a substantial correlation between therapeutic alliance and treatment outcome. In a study using VRET, the quality of the therapeutic alliance explained 46% of the variance of treatment outcome in patients with fear of flying [6]. Surprisingly, the therapeutic alliance hardly affected treatment outcome of VRET in patients with acrophobia [6]. Further studies are needed to investigate how to optimize the therapeutic alliance in technology-driven treatments, such as VRET and Internet-based therapy.

2.2. Clinically Relevant Samples

Relatively few studies have investigated the use of Internet-based therapy and VR treatment in children [4]. Given the interests of children and adolescents in cyberspace, this lack of research into clinical applications is astonishing. There is a clear need to develop cybertherapy programs for children with a variety of disorders. Some interesting examples do exist already. A recent study examined whether game elements would enhance motivation and working memory training performance of children with ADHD. Children with ADHD using the game version of the working memory training were more motivated to do the training task and showed better training results when compared to children using the regular working memory training [7].

Another challenge for the future is to make the patients participating in these programs more representative of the community. Generally, samples in the studies into the effects of Internet-based treatments in anxiety disorders and depression are characterized by highly-educated females with an age range from 30-45 years old [1]. Further, it should be noted that in most currently available programs, patients themselves chose an Internet-based treatment rather than face-to-face treatment, and are often self-referred. Thus, it is questionable how representative the participants are.

Another challenge for Internet-based treatment is to tailor treatment to participants' needs. Co-morbidity is very common in a clinical setting, for instance, the combination of mood disorders and anxiety disorders is not infrequent. An Internet-based treatment should have modules to deal with co-current problems in order to provide participants with adequate treatment.

2.3. Cost-effectiveness

Although it is generally assumed that technology-assisted therapies may reduce the cost of therapy, this has hardly been investigated [8]. It is generally assumed that technology-assisted therapy, such as VRET and Internet-based therapy, is more cost-effective than routine clinical care if technology-assisted therapy cuts the total human-contact time per patient compared to total time in traditional therapy [9]. Although studies using this criterion have estimated a savings of up to $600 per patient when compared to individual CBT routinely applied [10], such studies typically do not recognize the costs of development and maintenance of these programs, although there are a few notable exceptions [11]. Both in an Internet intervention and in VR treatment programs, the costs required to set up the intervention (including programming costs) and to maintain the intervention (including technical support and licensing of software used) are often very time-consuming and resource intensive [12]. Future studies addressing the costs of technology-based therapies should take the costs of development of these programs and the maintenance of

these programs into account as well. A related issue is how much of a reduction in therapist time is allowed before the treatment becomes less effective? Meta-analyses have shown that effects of computer-aided programs and Internet therapy are smaller when patients had less time with a therapist [13]. The most effective frequency and duration of therapist support have yet to be established.

2.4. Second Life

As to the implementation of VRET, there is a clear need for the development of more VR worlds in the public domain for a variety of anxiety disorders. Further, as a clinician, it is astonishing to see how few controlled clinical studies have been conducted in social anxiety disorder, panic disorder and agoraphobia, obsessive-compulsive disorder and posttraumatic stress disorder – clinically, the most prevalent anxiety disorders. Further, there is a clear need for studies investigating the possibilities of integrating VRET into Internet-based treatments.

The use of Second Life for conducting CBT has hardly been studied. Although Second Life could be an interesting medium for conducting therapy, as a first step, basic psychological research is needed in order to gain a better understanding of the created personality of avatars, and interpersonal aspects of avatar-based interactions. As a first step, it has to be investigated whether the personality traits of the avatar are comparable to the individual who directs the avatar. There is already some evidence that avatars behave in a gender-specific way. In a study in which Second Life users reported their activities in Second Life, men and women appeared to behave quite stereotypically [14]. Men were more likely to report building objects and working on their own virtual property, whereas females were more likely to meet people, shop, regularly change their avatar's appearance, and buy clothes/objects for their avatar. Thus, as summarized by the authors: even in Second Life, men build and women shop.

As to personality in avatars in virtual environments (VEs), it has been assumed that people use avatars to create a new personality with more “desired” personality traits than they possess in real life. Typically, subjects in such studies are directly asked to state differences in personality between themselves and their avatars. The results suggest that people tend to rate their avatar as being more extraverted and conscientious, and less neurotic than these subjects themselves are in real life [15]. In two studies at our department participants were asked to create and use an avatar within Second Life to communicate with other avatars. Finally, the avatar was asked to complete a Big Five personality questionnaire via a virtual interactive testing screen projected within Second Life. The virtual 5 PFT scores were compared to scores of the same questionnaire, which had been completed eight months prior to the virtual testing. Results showed a rather strong, positive correlation between personalities measured in real life and in Second Life [16]. In this series of studies we found no differences between any of the five subscales of the Big 5 personality scale (extraversion, friendliness, conscientiousness, neuroticism, development) using the pencil and paper questionnaire, and a virtual version of the personalty questonnaire, suggesting that users of VE do not create a “virtual” personality for their avatar. These studies add to our understanding of how personality traits may carry over to online virtual worlds and influence online behavior.

Second Life might offer an opportunity for treatment for patients with social anxiety disorder. As shown by Yee et al. [17], avatar-based interaction is rather comparable to interaction in the real world. For example, similarly to the real world, male avatars in a VE have more interpersonal distance and less eye contact than females. Given that Second Live is governed by similar social norms as real life [14,17], and that personality seems to be stable between the avatar and the real person behind it, [16] Second Life could form a platform for psychological interventions, especially for social anxiety disorder. Although exposure in vivo is the gold standard for treatment of social phobias, its effectiveness can still be improved upon. With exposure in vivo, patients are exposed to gradually more anxiety-arousing social situations for prolonged periods of time per session until anxiety dissipates and habituation occurs. One of the problems with exposure in vivo with social phobics is that many social interactions are time-limited; such exposure generally doesn’t last long enough for habituation of anxiety to occur. Another problem is that exposure treatment in real life cannot be done “anonymously.” These aspects are a serious drawback for the “normal” use of exposure in vivo for social phobics. Second Life could be a relatively safe alternative for the administration of exposure treatment. Exposure using VEs in Second Life may solve some of the problems currently associated with conducting exposure therapy with patients with social anxiety disorder. In Second Life, exposure to virtual social situations by using avatars is “anonymous” and can be repeated over and over again until habituation occurs. Furthermore, moving treatment from the clinic into the home may make treatment more accessible, helping to reduce the barriers for seeking professional help.

3. Conclusions

Although VRET and Internet-based psychotherapy have shown some promise, large-scale clinical implementation have not yet been achieved. VRET is typically applied in a few academically oriented institutions, and the evidence of its effectiveness is primarily limited to the treatment of fear of flying and acrophobia. Internet-based CBT may be as effective as face-to-face therapy for anxiety disorders and depression [1], but results are limited to volunteers who apply for psychological treatment through the Internet. There is no convincing evidence yet that Internet-based therapy and VRET are more cost-effective than more traditional (face-to-face) therapy. There is a clear need for further research in clinically relevant populations, including children.

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Efficacy and Effectiveness of Online Cognitive Behavioral Treatment: A Decade of Interapy Research

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Abstract. Since 1996, researchers of the Interapy research group of the University of Amsterdam have been examining the effects of online cognitive behavioral treatment (online CBT). Over the years, the group conducted nine controlled trials of online CBT for a variety of mental health disorders, among a total of 840 participants. These studies suggest that online CBT is a viable and effective alternative to face-to-face treatment. Treatment adherence was 82%, and reductions in psychopathology represented a large between-group effect size of SMD = 0.9 (95% CI: .7 to 1.1), which was maintained over long periods. The research culminated in the foundation of the Interapy clinic, which received Dutch health regulatory body approval in 2005. Since then, costs of online CBT are reimbursed through public health insurance. A large study of the treatment outcome of 1,500 patients of the Interapy clinic showed that effects in clinical practice are similar to those observed in the controlled trials, and comparable to selected benchmarks of naturalistic studies of face-to-face CBT. The accumulated evidence provides compelling support for the efficacy and effectiveness of online CBT.

Keywords. Cognitive Behavior Therapy, computer assisted protocol directed therapy, effectiveness studies, follow-up studies, Internet, randomized controlled trial, treatment outcome

Introduction

In 1996, researchers at the University of Amsterdam conducted a small feasibility study of Internet-based psychotherapy. Although the World Wide Web was still in its infancy at that time, they created a Web site through which they treated 20 students with posttraumatic stress. To the surprise of the research team, the results of what they called "Interapy" were very encouraging. Despite the lack of face-to-face contact, stress symptoms of 19 of the 20 students had reduced to normal levels after treatment [1].

The 1996 study was seminal. It was followed by over a decade of research which resulted in the full integration of Internet-based treatment in the Dutch public health system. In this article, we briefly summarize this research from a meta-analytical perspective. We discuss the Interapy method, the efficacy of Interapy as established in a series of controlled clinical trials, and the effectiveness of Interapy as observed in routine clinical practice.

1. What is Interapy?

Interapy is web-based, manualized, therapist-assisted cognitive behavior therapy (CBT). Screening, treatment, and outcome measurements are conducted without any face-to-face contact. With the exception of a diagnostic telephone interview, all interaction between patients and mental health personnel is conducted online through a secure Web site. Participants interact through an asynchronous exchange of text-messages, i.e., the dialogue resembles an e-mail conversation rather than a video-conference or an online chat-session. This dialogue is governed by a computer system that executes the treatment manual. The manual defines a fixed sequence of homework assignments that

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implement common CBT interventions, which are translated into a format suitable for delivery over the Internet. Therapist support consists of standardized, default feedback and instructions that are tailored by the therapists to the specific situation of their patients. In the feedback, motivational techniques are used to enhance the impact of the interventions, i.e., to ensure patients understand the purpose of the interventions, that they set realistic goals, that they do the exercises as prescribed, and that they continue treatment. These techniques target patients' motivation for change, the therapeutic alliance (e.g., by expressing empathy and understanding), and self-esteem and self-efficacy (e.g., by complimenting the patients on their progress and accomplishments). Treatments are brief, but intensive. The duration of treatment varies from 5-16 weeks, in which therapists provide feedback roughly two times per week.

2. The Efficacy of Interapy in Controlled Clinical Trials

Over the years, Interapy has been evaluated in the online treatment of depression, posttraumatic stress, bereavement, work-related stress, panic disorder and bulimia nervosa, in nine controlled trials [2-10]. Characteristics of these trials are listed in Table 1.

2.1. Method

Trials included a total of 840 participants. Most studies were randomized controlled trials (RCT), in which participants were randomly assigned to an Interapy treatment condition, or to a waiting list control condition. One study was a within-subject baseline-control study, and one study included bibliotherapy as an additional active experimental control condition. Outcome was assessed through well-validated self-report measures of primary and secondary symptom severity, such as the Beck Depression Inventory, the Impact of Event Scale, and the Depression Anxiety Stress Scales. These measures were administered at baseline, immediately after treatment (posttest), and one to three years after treatment (long-term follow-up). Outcome was analyzed in terms of mean change in symptom severity over time, and in terms of clinical significant change (i.e., reliable recovery [11]). Most trials involved conservative intention-to-treat analyses: participants, who did not complete posttreatment measurements, were assumed to have gained nothing.

Table 1. Characteristics of the Interapy efficacy trials.

Study	Symptoms	Target population	Experimental condition	N	Primary Outcome
Lange 2001	posttraumatic stress	student, Dutch	Interapy	13	IES
			waiting list	12	
Lange 2003	posttraumatic stress	community, adult, Dutch	Interapy	122	IES
			waiting list	62	
Wagner 2006	bereavement	community, adult, German	Interapy	26	IES
			waiting list	29	
Knaevelsrud 2007	posttraumatic stress	community, adult, German	Interapy	49	IES
			waiting list	47	
Ruwaard 2007	work-related stress	community, adult, Dutch	Interapy	177	DASS
			waiting list	62	
Ruwaard 2009	depression	community, adult, Dutch	Interapy	36	BDI
			waiting list	18	
Ruwaard 2010	panic symptoms	community, adult, Dutch	Interapy	27	PDSS-SR / panic
			waiting list	31	diary
Lange 2010	posttraumatic stress	Dutch, adolescent, victims of sexual abuse	baseline-control	24	IES
Ruwaard (submitted)	bulimic symptoms	community, adult, Dutch	Interapy	35	EDE-Q
			waiting list	35	
			bibliotherapy	35	

Note: IES: Impact of Event Scale; PDSS-SR: Panic Disorder Severity Scale, Self-rate; BDI: Beck Depression Inventory; EDE-Q: Eating Disorder Examination-Questionnaire; DASS: Depression Anxiety Stress Scales.

2.2. Results

Dropout rates were encouragingly low: an (unweighted) average of 82% of the patients completed every step of treatment. As illustrated by the left forest plot in Figure 1 (A), reductions in primary symptom severity were significantly larger with Interapy, in comparison to the experimental controls. The standardized mean difference (SMD) in improvement between Interapy and the experimental controls ranged from SMD = .5 to SMD = 1.3, with a pooled SMD of .9 (95% CI: .7 to 1.1). These are large effects, roughly equivalent to those of face-to-face CBT. Studies also revealed higher recovery rates with Interapy compared with experimental controls. Across the trials, the unweighted average recovery rate with Interapy was 60% (range: 36% to 85%) and 23% in the experimental comparison groups (range: 9% to 42%). As illustrated by Figure 1 (B), this equated to a significant, moderate-to-large odds ratio (OR) of 6.1 (95% CI: 4.2 to 9.0). One to three years after treatment, these treatment gains were found to be maintained.

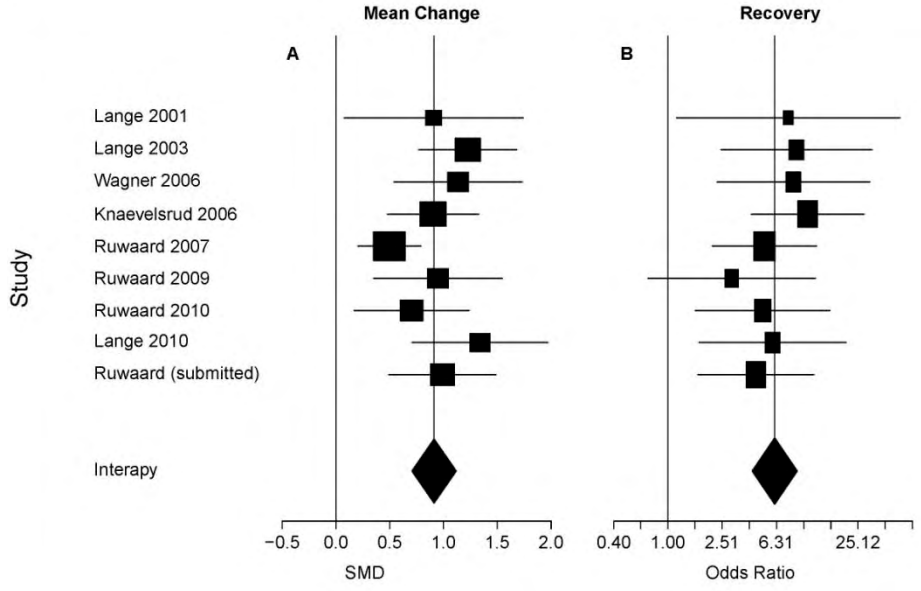

Figure 1. Forest plot of between-group effect sizes and 95% confidence intervals for the Interapy trials

3. The Effectiveness of Interapy in Routine Clinical Practice

In 2001, the Interapy research team founded the Interapy clinic with the aim of implementing online CBT in the public health system. This clinic has been in operation since. In 2008, the team examined treatment outcomes of 1,500 patients of the clinic to assess the effectiveness of online CBT during routine clinical practice.

3.1. Method

This was an uncontrolled, retrospective pretest-posttest study, with two follow-ups. Data were collected from unselected, consecutive electronic patient records of the clinic, which contained scores of self-report questionnaires that were administered at pretest, posttest, six weeks after treatment and one year after treatment. Patients were Dutch adults (female: 67%; age: Mean = 40; SD = 10) with a GP-referral for psychotherapy, who started treatment of depression (n = 413; 28%), posttraumatic stress (n = 478; 32%), panic disorder (n = 139; 9%) or work-related stress (n = 470; 31%). The majority of patients scored above clinical cut-off on the primary outcome measures (*n* = 1420, 95%; range 74%- 99% across treatments). Scores of about a quarter of the patients (24%; *n* = 364) indicated

severe symptomatology. Most (n = 1052; 71%) did not use psychiatric medication. Primary outcome variables were treatment adherence, primary and secondary symptom severity and recovery rates.

3.2. Results

Due to routine outcome measurement, posttreatment data were available for 79% of the patients. Treatment dropout was 29%, which is comparable to known dropout rates in Dutch mental healthcare (30%). Symptom reductions met selected benchmarks of naturalistic studies of face-to-face CBT. On the short-term (at post-test and six weeks follow-up), patients reported significant ($P < .001$) reductions in symptom severity, which represented a large pooled (uncontrolled) effect size of SMD = 1.4 (range: $0.7 \leq \text{SMD} \leq 1.9$). Among patients who completed treatment, 71% reliably improved and 52% experienced a clinically significant change (i.e., recovery). Follow-up measurements were difficult to interpret given an attrition rate of 67%. Nonetheless, available data suggested that improvements were sustained up to one year after treatment.

4. Conclusion

A decade of research has provided compelling support for the efficacy and effectiveness of online CBT. Treatment adherence rate is high (82%), effect sizes are comparable to those of face-to-face CBT, and method and outcome generalize well to routine clinical practice. Despite limitations of the present evidence (most comparison groups were waiting lists, most long-term follow-up results were uncontrolled, outcome was determined through self-report measures, and the applicability of Interapy to other disorders is unclear), the results identify online CBT as a valuable addition to existing treatment options. Online treatment provides relatively easy access, and may facilitate the timely implementation of new evidence-based treatment methods in routine healthcare. Dutch regulatory health bodies have recognized this potential. In 2005, these bodies endorsed the services of the Interapy clinic as a valid alternative to regular, face-to-face treatment. Since then, costs of online treatment are reimbursed through public health insurance to all Dutch citizens with a GP-referral for psychotherapy. The implementation and dissemination of online treatment has started.

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Between Cyberplace and Cyberspace: the Researcher's Role in Virtual Setting Research

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Abstract. Disciplines such as Internet Research, the Psychology of Cyberspace and the Social Psychology of Cyberplaces call for an epistemological reflection not merely on the universe of objects they deal with, but also, and perhaps especially, on the research settings used to investigate them. With this work, we intend to make a contribution to the debate on three issues: psychosocial interpretation of the new environments, the "mediated" nature of the researcher-setting-study object relationship, and cyberplaces as settings for mediated interaction research.

Keywords. videogame, interaction, social network, identity

1. Introduction

Disciplines such as Internet Research, the Psychology of Cyberspace [1] and the Social Psychology of Cyberplaces [2] call for an epistemological reflection not merely on the universe of objects they deal with, but also, and perhaps especially, on the research settings used to investigate them. As pointed out by Blascovich et al. back in 2002, virtual environments (VEs) give social psychologists the opportunity to build a third place – besides the "laboratory" and "field" – in which to conduct their research [3]. This third place is a very unusual research setting, characterized by particular elements and specific issues. For example, this "new opportunity" has to come to terms with the way in which the conventional approaches to the study of new media, within the theoretical horizon of CMC, used to represent the researcher, considering him to be "external" to the media environments, and, similarly, with the role attributed to new technologies, considered solely as tools for planning and managing experimental situations that were strongly characterized in terms of controlled artificiality. More recently, with the consolidation of approaches akin to ethnology and anthropology (such as netnography), there has been a tendency to think of the researcher as being hidden by the new technologies, thus, eliminating his potential meddling in the data production process. Any complex approach to objects found in these environments must consider the field of research is widening: from cyberspaces to cyberplaces. Environments characterized by any level of virtualization (from simple Internet places to Massively Multiplayer Online Role-Playing Games to augmented reality) may become cyberplaces.

To study them it is necessary to frame an aspect of interest and approach it with a relevant method. First attempts to comprehend these worlds were made by applying models from Social Psychology or Communication Studies [1] but were revealed to be woefully inadequate. As of today, the field has matured and has its own name: Cyberpsychology, or psychology applied to the New Technologies field. When the research focuses on social dynamics and mediated interactions, Social Psychology of Cyberplaces is the complementary field to Social Psychology [4]. This change meets an epistemological need. Research objects results from applying a particular perspective on "things" present in everyday life. Therefore, research objects will result from both a synthesis of a particular 'thing' experienced by social actors in everyday "cyberlife" (chat, blog, communities, etc.) and a particular point of view (attention to actions, interactions, relationships, etc.). By assuming a psychosocial perspective, research objects are different from the ones framed by Cyberpsychology. According to Social Psychology of Cyberplaces, the focus of the research is mediated interaction, instead of the effect on people of the

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medium itself. Virtual worlds are social places where social needs and social dynamics are applied, not just cybernetic spaces characterized by technological features. These new objects are Cyberplaces [5] and present a challenge for the researcher, since they are very complex. As explained elsewhere [1,4], only an integrated approach to these objects may capture their complexity. Here at this more traditional level, the researchers take an active role in choosing:

a) Their reference *theory*: researchers can decide on a theory focusing on Subjects (actors), on Objects (artifacts), or on the interaction involving both of these components (process). These theories are not mutually exclusive and have to be considered as different points of view on the psychosocial dimension of phenomena taking place in cyberplaces. Each theory is related to and integrated by the other theories.

b) The *level of analysis*: researchers must choose the level of detail they want to study. Local mediated interaction focuses on the relational process taking place via artifacts (e.g. computers, mediated environments or groups etc.): social dynamics, reciprocal goals negotiations, affordances and behaviors among interlocutors and between interlocutor and artifact. A more general level refers to the situation where interactions are located, in their everyday components (e.g. roles, micro-group processes, norms, etc.). The last focal level is the social context and how it shapes these interactions.

c) The *method* to make and analyze data: the researchers have to choose the most appropriate and feasible method to frame their object of study. The more complex the object, the more complex the method: quantitative, qualitative or mixed.

After making these choices, the researcher obtains a research object. On a second look, in a less obvious way, the researcher also plays a big role in constructing the contextual elements the object is in. When dealing with cyberplaces, this matter may be phrased as follows: how does the researcher take part in the construction of the VEs? Three dimensions appear central to this process: 1. *Intersubjective*; 2. *Pragmatic*; 3. *Symbolic*.

2. Methodological Issues: Researchers' Implication in Virtual Settings

Researchers have a considerable effect on the data they collect, not only because they decide how the data is produced, but because they are often within the setting the data are created in. The social dimension of the research setting is worthy of consideration for this very reason: the presence of the researchers in the setting may have an impact on the data and this may reveal important aspects of how the VE works. In a way, the research setting as a research instrument tends to be isomorphic to the research object.

Here, we consider some of the aspects that the assumption in critical terms of the new settings for mediated interaction research inevitably entails.

a) A more markedly psychosocial interpretation of the new environments with varying degrees of virtualization requires a shift in emphasis: rather than cyberspaces, it urges us to consider them cyberplaces, recognizing in them the co-construction of meanings and management of the interactions between those who act inside them, thus considering them as contexts in which the construction of intersubjectivity occurs partly in the same way as in face-to-face social spaces [2], and partly according to processes that are yet to be explained. And, if the researchers are present within either the virtual or non-mediated context, they take part in these processes together with the research participants. In a recent study in applied social psychology conducted by two of the authors [6], five groups of students were followed and filmed for 12 weeks of a blended environment class that required them to film a short movie on a theme important to Social Psychology. The aim of the research was to study how intersubjectivity is created within natural groups. In this case the setting was considered as a process and not a series of discrete events and the researchers participated in: 1) determining the phases of the study; 2) in each phase; 3) in regulating the relationships within each group; 4) in the evaluation of the work done by the groups. The researchers became part of the intersubjectivity created by the groups, on an utterance level, on the level of intra- and inter-group relationships, and as a mediator of the definition of symbolic significance of the work the groups did. Generally, researchers are part of the research setting, and must be aware their presence within the VE contributes to changing it and shaping interaction with the participants. Researchers not only design the research setting, but they are a very important

variable of the setting itself. This means that each researcher must have a strong knowledge of their own interaction modalities and their interpersonal repertoire, because these elements influence the VE, and consequentially, strongly affect the research results.

b) The researcher-setting-study object relationship is mediated, and requires a reflection on the ways in which it "immerses" into the medium. For example, one recent study focusing on user dynamics in Massive Multiplayer Online Role Playing Games (MMORPG) in school contexts conducted by one of the authors highlighted how the researcher, in order to observe, understand and interpret the alternating in-game/out-game processes or group dynamics, had to actively "immerse" himself in the environments (both in the game and in the class), considered not merely as a setting useful to the organization of a complex trial design, but rather as an environment to "be inhabited" and that is anything but easily controlled, in which the "here and now" of the events could not be reduced to action tracking, the simple recording of discursive, exploratory, competitive or play activities. This immersion within the environment allows for a deeper understanding of the research objects, but also entails that the researchers know how to keep the right distance from the objects and participants they are involved with.

c) The symbolic aspects of the new media have effects on the research. The symbolic load of a social network or a VR environment may influence the narrations produced/co-produced by the individuals and groups object of study and on their mediated interactions. Also, the network of relationships between the (cyber)places investigated and unmediated reality must be investigated, to grasp implications and mutual contaminations. Indeed, it is not unusual for those who study these new settings to encounter reluctance and refusal based on questions "external" to the VE forming the object of the study, or "transverse" to numerous environments, for example, of an organizational or institutional nature. For example, another recent study involving senior citizens using the Nintendo Wii for improving balance [7], participant recruitment was difficult because of the symbolic value the seniors attributed to the technology itself. For those participants who finished the research protocol, the researchers not only had to consider other symbolic aspects, such as investment towards the activity itself, the operators and the researchers, but towards their own avatars. When researchers select a medium to create a virtual setting and study specific objects, they must consider the symbolic load the medium has for the participants and if the medium, for its characteristics and for this symbolic load, requires that the researchers themselves enter the virtual setting and become active in it. Both the researchers and the participants bring different symbolic meanings which become embedded within the VE, creating a "setting micro-culture," which has effects on the results obtained by the participants and may not be easily reproduced in other contexts.

3. Conclusion

Any researcher dealing with a situated research environment or wanting their research to be portable outside the lab is required to re-think their own role, the nature of the research object and of the virtual setting.

In this paper, three main aspects were brought to the attention of the researchers studying cyberplaces to consider prior to and during data production and analysis (Figure 1):

1. The intersubjective dimension of the virtual research setting: the researcher is involved with the participant to create meanings and the VE itself;
2. The pragmatic dimension: to understand the environments of study, researchers must take an active role in them;
3. The symbolic dimension: the medium is rich in meaning both for the participants and the researcher, and such meaning effects the research setting and data production.

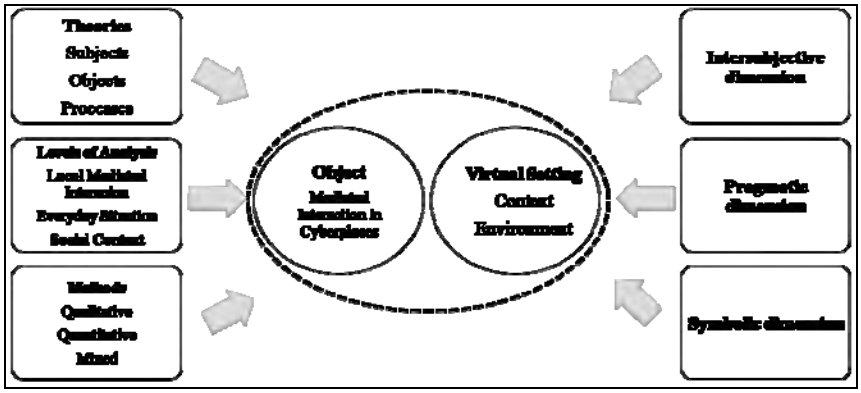

Figure 1. 3+3 dimensions for creating a Virtual Environment

In conclusion, keeping these three (plus three) dimensions under control should not be a minor occupation for researchers in their activity, but a real source for data production and interpretation, a way to respect complexity and escape from a simplistic "whatever works" attitude in exploring virtual settings.

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The Similarity Between the Virtual and the Real Self – How the Virtual Self Can Help the Real Self

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Abstract. In the exploration of a person's self-image in the Internet, it seems that there is one representing profile. But, is it coherent with the real self? Today we are able to perform counseling and therapeutic practices, and we can affect and change the human self and mindset in virtual spaces. Using the connection between neuroscience and philosophy, we show that there are different types of the self people adopt in cyberspace. By showing how their disposition changes many questions can be answered. What mind state provokes addictive impulses and enables therapy? How does the sense and concept of reality change? Can we transfer the experiences we gain in the virtual into real life? By investigating how the virtual affects us in a positive or negative way, support to successful treatment applications are possible. The goal of this study is to find answers for the virtual space usage as a treatment tool and to see what the future holds for such therapeutic tendencies.

Keywords. virtual space, virtual self, therapy, counseling, treatment, addiction

Introduction

This paper presents a philosophical investigation of the self people create in virtual spaces. Considering that the term "virtual space" includes all types of virtual simulations, we tried to make an integrative viewpoint towards the idea of the virtual self in them. Based on personal investigation and literature examples of phenomena in the virtual space, we developed an empirical qualitative study. The research analyzes user's Internet activity and compares it with users' dispositions in different moments in the development of cyberspace. The exact formation of online identity shows the way in which people perceive themselves while being "wired," and how the perception affects their real world perception and respectively, their self-image. We can see by the study analysis that people change or are affected by the specifics of the reality, although it is defined as "virtual." It is important to explicate how such power of the virtual space is possible.

This study makes a theoretical model of the types of virtual selves and traces their changes over time, assuming that this shows the importance of the virtual experience and its connection to cybertherapy. Due to the limited space, it is not possible to present a comprehensive review of the literature on the subject. The criterion for choice of the references is based on sample of older and more recent views on virtual spaces. The aim is to make a philosophical review of the virtual communication timeline, to define the types of selves created online, to see how the self changes in the virtual space, and on the basis of these findings, to see how positive influences are possible by using the virtual experience. To answer our questions, we conducted an empirical study with the assistance of 15 participants from Japan. We qualitatively assessed the results of the survey.

With such an approach toward the phenomena of virtual selves this study will aim to explain how treatment is successful on a virtual level. One of the reasons for such a claim is that the negative and positive effects are stronger in the virtual environment (VE); actually they are, in a way, multiplied by the characteristics of the virtual. The way people create their virtual personalities is a symptomatic process for the overall impact of technology on the self in the contemporary epoch. This influence is interpreted by philosophical observations and supported by empirical data in order to explain people's motivation to change their virtual and real selves by engaging in virtual activity.

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Method

To see how the process of creation of the self happens, the study follows the concepts of self in connection to technology. The introducing of the referenced authors, although not systematic, however, covers a variety of topics on the self in the virtual space. It is a comparison of the past and present viewpoints on online activity and observation of the different concepts for users that can lead to a discussion of the positive effect of the virtual on the self. A popular view claims that the mixed reality we live in today [1] is a ground for dissociation and multiplicity of the self as an effect with arguable values. This problematic view can help the research to grasp, in one concept, the possible types of selves online or in other kinds of VEs assuming that people interact with many kinds of virtual worlds. The analysis of those types can show how the self changes and gains experience in the virtual space and how the real self is affected, or, the real person's physical health condition. Still, the effects of this change can be polarized – from very negative to very positive. The goal of this work is to present the *similarity* between the virtual and the real self as a premise for the transfer of positive experiences from the virtual to the real life. From the survey analysis, we present the findings with various examples of strong effects on the self which are made in the virtual space. We qualitatively analyzed these results in order to explain this is possible, especially with the *similarity* (80% response) of the self-projections online and offline.

A starting point is to explain why the self feels engaged with the online activities and how it gets involved with the virtual realities, in general. This requires a description of the person's mental states in the virtual space, which is a basis to support treatment of problematic conditions in this environment. The specific cases of *addictive* behavior in users, detected by the survey, show the high estimation of the virtual space reality. Thus, by seeing how the negative effects occur, the positive ones can also be explained.

The virtual personae are explored in different studies. A focus here is made on the narrative approach in one study [2]. The reason is that the research shows a tendency for people to play with their identity online and to search for their true selves, partners and ways to handle their challenged aspects of selves. This process of self-exploration happened while experimenting with a new ground for representation – the Internet. But the attitude towards the virtual space has changed, that is why our study compares the relatively old view and contemporary research with the results of the survey. Thus, as a tool for the current research, the survey is made in regards to the identity formation online and in order to confirm the hypothesis for the virtual self types that can currently be detected. Also, a consideration of the dependability of the involvement in the virtual space and the positive effects of the virtual space on the self is one of the desired results.

Results

By comparing previous activity to today's distribution of interests in online activity, computer game-play and 3-D simulations, we developed content analysis of the survey and it shows that people present themselves in a more open, social, realistic and positive way. This is confirmed by the tendency to create virtual self, which is a *similar* representation of the self of the person in real life. When the virtual self is a certain type, this creates many other specifics, some of them being negative. This happens in virtual cases of crimes [3], thefts, or bullying [1], because the virtual self is not a fictional but actual self. We see that the self is closely copying the real self's personality online, and is a vulnerable entity which can be the subject of negative influence. Besides this kind of impact, users agree on having problems with procrastination (60%) and even *addiction* (53.3%) to certain types of Internet services. Nevertheless, they find it comfortable to meet friends, establish relationships, and conduct business online, in a more advanced or more entertaining way when compared to offline communication. How are such twofold effects are possible?

The survey helps to present a hypothesis for three types of virtual selves people have. Analyzed precisely, we can define the following types: people with a virtual self more or less *similar* to their real self; people with a virtual self more or less *different* from their real self; and a virtual self of people *addicted* to the virtual space (they may include the *similar* and *different* types). This hypothesis is based on previous works [2], [4] and is confirmed by the survey performed with participants including Japanese and foreign inhabitants of Tokyo who actively use the Internet, especially social networking services. The mixed cultural background of computer-savvy respondents was found to be suitable for the results' variety and saturation. The reference above is exemplifying the specific role of the virtual – to be a playground for the self. Still, this self is *different*, hidden, escaping or anonymous. That is why

we needed results which can show the current user attitude, namely, the presentation of the *similar* type of virtual self.

These virtual self-representations, how they act and are acted upon in the virtual space, can be symptomatic for the human affection via the usage of technology on an everyday level. People create online personae to change social reality, to add features to their existing real self or just to represent it in a certain way. This is supported by the finding that people have a real identity that is the subject of a healthy alteration of time, known as qualitative (not numerical) identity [1], but the online identity is a subject of great and fast-acting change because the virtual space is more flexible, in general. Still, people maintain that their virtual persona is constant and claim it is not *different* from their real life persona.

The *similar* virtual self as a replica of the real person's self is susceptible to greater change but the *different* self is already an evident change in the self that is experiencing new opportunities, specifically opportunities presented by the virtual sapce. One interesting claim made in this survey is that although slightly *different* and let us say, containing exaggerated features, the virtual self serves one purpose: acting as a better online projection of one's self and by this, becoming a major reason for personal improvements to be made in real life. Such personal reasoning by the respondent is actually ascribed to the virtual space, the power to direct the projection of the self online, and as a result, the real self too.

The findings of a past study [2] show that people used the Internet as tool for self-understanding; to try out new features in a fascinating environment. This fact shows virtual simulations can be used in the same way, especially if they are innovative, because they provoke experimental behavior. The tendency in the virtual space usage is activity is becoming more social and working to rebuild real world structures; the self is not *different* and the difference is aimed at presenting the desired image of the self. If we try to explicate previous research on the virtual self [4], it is possible to achieve unity of the self or to correct something that it was not possible to correct in the real world, mainly using the *different* virtual self representation, which was anonymous or hidden. The question is whether this is possible now [5] and with what self-representation today we present our virtual selves as a quite *similar* extension of the persona we are in real life. An investigation of the requirements for the self people create will lead to understanding how to provoke change in the virtual self in a more effective way.

A focus on the treatment application of the virtual space [7, 8] might bring about the question for the usage of the virtual space with the participation of both the *similar* or the *different* self with the real world self. Such kinds of representations occur online, so by using the examples of Internet users, we can conclude that therapy can be successful for all types of the virtual self, it is still needed to consider which type it is aiming at. Together with this, we investigate how the users' mind perceives the virtual space.

One important finding is that the respondents discover that the cyberworld is mirroring the real world: by effects of breaking news; by the virtual money being real capital; by relationships that start and end with online activity. In the same way, virtual simulation with a therapeutic, training or educational purpose [6] should consider which the target type of self-representation is and what change is intended. Whether it is a relaxation including fantasy substituting reality, or a creation of "better me" that will replicate the real world in the way desired by the patient, we need to choose how *similar* the virtual self will be. In other words, these are ways to explore the boundaries of the *similar* virtual self. It is still doubtful how this is a premise for successful treatment, but at least it answers questions for the various effects on the self in the virtual space.

The activation of the brain while using the Internet shows that brain altering occurs [9], but this actually shows a type of symbiosis which might be helpful for treatment or be symptomatic for an inclination to the variety of stimuli online. The case of *addiction* is of special attention: we witness it can be influential to a different degree in the virtual space. The respondents of the survey agree what *addictive* behavior entails, but the problems and impact on real life remains to be discussed. There are *addictions* in real life and it is possible to review the possibility to treat them in the virtual space because the simulation of actions is, so to say, relatively harmless, but the scale of the provided effect is sufficient.

The virtual space has the possibility of provoking *addiction* since it is interesting and absorbing. It consumes one's time as grounds for procrastination or feeds characteristics of the weakness of the self. But the exact impact on interest in the virtual space is discussed as to how it can be used for positive influence. For example, research on problems with attention span is connected with disorders like ADHD – also with their generation (such as the Internet enables them), or with the possible addressing of such problems, again, in the virtual space. Connected with the need for irrelevant new information and striving to keep the user's interest satisfied, procrastination as a result of

online activity is an example of Internet abuse. Sometimes exceptionally deviant cases (e.g. suicide after the loss of virtual self [10]) can be presented.

To answer this, we noted that brain activity is specific in the virtual space which is perceived by the agent as real, and even quite often as hyper-real (i.e. faster, with more stimuli, more fluid than real world). Regardless of this, users describe the online experience as “not tangible,” not “face-to-face,” “virtual, pseudo,” etc. On the surface this reality is defined using these example, but when actually addressed, people confirm it is real enough to change their lives. The user thinks that in the virtual it is safe to repeat/redo activity. Also, it is a freer environment with more opportunities because it feels hyper-real. The users do not think they are *different* in the Internet context and their experience is social.

Especially, this extraordinary perception supports the strong after-effect of the virtual space in therapy. People learn from online experiences and transfer it from their extended self in the everyday reality (75% of the respondents do so). The possibility of transferring the perception from the virtual space’s virtual self to the real self is the reason for the research to conclude that there are positive tendencies in the changes from the cyber world. Then, with such positive outcomes, we may rely on developing the virtual space as a tool for addressing people's problems or, actually treating them.

Conclusion

Using the support of the empirical survey, we made the virtual selves model to show that their experience changes them and that the different types need to be addressed in cybertherapy. We confirm that the present tendency in the creation of virtual self is the one of the *similar* type of virtual self. This type is a subject of greater alteration or influence by the virtual. The conclusion supports the virtual self in connection with healthcare.

The Internet and virtual simulations encourage people to develop an involvement with the reality, which has positive and negative effects. Users become engaged in the virtual space depending on their *similar* or *different* selves. As negative effects reach real selves we rely on the fact that positive effects can also be a stimulus for changes for the better in real life. The analysis of the contradictory effects of the virtual space and the way people create and re-create themselves there are interconnected problems to be investigated. This research connects them with the support of the application of the virtual space as a treatment tool.

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Use of Robotics Kits for the Enhancement of Metacognitive Skills of Mathematics: a Possible Approach

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Abstract. The present study is aimed at analyzing the process of building and programming robots as a metacognitive tool of mathematics. Quantitative data from a study performed on a sample of students attending an Italian secondary school are described. Results showed that robotics activities may be used as a new metacognitive environment allowing students to improve their attitude towards mathematics, and to increase their attitude to reflect on themselves and on their own learning, and their higher-level control components, such as forecasting, planning, monitoring and evaluation exercises and problems related to implementation.

Keywords. educational robotics, metacognition, learning, new technology

Introduction

The study of robots, as a teaching tool, begins with the contribution of Papert [1], who has incorporated the principles of Piaget's "knowledge as action" with innovative developments in computer science. Within this theoretical framework, "learning" means "building" knowledge, or manipulating "concrete" artifacts (e.g. small robots). Such artifacts become "objects to think by."

Robotic kits are *high tech* toys which allow users to build and to program small mobile autonomous robots into the physical environment [2]. These kits allow users to develop a game consisting of two steps; in the first step, participants have to build a robot body and, subsequently, they have to create a program in order to enable it with artificial intelligence (e.g., create a robot that is able to move and change its behavior if it faces an obstacle). Finally, subjects test the robot's performance in the physical environment in order to check its success/failure. The final test is quite important because users can instantaneously see what they have planned for the robot and verify if it behaves as it was planned to do. The final test allows users to verify the correct execution of commands given to the robot.

Several theoretical studies and empirical research has shown that playing with robots allows students of different ages to improve their planning, reasoning and problem-solving capabilities [3, 4], as well as social skills related to peer conflict resolution, group decision-making and so on [5]. Moreover, children with mental retardation and autistic disorder seem to benefit from rehabilitative activities based on robotics [6, 7]. Further, according to our knowledge, there are studies which analyzed the possibility of using robotics kits as metacognitive tools [8]. In general, metacognition consists of two basic processes occurring simultaneously: the first is monitoring the progress of learning; the second is making changes or adapting learning strategies as subjects perceive alterations are needed [9]. Specifically, metacognitive skills include monitoring the progress of learning, correcting errors, and changing strategies when needed [10]. From this perspective, the whole experience of playing with robots may be considered as a metacognitive process which leads users to become more aware and conscious of their way of thinking, learning, and organizing the game itself.

We performed a study on a sample of students attending a secondary school involved in a robotics laboratory, in order to check the improvement of their metacognitive skills related to mathematics through the use of robotics kits.

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1. Method

1.1. Participants

We recruited thirty students and assigned them to a control or experimental group, each composed of fifteen subjects (nine male and six femlae; mean age: 11 years, range 10-12). Students were randomly selected from the first classes of a secondary School of Palermo. All students signed an informed consent form and the study was approved by the ethics committee.

1.2. Materials and Procedure

The study was composed of three phases: the first (pre-test) consisted of an assessment of metacognitive skills and beliefs related to the acquisition of the subject of mathematical knowledge; in the second phase (treatment) the experimental group was involved in a robotics lab (described below); the third phase (post-test) provided a second measurement of the two group's metacognitive skills.

The Metacognitive skills were evaluated individually, during the pre-test and the post-test assessment, using the Questionario di Matematica e Metacognizione-MM [11] encompassing three sections: *attitudes*, *belief*, *control processes* influencing math learning.

The questionnaire allows for several qualitative observations, such as exploring the presence of specific mathematics skills and some aspects of metacognition in mathematics. Section "A" concerning attitudes, presents situations in which students have to solve math problems and operations. Subjects are invited to respond "often," "sometimes," "never or almost never." The items, all relating to mathematics, can be classified mainly in two distinct areas: one refers to the experiences and attitudes towards the discipline, the other refers to behaviors and approaches to solving mathematical problems.

Section "B" presents statements regarding the most common metacognitive beliefs in mathematics (e. g., *If I am not able in mathematics, then I think I am a fool; a math problem must be resolved soon, or cannot be resolved anymore).* Students are invited to express an opinion with answers "true" or "false." The items refer to the three main types of mathematical beliefs: skill, discipline and learning.

Section "C" investigates higher-level control processes: forecasting, planning, monitoring and evaluation. In this section, students have to solve mathematical exercises, operations and problems. In some cases, they only have to read the question and answer concerning the degree of difficulty of the problems without doing the calculation, while in other cases, they have to resolve problems by following the precise instructions and provide the answer.

According to previous research [3, 4], each group was provided with a robotics kit and was involved in extra-curricular hands-on laboratory sessions based on robotics activities (10 meetings; two hours each, once a week). After becoming familiar with the hardware and software elements of the kit, all the students were given construction and programming tasks with an increasing level of difficulty, as measured by the number of bricks, which had to be manipulated for constructing the robot body and by the number of drives, which had to be linked to create a specific behavioral task for the robot.

The initial task was to build a robot, then, participants were involved in programming it by using the software interface. Each group was provided with a desktop computer and a USB cable to download the software program into the robot, and assigned with the following programming tasks, having an increasing level of difficulty measured by the number of commands necessary for programming the robot:

- Build the chassis and the wheels;
- Build the chassis with the sensor;
- Program a robot able to move along a linear route;
- Program the robot to be able to move and move along a geometric figure such as a square;
- Program the motors and the color detection sensor/create and program a robot which is able to move and change trajectory if there is a red line along its route;
- Program the motors, the color detection sensor and the ultrasonic sensor/create and program a robot which is able to move and shoot balls if there is an object along its route (figure 1).

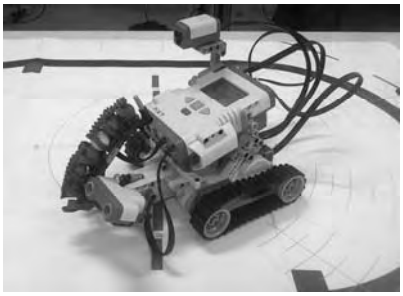

Figure 1. Robot which is able to move and shoot balls if there an object along its route.

2. Results

A multivariate analysis of variance with repeated measures was carried out to examine the effectiveness of treatment, with two levels of the between-subject Group factor (experimental group and control group) and two levels of the within-subject Time factor (pre-test and post-test), respectively, on the scores: *attitude, belief, and control*.

For the multivariate test there does not appear to be any main effect between-subject factor Group ($F_{3\text{-}26}$=2,133; n.s.); whereas the within-subject time factor ($F_{3\text{-}26}$=4,368; p<.01) is statistically significant. A main effect of Time x Group interaction ($F_{3\text{-}26}$=6,454; p<.01) has been shown as well.

The univariate tests showed that the Group factor does not statistically effect any of the considered variables, whereas the Time factor statistically effects only the score related to the dimension of attitudes ($F_{1\text{-}28}$=3,98; p<.05), but not those related to the dimension of Control ($F_{1\text{-}28}$=1,56; n.s.) and Belief ($F_{1\text{-}28}$=3,38; n.s.). On the contrary, the effect of Time x Group interaction is statistically significant for all the variables considered.

As reported in Table 1 for the variable Belief, the performance of the experimental group decreases from pre-test to post-test because of treatment ($F_{1\text{-}28}$=5,63; p< .05), while the score of the control group participants increased. For the Attitude variable, the difference between the experimental group and the control group is statistically significant: the subjects of the experimental group increased their positive attitudes towards mathematic from pre to post-test, whereas the subjects of the control group decreased their positive attitude towards this discipline ($F_{1\text{-}28}$=6,67; p<.01). Finally, for the variable Metacognitive Control, although the post-test scores increased in both groups, from pre to post-test, the increase in the experimental group is higher than the increase shown by the control group ($F_{1\text{-}28}$=10,22; p<.01).

Table 1. Repeated Measures ANOVA between subject and within subject (before and after training)

	Experimental group				**Control group**			
	Pre-test		**Post-test**		**Pre-test**		**Post-test**	
	M	**DS**	**M**	**DS**	**M**	**DS**	**M**	**DS**
Belief	54,720	2,941	53,840	2,29	46,01	2,941	52,960	2,294
Attitude	54,340	2,270	59,593	1,809	56,133	2,270	55,460	1,80
Control	54,1	2,088	56,873	2,082	53,487	2,088	47,187	2,082

3. Conclusion

Results showed an increase in post-test performance for the experimental group compared with the control one.

Specifically, our results suggest that using robot kits improves students' attitude in mathematics, and also enhances their attitude to reflect on themselves, on their own learning, and higher-level control components, such as forecasting, planning, monitoring and evaluation exercises and problems related to implementation. This study is the

first attempt to investigate the possibility of using robotics activities to modify dysfunctional beliefs which may influence mathematics learning; it also investigates other wider issues, such as the concept of intelligence as related to scholastic success, and those more specifically related to the solution of exercises and problems.

In general, our results show that the training with robotics kits may help to develop students' awareness and metacognitive abilities. Indeed, the results showed that the involvement and improvement of the logical reasoning ability allows subjects to anticipate and to plan the sequence of actions needed to solve a particular behavioral task. These skills are independent from the proposed task and can be applied to the specific content of the discipline. Therefore, we considerate robotics kits as a rehabilitation tool which improve problem solving, planning and self control skills, and support motivation, even in subjects with learning disabilities. These results lead us to consider, in future work, the possibility of realizing educational robotics laboratories involving small groups of subjects matched for cognitive levels, and taking into account both the cognitive and social dimensions of intelligence, as tools for rehabilitating children, adolescents and adults as pertains to their psychological wholeness.

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Interpretations of Virtual Reality

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Abstract. University students were surveyed to learn what they know about virtual realities. The two studies were administered with a half-year interval in which the students (N=90, specializing either in mathematics and science, or in social science and humanities) were asked to name particular examples of virtual realities. The second, but not the first study, was administered after the participants had the chance to see the movie "Avatar" (no investigation was held into whether they really saw it). While the students in both studies widely believed that activities such as social networking and online gaming represent virtual realities, some other examples provided by the students in the two studies differ: in the second study the participants expressed a better understanding of the items related to virtual realities. At the same time, not a single participant reported particular psychological states (either regular or altered) as examples of virtual realities. Profound popularization efforts need to be done to acquaint the public, including college students, with virtual realities and let the public adequately understand how such systems work.

Keywords. Virtual Reality, survey study, university students, interpretation, avatar

Introduction

While scholars and engineers believe that *virtual reality* (VR) technologies are on the cusp of entering into the practice of management and control, education, business, entertainment and even everyday life, particular technological and conceptual ideas underlying VR systems are not yet widely known. There are at least three trends in interpreting the concept "virtual reality." These trends, or interpretations, can be traced, at least in Russia but probably also outside Russia, both in popular media and in scholarly works.

The *first* trend, the one which is being articulated more and more often, is oriented towards the interpretation of VR as a joint product of psychological knowledge and computer technologies, which require equipment, including powerful computers, head-mounted displays or goggles, motion trackers, 3-D monitors, haptic gloves, and effective computer simulation programs [2]. The *second* trend involves a widely accepted idea that any activity performed in an online modus represents a genuine VR; the possible activities include (but are not limited to) video gaming, chatting, web navigation and exploration, writing and reading blogs, social networking, downloading music and movies, twittering, uploading photos, etc. [1-3]. Finally, the *third* trend corresponds to unique processing in each person's mechanisms of perception and categorization of the outer and inner world's events: any personalized view (albeit mainly common to the others' views, but necessarily altered, in many ways biased) on the environment forms a sort of a special, or virtual, reality [4].

The three types of interpretations may be covered by the concept of *Presence*: while some scholars express interest in this theory, it is not yet widely known in Russia.

The parallel interpretations seem to co-exist, at least in public opinion. It is worth studying which of the current trends is dominating. This can be done by administering a survey: the suggested *method* is to collect examples provided by laymen respondents and to classify the examples as referring to particular interpretations. That is, the *aim* of the study is to learn the full diversity of the currently existing interpretations known to laymen, and to determine which particular interpretation is currently dominating. This technique – to put direct questions and collect the respondents' replies, that is to make their implicit knowledge explicit – is similar to the question-answering methodology used by J. Piaget for collecting data in his seminal books on developmental epistemology.

The media offers support to both correct interpretations and misinterpretations. Popular movies are the champions in presenting manifold views. Movies such as "The Matrix" (as well as "The Matrix Reloaded") and

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"Avatar," are likely to provide both correct and false hints to the nature of VR. The difference is that "The Matrix" was seen by many viewers who had rather accidental experience in the use of information technologies, while "Avatar" was seen by a population of viewers, the majority of whom are active in widespread social networks, and use numerous web services. The role of movies is not the goal of the current paper; they are mentioned to note that the media provides support for different views on VR. The two studies reported here were done before and after "Avatar" was released.

1. A study of the University Students' Views on Virtual Realities

The aim of the current work is to find out what ordinary, educated, non-professional people understand about the notion of VR. The investigation consists of surveying university students. The participants were surveyed in person.

The same methodology was used in the two studies. The first was administered in late spring, 2010; at that time the majority of viewers had no experience with a purely 3-D environment as exemplified in the movie "Avatar." The second study was performed in late fall, 2010, after "Avatar" was widely advertized and shown.

1.1. Methodology

The participants were asked either one or two questions. First, "Can you explain what a virtual reality is?' In case the respondents either were or were not able to provide an explanation, they were given the second question, "Can you give examples of a virtual reality?" They were encouraged to provide as many examples as they could.

In a pre-study session (with eight participants) it became evident that the students were only rarely prepared to conceptualize the essence of a VR system; they are apt to either confess they know too little on the theme, or answer the first question by simply giving examples of what they think VR is. There was no need to give them the second question in the latter case; instead, the respondents were encouraged to provide as many examples as they could. Thus, it was expected that the second question would either not be necessary, or only asked to a few participants.

The oral replies were tape-recorded; the protocol was based on recordings including all the examples given by the participants. At the same time, we ignored all the accompanying comments the students expressed, for example, concerning their personal attitudes towards the technologies they mentioned, about the values of these technologies, etc. We also recorded the participants' gender, age, and field of study, either (1) social sciences and/or humanities, or (2) mathematics and/or science.

1.2. Participants

Forty-two university students took part in the first study, among them 23 females and 19 males, aged 17-24 years old (mean 19.8), styding social sciences and humanities (N=24, 14 females and 10 males) or mathematics and science – biology, geology (N=18, 9 females and 9 males). Forty-eight university students took part in the second study, among them, 22 females and 26 males, age 17-26 years old (mean 20.4), studying social sciences and humanities (N=23, 13 females and 10 males) or mathematics and science – biology, chemistry (N=25, 9 females and 16 males). All the respondents were students at the Moscow State University; none of them specialized in computer science, psychology or film studies.

2. Results

2.1. Results, First Study

When answering the first question, two students (males, one mathematician and one biologist) provided theoretically correct explanations: they mentioned differences in computer-generated images projected to either eye/ear, trackers to trace the user's movements and to pass this information to the computer to render and change the image. These two students were then asked the second question: "Can you give examples of VR?" Two students (females, in humanities) refused to give any explanation. They were given the second question, "Can you give examples of VR?"

The rest, 38 students, started answering the first question giving examples of VR. They were not given the second question; instead, they were encouraged to provide as many examples as they could.

All respondents provided examples of VR. The number of examples provided by participants ranged from two to eight (mean=3.4). All the examples provided by the participants are shown in Table 1. The examples are cited exactly as they were provided, without coding or classification, only, sometimes shortened. For example, when a particular TV program was mentioned, it was placed in the table as "television." The figures in the middle and the right columns specify how often the example was provided, classified by participants' gender and specialty in the university.

Table 1. Examples of Virtual Realities, classified by gender and specialty in University (Spring, 2010).

Type of Activity	**Gender (f/m)**	**Specialty in University (Soc. Sci. & Hum. / Sci.)**
Social Networking	18/11	19/10
MMO gaming	7/14	9/12
Twittering	5/8	8/5
Chat Groups	4/7	9/2
Web Shopping	4/3	2/5
Instant Messaging	3/4	6/1
YouTube	4/1	4/1
E-mailing	2/3	5/0
Web navigation	4/0	1/3
3D	1/3	0/4
Blogging	0/3	2/1
Web Money	0/3	0/3
Special Effects in Movies	2/1	3/0
WWW	2/0	2/0
Television	1/1	2/0
Web Auctions	0/2	0/2
Nintendo Gaming	0/1	0/1
Movies	1/0	0/1
Electronic Newspapers	1/0	1/0

It might be mentioned that no particular item genuinely related to VR, has been reported, with the exception of a rather amorphous "3-D", reported by four participants (three males and one female, all studying science). The respondents believe that as they use social networks, play online games or game consoles, chat, twitter, blog, send e-mails and IM, watch YouTube, TV or movies with special effects, pay for items online while e-shopping, read e-papers, etc., they are immersed in VR. It is easy to conclude that the students tend to name a variety of electronic media as "virtual reality," mainly, social services, which they know best and supposedly, use often.

At the same time, not a single purely psychological state has been reported: that is, the students do not accept or, more likely, are totally unaware of, a trend to treat individual traits and subjective biases in categorizing the world in VR terms.

2.2. Results, Second Study

By supposition, the difference between the participants in the second and in the first study is that the former have had a chance to see the 3-D movie "Avatar." Irrespective of whether they have indeed seen this movie, they supposedly have acquired some knowledge about the advancements of 3-D technologies, due to intensive advertizing.

The results of the second study are as follows. Forty-eight students took part in the current study; three of them (one philosopher and two mathematicians) were able to provide a reasonably correct explanation of what a VR is, while two students reported they were unable to do that. These five students were given the second question, and like the other 43 students, they provided examples of VR. The number of examples provided by particular participants was two to six (mean 3.1). These classified examples are placed in Table 2.

Table 2. Examples of Virtual Realities, classified by gender and specialty in University (Fall, 2010)

Type of Activity	Gender (f/m)	Specialty in University (Soc. Sci. & Hum. / Sci.)
MMO gaming	9/16	7/18
Social Networking	14/11	15/10
Avatars	10/14	9/15
Ipad	7/9	5/11
Web money	4/7	8/3
Special Effects in Movies	5/6	10/1
Blogging	6/6	7/5
Twittering	2/6	6/2
Advanced 3D monitor	1/3	0/4
YouTube	4/0	3/1
E-mailing	2/1	1/2
3D	0/3	2/1
Instant Messaging	1/2	1/2
Television	2/1	2/1
3D spectacles	1/1	2/0
Movies	0/1	0/1
Iphone 4	0/1	0/1
Augmented reality	1/0	1/0
E-papers	0/1	0/1

It is evident that the items in Table 2 are in many ways different from the items in Table 1. Of particular importance is the fact that quite a number of items directly refer to what is related to a VR. While it is to be expected that half of respondents (24 persons) reported "avatars," it is a bit strange that only two students reported "3-D spectacles," since this item clearly corresponds to their movie-viewing experience (the others might supposedly have seen the movie in a 2-D format, or else might disregard the salient effect of special spectacles for 3-D performance). Meanwhile, we find it is of primary significance that as many as eight respondents out of 48 are aware of lesser known (and probably more characteristic of the VR systems) items such as "augmented reality" (once), "3-D" (three times), and "advanced 3-D monitor" (four times). Of less importance is the fact that every third participant mentioned an "iPad" as an example of a VR; a likely explanation is that it is a by-product of intense advertizing of Apple products such as the iPad (reported 16 times) and iPhone (reported once).

Similar to a survey that was administered half a year earlier, no psychological states have been reported; that is, the students do not correlate either regular or altered states of conscience to VR systems. They obviously relate a VR to one of the advanced products of modern information technologies.

3. Discussion

The two studies show that the abovementioned trends toward different interpretations of VR are not equally popular or equally well known within a population of non-professionals – students who study various disciplines at the Moscow University. The third trend, which emphasizes the importance of psychological states in formatting processes of perception and categorization of the environment, is not presented at all, either in Table 1 or in Table 2. That means the frequency of occurrence of this particular trend has not increased within the time period between the first and the second study. If the tendency is stable, then in the course of time, this interpretation is not likely to become more popular than it is now, and presently, it is not popular at all.

The overwhelmingly dominant interpretation of what is VR is certainly the second trend, namely, the belief that any sort of online activity refers to VR. At the time when the first study was carried out this interpretation seemed to be the only known interpretation to the public, but by the time of the second study, it became evident that some elements of the first interpretation were known to the public, too. Supposedly, this modification can be explained in terms of participants' personal experience with 3-D products such as the movie "Avatar." This supposition corresponds to psychological data, recommending that human beings are provided with personal experience in the desired sort of activity, in the use of new products, in accepting new mental ideas, etc.

The second trend in interpretations of what constitutes VR is habitual and supported in the media. Moreover, it corresponds to everyone's personal experience, those who use the Internet and social services on the Web. In an attempt to foresee trends in the near future, one might suppose that this type of interpretation is not likely to disappear. The aim is, however, not that this trend will continue to be the only one, and that knowledge will increase as a parallel way of interpretation.

The community of practical workers, creators of VR systems, is responsible for their interpretation trend to become well known to the public: namely, the trend which operates with head-mounted displays or goggles in which a person perceives computer simulated images. This is the first trend, as it was randomly listed in the Introductory section. Hopefully, it will sooner or later become the most often mentioned trend when someone needs to provide an interpretation of a VR.

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Towards Immersive and Adaptive Augmented Reality Exposure Treatment

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Abstract. In this paper we introduce a novel augmented reality based exposure therapy system for phobia treatment. This allows patients to see virtual fear stimuli overlaid onto the real world and to fully interact with them in real time. Extending on previous work, we focus on creating a controllable and interactive system (through gesture recognition and physiological sensors) with a visually realistic context. Our goal is a very life-like system that allows full parameterization over stimulus intensity and other factors necessary for an effective exposure therapy system.

Keywords. augmented reality, exposure therapy, interactive AR, natural feature tracking, gesture recognition

Introduction

Exposure therapy is a very effective treatment for specific phobias [1]. However, it entails being confronted with intense fear inducing situations, so many people never seek or refuse treatment, and it can be challenging and expensive to provide appropriate therapeutic stimuli [2]. Virtual reality exposure therapy (VRET) addresses some of these concerns. In this case a virtual environment (VE) is generated with fully controllable virtual stimuli which therapists can use to let clients gradually face their fears.

Various surveys and meta-analyses have studied VEs, especially for specific phobias [1-5]. Overall, the research suggests that VRET is very effective in treating specific phobias and provides a much-needed addition to traditional therapies [1].

It seems that the feeling of presence plays an important role in the effectiveness of VRET [2]. High levels of presence mean that users perceive their experience in the VE as "real" and not mediated through technology [6], and can aid the development of anxiety in an immersive VE [7].

Although immersive virtual reality (VR) systems were found to be effective for exposure therapy, they separate users from the real world. Hoffman et al. [8] studied the addition of real elements to a VRET system by using a real toy spider that provided tactile feedback, and found that VR plus tactile augmentation was more effective than VR alone. They argue that blurring the distinction between what is real and what is virtual helps generalize desensitization from the virtual to a real spider. Being able to physically touch the virtual fear stimulus increased the degree of realism, the sense of presence, and the experienced anxiety during treatment.

More recently, augmented reality (AR), a technology that overlays virtual content on the real world, has gained interest from researchers in clinical psychology. VR systems generally immerse the user in a fully computer generated environment, whereas in AR systems the user still can see the real word with virtual objects superimposed upon it [9]. Milgram et al. illustrated the difference between VR and AR in their Reality-Virtuality Continuum (see Figure 1) [10].

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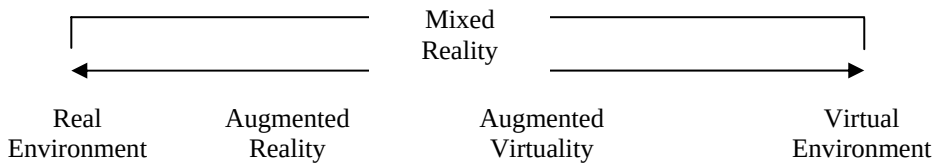

Figure 1: Milgram's Reality-Virtuality Continuum [10]

AR systems provide either direct or "mediated" perception of the real environment, real artifacts and our own bodies. They may increase ecological validity and effectiveness of virtual exposure treatment by embedding virtual fear stimuli directly into the real environment.

1. Augmented Reality Exposure Therapy

AR systems have been developed for exposing patients to spiders [11] or cockroaches [12-14]. These systems use a basic hardware and software setup with clients wearing a head mounted display with an attached USB camera to track AR markers [15] . Virtual 3-D models of fear stimuli are overlaid on top of these markers and animated with predefined basic motion. One disadvantage is the use of visual markers for tracking which give the client a clue that a fear stimulus is going to appear at this position. Therefore, Juan et al. [16] used special ink that was only visible to a camera sensitive to infra-red light, but there have been no evaluation results presented using this system so far.

One benefit of an AR system is that it allows patients to use real objects or their hands to interact with the stimuli [11]. However, this type of interactivity has not yet been implemented in AR-based exposure therapy (ARET) systems. While interaction possibilities in current systems is rather limited (only controlled by a therapist), they are capable of inducing the levels of anxiety necessary for exposure therapy to be effective. The main element that elicited the highest anxiety levels was "giving movement" to the stimuli [13]. We suggest that a virtual stimulus that is not just moving but also reacting and adapting to the client's presence or actions (i.e. body posture, gestures, gaze or emotional state) might make them appear even more realistic and create more effective exposure therapy.

These studies on the use of AR technology as a basis for an exposure therapy system are very promising. AR affords interesting opportunities to create unique therapeutic environments by letting clients interact with virtual fear stimuli in the real world. Some of the distinct features of ARET systems are that they can:

- lead to a more realistic experience compared to fully immersive VR (enhanced ecological validity) that still allows full control of the virtual fear inducing objects,
- afford direct interaction with virtual stimuli that "react" to the client's actions and behavior (for example, clients can use their hand to interact with virtual objects),
- easier to setup and more deployable than current VR solutions because AR requires only partial 3-D virtual authoring of the environment (the rest is provided by the "view" of the real world) [13].

In summary, evaluation studies suggest that AR systems can be valuable tools for therapeutic purposes, but more research is needed into the effectiveness of more naturalistic and interactive AR environments for exposure therapy. In the next section, we present our approach at creating an experimental test-bed to explore these issues.

2. An Advanced Augmented Reality Based Experimental Test-bed

We are developing an advanced interactive ARET system that will provide a high quality experimental test-bed and allow us to study the potential of using non-disruptive interactive AR as a tool for exposure therapy. The novelty of our system lies on using user actions as a control input to the system and creating a naturalistic environment.

We have implemented a prototype that allows users to see and interact with virtual stimuli in their real surroundings. Our development is guided by the following aspects:

- Stable low cost hardware setup: We are exploring different hardware solutions for this system. The main focus is on creating a stable and usable platform that allows us to thoroughly evaluate the use of non-disruptive, interactive AR for exposure therapy.
- Provide a natural environment: With using advanced tracking technology (natural feature tracking, NFT), we can track the real world without the need for additional visual markers or tags. This creates a less disruptive and more "life-like" environment that does not give clues as to where virtual stimuli might appear. We are able to place virtual stimuli on any sufficiently textured surface which considerably enhances the realism of the system.
- Gesture recognition: Having virtual stimuli react to the client's presence can significantly enhance interactivity. This is supported through hand interaction above the tracked surface, using a basic gesture recognition technique and a vision-based hand tracking algorithm. By tracking the user's hand we can detect movements (e.g. static, shaking, moving forward) and use these as input for controlling the system and having the virtual stimulus react to it.

The prototype was developed in C++ using the OSGART [17] framework developed at the HIT Lab NZ. OSGART handles the rendering, animation and displaying of the scene. Coupled with OPIRA [18] tracking library, we are able to use a planar NFT target as a means of finding the space where the therapy is to take place. Tracking targets can be easily changed to any sufficiently textured image. An ideal target should be banal enough that the participant is not consciously aware of its presence, yet sufficiently detailed for the tracker to reliably track it. A 3-D spider model[2] was integrated in our program with animations that can be easily triggered separately.

For the participant to interact with the phobia stimulus we used an extension of OPIRA to track the hand using an algorithm that calculates the difference between the camera image and the image of the NFT tracked image. The resulting difference image is then thresholded, followed by a contour identification and selection of the largest contour which defines an average location of the hand.

For the current prototype we used a Logitech Pro 9000 webcam and a standard computer screen for displaying the AR image. This setup can easily be changed to an integrated AR head mounted display (e.g. Z800 Visor Display + webcam) to provide a more immersive experience. See Figure 2 for an overview of the entire system.

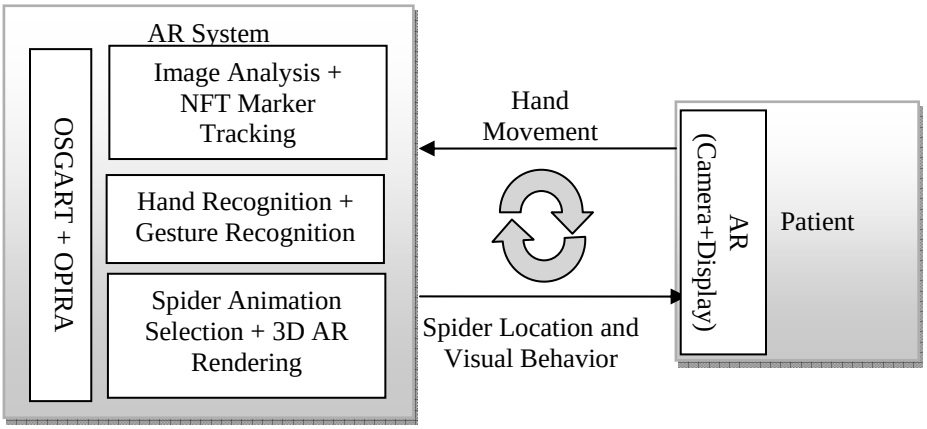

Figure 2: Overview of the AR exposure treatment system

3. Future Work

In the future we envision integrating more input control such as physiological sensors (galvanic skin response or heart rate sensors) or tangible objects (physical proxy of real object). Physiological measurements have already been

[2] Model downloaded from http://www.turbosquid.com/

used as assessment tools in exposure therapy [3]. During therapy sessions the sensor readings can be used by the therapist to adapt exposure intensity. By integrating such sensors into an ARET system, stimulus intensity and behavior can be adapted automatically according the sensor output, making the system more interactive.

During the design and development process frequent small-scale usability tests with a non-clinical population will ensure that the development requirements are met. Further evaluation trials will follow once a stable prototype has been developed. Our evaluation studies will focus on investigating:

- The benefits of creating a more realistic exposure treatment environment with an AR system using natural feature tracking, and
- The effectiveness of adding more interactivity to such an AR based treatment system by incorporating gesture recognition and physiological sensors.

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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

Isolating the Effect of Virtual Reality Based Exposure Therapy for Agoraphobia: a Comparative Trial

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Abstract. The isolated effect of Virtual Reality Based Exposure Therapy (VRBET) for agoraphobia was analyzed through a comparative trial involving the first 10 agoraphobic participants. The participants were randomly assigned to two groups: VREBT only and VREBT combined with cognitive therapy. All the required Virtual Environments (VE) were created with an inexpensive Game Level Editor (GLE). Outcome measures supported the immersive effect of the VEs. Questionnaires, behavioral tests and physiological measures indicated a positive effect of VRBET alone. The addition of cognitive therapy to VREBT did not appear to generate any significant differences. Consequences for future research and practice are discussed.

Keywords. Virtual Reality, exposure therapy, virtual environments, agoraphobia, cognitive therapy, game level editors

Introduction

The ongoing Mars 500 experiment which involves volunteers living in a hermetically isolated environment for 520 days [1] may seem a challenge for many, but for a certain percentage of people suffering from a phobia entitled agoraphobia even reduced and/or enclosed spaces commonly found in an urban environment (crowded places, mall, subway, underground car parks, public toilets, lifts, skyline, etc.) can be perceived as threatening or panic provoking [2]. Agoraphobia is indeed defined as the fear of being in places or situations from which escape might be difficult or embarrassing [2]. The subsequent avoidance behavior exhibited by agoraphobics can have disabling consequences.

Recent research involved the use of Virtual Reality (VR) for phobia exposure therapy, a process for obtaining fear extinction [3]. During the exposure, reality is replaced by artificially created stimuli inside a computerized world. Past clinical studies demonstrated the efficacy of Virtual Reality Based Exposure Therapy (VRBET) to treat participants suffering from agoraphobia [4, 5]. However, these studies employed a treatment that combined VRBET with cognitive therapy and/or relaxation. Therefore, it is impossible to assess the efficacy and the role of the VR itself. Moreover, the virtual environments (VEs) in previous studies were constructed with exclusive in-house programs or relatively expensive professional software. To reduce cost and improve access, several research teams have successfully employed VEs created from inexpensive (20 to 60 USD) Game Level Editors (GLE) to treat arachnophobia and claustrophobia [6, 7]. *Ipso facto*, our objectives are twofold. Firstly, the study measured the isolated effect of VRBET when compared to a combined treatment of VRBET and cognitive therapy, following the protocol of previous studies [4, 5], by assigning a sample of agoraphobics to two groups. The efficacy of the treatment was assessed by using self-report questionnaires, behavior tests as well as physiological measures. Our secondary objective focused on demonstrating that affordable means such as an off-the-shelf GLE allow an experimenter with no programming skills to construct various VEs realistic enough to induce a feeling of presence and to obtain therapeutic efficacy. The study was approved by the university ethics committee.

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1. Methodology

1.1. Sample

The first 10 participants (weight women, two men) diagnosed with panic disorder with agoraphobia were recruited for the clinical trial and completed the study. Diagnoses were established by independent clinicians based on a semi-structured interview, the Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV) [8]. The mean duration of agoraphobia was 18.4 years. Comorbidities included social phobia and height phobia.

1.2. Assessments

Presence Questionnaire PQ v3.0 [9]. The PQ consists of 32 items rated on a 7-point scale, assessing the participant's perception of presence.

Subjective Unit of Discomfort SUD [10] is 100-point scale that measures the perceived level of anxiety at a given time.

Depression Anxiety Stress Scales DASS 21 [11] is a 21-item subjective questionnaire that uses a 4-point scale to measure mood and depressive symptoms, anxiety and stress.

Anxiety Sensitivity Index ASI [12]. This instrument is a 16-item questionnaire which rates the fear of anxiety-related symptoms (e.g., shortness of breath, tachycardia).

Agoraphobia Cognitions Questionnaire ACQ [13] is 5-point scale questionnaires comprised of 14 items to rate the intensity of thoughts regarding agoraphobia cognitions.

Mobility Inventory for Agoraphobia MIA, part 1 [14]. This a 5-point Likert scale rating the severity of behavioral avoidance of situations dreaded by agoraphobics. It includes a total of 27 items. An additional 28th item measures the number of panic attacks in the last seven days (PA/w) and is presented separately.

Behavioral Avoidance Test BAT. This is a classic objective behavioral measures of phobia intensity and clinical progress. A real elevator (2x1.8x2.4m) was designated for the test. Each achieved step grants a point on the scale, ranging from 0 to 10.

Heart Rate (HR) and *Heart Rate Variability* (HRV). A HR monitor was used to measure HR for the whole duration of the BAT. HR variability was calculated through the pNN50: the proportion of NN50 divided by the total number of NN or RR intervals. The HRV indicates the fluctuations of HR around an average HR. HR and HRV reflects the autonomic responses involved in emotional arousal, most notably during anxiety where the HR is expected to increase and the HRV to decrease [15]. There is evidence that HR change is correlated with presence [16].

1.3. Procedure

After signing informed consent forms, participants were randomly assigned to two therapeutic groups: one group receiving VRBET only (VRO) and one group receiving VRBET and cognitive therapy (VRC). The protocol included 10 weekly 90-minute sessions for the two groups: eight sessions of VRET for both groups, two "neutral" sessions for the VRO group and two initial sessions of cognitive therapy for the VRC group. For the latter group, cognitive therapy consisted of psychoeducation, anxiety acceptance, cognitive restructuring and positive self-statements as outlined by several works of reference [17, 18]. The eight sessions of VRBET comprised an exposure to nine different context graded VEs related to agoraphobia. Questionnaires, behavior tests and physiological measures detailed in the table *infra* were registered before and after the treatment procedure. Finally, in order to avoid any external influence on the therapeutic effect, participants from both groups were asked not to practice voluntary self-exposure between sessions until the clinical trial is duly completed.

1.4. Apparatus and Virtual Environments

The VR system includes a ruggedized Virtual Realities® HMD 42 Pro Head-Mounted Display (HMD, 800x600 non stereoscopic OLED screen) coupled with a 3 degrees of freedom head tracker embedded inside (angular resolution: 0,02°, latency 4 ms).

The HR monitor is a Polar® S810i. This monitor has proven to be as effective as an ECG for recording RR intervals and Heart rate measurements [19]. The software exploited to create and run the VEs is the commercially available level editor Sandbox 2 of the video game Crysis™ (Crytek GmbH). Prior to its full use for the trial, this GLE was tested and compared to six other commercially available GLEs by considering several distinct criteria and requirements [20].

Since agoraphobia features the most varied amount of avoided situations among all phobias, the experimenter (a Ph.D. student studying Psychology) exploited the aforementioned GLE to build nine specific context graded VEs. The VEs constructed are recognized as fear eliciting situations for agoraphobics according to empirical works on agoraphobia [17, 21], past studies [4, 5] and the criteria of the DSMIV [2]: a valley for training purposes, a town square with a buildings featuring lifts of different sizes, a supermarket in a mall with the possibility of standing in a queue, bridges in the Australian outback, a subway station with a working train, an underground car park, a cinema with a viewable movie, a highway with a tunnel/traffic jam and an airplane with all flight procedures. All VEs were supplemented with interoceptive cues, such as heartbeat sounds, tunnel vision, etc.

2. Results

Means, standard deviations and Analysis of Variance (ANOVA) F values listed in the table evidenced a significant time effect for all subjective and objective measures. There was no significant interaction (time/group) for any of these scores. Mean PQ high rating indicated that the patients felt immersed in the VEs.

Tests	Group	Pre-test Mean (SD)	Post-test Mean(SD)	ANOVA Time F (1,8)	Eta^2	ANOVA Interaction F(1,8)
DASS	VRO	30.6 (10.92)	22.6 (12.36)	5.38*	0.40	0.01ns
	VRC	29.0 (21.24)	20.8 (18.39)			
ASI	VRO	33.60 (14.01)	23.40 (15.47)	5.47*	0.41	0.04ns
	VRC	37.0 (15.98)	28.40 (18.17)			
ACQ	VRO	31.80 (8.79)	26.2 (10.64)	5.41*	0.40	0.43ns
	VRC	40.6 (13.87)	30.60 (12.77)			
MIa	VRO	82.40 (30.35)	64.60 (28.88)	7.89**	0.55	0.06ns
	VRC	87.20 (22.68)	72.40 (22.60)			
PA/w	VRO	1.8 (1.30)	1.0 (1.22)	5.69*	0.42	2.30ns
	VRC	4.0 (4.41)	0.40 (0.40)			
BAT	VRO	8.20 (2.49)	9.6 (0.89)	13.57**	0.63	1.50ns
	VRC	5.0 (3.19)	7.8 (2.68)			
SUD_{BAT}	VRO	32.10 (25.09)	15.16 (7.76)	12.09**	0.60	0.069ns
	VRC	52.00 (21.38)	32.30 (15.08)			
$HR_{BAT\ (bpm)}$	VRO	104.67 (23.18)	82.90 (5.16)	16.30***	0.67	0.074ns
	VRC	100.33 (8.03)	81.32 (16.05)			
$pNN50_{BAT\ (ms)}$	VRO	4.14 (2.92)	10.24 (7.09)	6.56**	0.45	0.00ns
	VRC	1.74 (1.21)	8.20 (7.49)			
PQ			145.27 (16.65)			

Table 1. Means, standard deviations of the dependent variables, results of two way ANOVA Between Pre-and Post-test period (Time) and ANOVA for time x group comparison (Interaction).

VRO: VR only; VRC: VR and cognitive therapy; DASS: Depression Anxiety Stress Scales; ASI: Anxiety Sensitivity Index; ACQ: Agoraphobia cognitions questionnaire; MIa Mobility inventory for agoraphobia (alone); PA/w: number of panic attack per week; BAT: Behavioral Avoidance Test; SUD: Subjective unit of Discomfort; HR: Heart Rate (ms); pNN50 :Proportion of NN50 divided by the total number of NN intervals; PQ: Presence Questionnaire; *** $p<0.001$; ** $p<0.025$; *$p<0.05$; ns: non- significant.

Figure 1 & 2. Screenshots of two VEs built with Sandbox 2 for the present study. Note the high resolution textures, the sun lighting, the shadows, the drivable vehicle and the avatar attitudes (airplane cabin and highway).

3. Conclusion

The present clinical trial demonstrated the therapeutic effectiveness and presence eliciting effect of VEs constructed with an inexpensive off-the-shelf GLE. Results of the first ten participants also revealed the isolated positive outcome of VRBET for agoraphobia. The addition of cognitive therapy to VREBT did not appear to generate any significant differences. The absence of detectable differences replicates previous findings concerning cognitive therapy and traditional exposure in vivo [22, 23]. However, given the small sample of the study, further trials are needed. If confirmed, future research should explore the use of other components in addition to cognitive therapy and VREBT (relaxation, mindfulness, mental imagery, etc.) in order to determine if a multiple component therapy can effectively enhance VREBT for agoraphobia.

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Virtual Reality Exposure Treatment of Agoraphobia: a Comparison of Computer Automatic Virtual Environment and Head-Mounted Display

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Abstract In this study the effects of virtual reality exposure therapy (VRET) were investigated in patients with panic disorder and agoraphobia. The level of presence in VRET was compared between using either a head-mounted display (HMD) or a computer automatic virtual environment (CAVE). Results indicate that there was no relationship between the level of experienced presence and treatment outcome. Analyses indicate that VRET in general was more effective than no treatment. No differences in effectiveness were found between VRET using an HMD or CAVE.

Keywords. virtual reality exposure therapy, presence, panic disorder, agoraphobia

1. Introduction

Research concerning virtual reality exposure therapy (VRET) and the level of experienced presence is often done with non-phobic populations and limited to specific phobias. Hardly any research has been conducted in more complex anxiety disorders such as panic disorder and agoraphobia [1]. Research suggests that a computer animated virtual environment (CAVE) produces a higher sense of presence [2, 3]. However, research with clinical samples concerning the level of experienced presence and anxiety has been inconclusive [e.g. 2, 4, 5]. It has generally been found that a higher amount of presence is associated with higher anxiety [4, 5]. Research concerning the relationship between the experienced amount of presence and treatment outcome, however, indicates that a higher degree of presence does not necessarily lead to a better treatment outcome [2, 4].

In this quasi-experimental study patients with panic disorder and agoraphobia were assigned to receive either VRET via a HMD or a CAVE, or were assigned to a waiting list control condition. It is hypothesized that both active treatment conditions will result in a significantly higher reduction in anxiety for panic and agoraphobia measures than the control condition. Further, it is hypothesized that there will be no difference in treatment outcome between the CAVE and the HMD condition.

2. Method

2.1. Participants

All patients had to meet current diagnostic and statistical manual of mental disorders (DSM-IV-TR) criteria for panic disorder and agoraphobia [6]. Additionally, patients were aged between 18-65 years old and had to possess sufficient fluency in the Dutch language in order to accomplish treatment protocol and complete the measures.

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2.2. Design

This was a quasi-experimental study. The first series of consecutive patients were randomized to either a waiting list control condition or the CAVE condition. The subsequent series of patients were randomized to either a waiting list control condition or the HMD condition.

2.3. Assessment

2.3.1. Structured Clinical Interview for Axis-I Disorders (SCID-I)

To verify the diagnosis of panic disorder with agoraphobia, the structured clinical interview for axis-I diagnosis the SCID-I was administered [7]. The SCID-I is a clinician-administered, semi-structured interview used to diagnose according to the current DSM criteria. It consists of nine diagnostic modules, which classify and describe the major mental disorders. The SCID-I is widely used for clinical assessment.

2.4. Outcome Measures

2.4.1. Igroup Presence Questionnaire (IPQ)

The Igroup presence questionnaire was used to control for the manipulation of presence by assessing the level of experienced presence after each VRET session [8]. The questionnaire consists of 14 items concerning three factors 1) spatial presence, 2) involvement: the attention which is paid to the real world and to the virtual environments; and 3) the realness of the virtual world. The subject could give an indication of how real the virtual world was on a scale ranging from -3 to +3, respectively "*completely disagree*" and "*completely agree.*" The IPQ is scored by reversing the negative items and then calculating the sum scores over the whole scale.

2.4.2. Panic Disorder Severity Scale (PDSS)

The PDSS is a seven-item clinician-administered scale to assess panic disorder severity in patients who already have been diagnosed [9]. Items are rated on a five-point scale ranging from 0 (none or not present) to 4 (extreme, pervasive, near constant symptoms). The dimensions assessed include panic frequency, distress during panic attacks, avoidance of agoraphobic situations and fear of panic related symptoms. Internal consistency is satisfactory with a Cronbach's alpha of .65. The PDSS appears to be sensitive to change following treatment.

2.4.3. Mobility Inventory (MI)

The MI is a 27-item self-report instrument measuring the severity of agoraphobic avoidance and panic attacks [10]. Each item is rated twice using a 5-point scale ranging from 1 (never avoid) to 5 (always avoid). The first rating measures avoidance when accompanied and the second rating measures avoidance when alone. The MI is scored by calculating the mean for the items separately for the avoidance accompanied scale and the avoidance alone scale. The internal consistency is excellent with Cronbach's alpha ranging from .94 to .96 for the avoidance alone scale and from .91 to .97 for the avoidance accompanied scale [10]. In the present study only the MI alone scale is reported.

2.4.4. Agoraphobic Cognitions Questionnaire (ACQ)

The ACQ is a 15-item self-report instrument in which patients rate the frequency of specific cognitions that occur when they feel anxious or frightened [11]. The ACQ is constructed to measure fearful cognitions associated with panic attacks and agoraphobia. Each item is rated on a 5-point scale ranging from 1 (thought never occurs) to 5 (thought always occurs when I am nervous). The ACQ is scored by calculating the means for items 1 through 14. The ACQ shows high reliability scores with a Cronbach's alpha from .80 [9].

2.5. Procedures and Treatment Protocol

Patients were assigned to cognitive behavior therapy (CBT) followed by two variants of VRET: CAVE versus HMD. The first module (CBT) was identical in both conditions and consisted of four sessions of psycho-education, cognitive restructuring and interoceptive exposure. The second module consisted of six sessions of virtual exposure to agoraphobic situations either in HMD or CAVE. The treatment is an adapted version of the panic treatment protocol of Craske and Barlow [12]. At pre- and post treatment panic and agoraphobia symptoms were assessed with self-report measures.

2.6. Computer Equipment and Virtual Environments

In the CAVE virtual environments were projected on the floor and three sides of the cubicle. The participants wore Crystal Eyes active stereo glasses; Ascension Flock of Birds was used for head tracking. The projection was provided by eight projectors, each with a resolution of 1400x1050 pixels en 60 Hz refresh rate. VRET with HMD was given using a Dell precision T3500 and a Dell Optilex 760, collaborating with a Nvidia FX 1400 low-end card with drivers which was used to generate the virtual environments. The software was Vizard worldviz (2010). The worlds were displayed using the Nvisor sx. Projection was stereographic. Tracking was done with the Worldviz ppt tracking system including four cameras and the Nvis dual channel sx control unit. The same virtual environments were used in both conditions.

3. Results

Three patients did not complete treatment in both the CAVE and the HMD condition. To investigate whether VRET was more effective than no-treatment, the data of the subjects who complete treatment using the HMD (n=5) and CAVE (n=6) were pooled. Repeated measures MANOVA revealed a significant time effect on PDSS [$F(1,15) = 10.68$, $p = .005$, $\eta_p^2 = .416$], the MI [$F(1,15) = 20.08$, $p = .000$, $\eta_p^2 = .572$] and ACQ [$F(1,15) = 2.62$, $p = .127$, $\eta_p^2 = .149$]. Further, on all measures VRET was found to be more effective than the control condition (interaction effect): PDSS [$F(1,15) = 3.17$, $p = .095$, $\eta_p^2 = .174$], the MI [$F(1,15) = 8.72$, $p = .010$, $\eta_p^2 = .368$] and ACQ [$F(1,15) = 4.89$, $p = .043$, $\eta_p^2 = .246$]. Using a repeated measures MANOVA differences between HMD and CAVE on treatment outcome measures were tested. Results revealed a highly significant time effect. No differences were found in effectiveness between VRET using an HMD or CAVE (see table 1).

Table 1: Main outcome measures over time for both conditions.

		Pre	Post	Time			Time*Condition		
		M (SD)	M (SD)	F(df= 1,9)	p=	η_p^2	F(df= 1,9)	p=	η_p^2
PDSS				14.19	.004	.61	0.33	ns	.04
	CAVE	2.14 (0.48)	0.86 (0.97)						
	HMD	1.34 (0.33)	0.40 (0.37)						
MI alone				25.70	.001	.74	0.61	ns	.06
	CAVE	3.54 (0.76)	2.37 (1.33)						
	HMD	3.03 (0.29)	2.17 (0.51)						
ACQ				6.25	.034	.41	0.22	ns	.02
	CAVE	2.70 (0.40)	2.07 (0.49)						
	HMD	2.59 (0.76)	0.86 (0.97)						

ns: non-significant; η^2 = Partial Eta Squared

Results further indicate that there was no significant difference between the level of presence experienced in the CAVE (M= 45.7; SD = 9.1) or in the HMD (M= 44.9; SD= 7.2): $t(9) = .16$, $p = .88$. The relationship between treatment outcome (pre-post change) and mean experienced presence was investigated using the Pearson product moment correlation coefficient. There was no significant correlation between the IPQ and improvement on PDSS [$r = -.05$, $p = .44$], the IPQ and MI [$r = -.25$, $p = .23$] and the IPQ and ACQ [$r = -.31$, $p = .18$].

4. Discussion

VRET led to an overall improvement of symptoms of panic severity, avoidance behavior and agoraphobic cognitions, corroborating the results of an earlier study treating panic disorder and agoraphobia with VRET [13]. This is the first study in which clinically distressed patients with panic disorder and agoraphobia underwent VRET in two different conditions (CAVE versus HMD). VRET was superior to no-treatment on panic and agoraphobia measures. No differences in effect were found between VRET by means of CAVE or HMD. Presence, often assumed to moderate successful outcomes in VR treatment [8], did not have any effect on treatment outcome in this study.

Contrary to an earlier study with a clinical sample [2], manipulating presence by means of CAVE or HMD in the present study did not result in different levels of experienced presence. In line with earlier studies, the level of presence did not relate to treatment outcome [2, 4]. Although no correlation between presence and treatment outcome was found, treatment led to significant changes in symptoms of panic severity (PDSS), avoidance behavior (MI) and agoraphobic cognitions (ACQ). Clinically successful therapy outcome, as indicated by the large effect sizes, further contradicts the importance of a high sense of presence in VRET. Given that presence does not correlate with treatment outcome, it can be assumed that a moderate level of presence is necessary to prevent patients from dropping out, but high presence is not necessary to obtain a better treatment outcome.

In spite of a lack of statistical power, significant effects were found between the waiting list control condition and the VR condition with high effect sizes. No differences in effect were found between the HMD and CAVE condition, as reflected in the effect sizes. Furthermore, it should be noted that a few limitations of this study make generalizations difficult. First, due to logistical reasons (the SARA Computing and Networking Services closed down their CAVE facilities, which made further collaboration impossible) this is considered a quasi-experimental study, which means that patients were not assigned at random to receive either HMD or CAVE. However, patients were randomly assigned to receive VRET or waiting list condition. Additionally, the sample size of this study was rather small and therefore, results have to be interpreted with caution given the limited statistical power. However, results of this study are in line with earlier research in clinical samples [2, 4], again indicating that high presence does not play such an important role in VRET for treatment outcome.

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New Technologies to Manage Exam Anxiety

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Abstract. A Stress Inoculation Training-based protocol tested if multimedia audio-video content induced emotional changes and reduced exam anxiety in university students. Seventy-five participants took part in six experimental sessions consisting of viewing multimedia content and performing relaxation exercises. Participants were randomly assigned to five experimental groups: 1) audio and video narrative on mobile phone (UMTS); 2) audio and video narrative on DVD (DVD), 3) audio narrative on MP3 player (M3), 4) audio narrative on CD (CD), 5) control group (CTRL). Results showed that audio/video content induced a significant reduction in exam anxiety and an increase of relaxation in students, compared to the audio-only contents.

Keywords. exam anxiety, Stress Inoculation Training, new technologies, mobile phone, video clip

Introduction

Exam anxiety in students has negative effects on academic performances [1-3] and it may induce emotional (fear and panic), cognitive (loss of concentration) and neurovegetative reactions (perspiration, heart rate acceleration).

More specifically, exam anxiety may cause physiological symptoms such as abdominal cramps, wet and trembling hands, dry mouth, etc.; emotional/psychological symptoms, such as fear or panic, memory problems, or some concentration and attention difficulties; and behavioral symptoms, such as nail-biting, sleep disorders and hyperactivity. According to Misra and McKean [4], university exams are usually related to a deep sense of anxiety, but when anxiety and related symptoms are extreme, they may seriously interfere with the student's performance and with the exam result. For this reason, all these components must be taken into account to manage and reduce exam anxiety. Mandler and Watson [5] claim that when a person knows he/she is being evaluated during a performance (e.g. a student during an exam), she/he may engage in one of the following behaviors in response to the stressful stimulus: feeling concerned about their actions and the possibility that another person could do better than themselves; having continuous and repetitive thoughts about alternative chances to better manage the situation; feeling unable to cope with the stressful event.

For these reasons, it is important for a person to learn to manage his/her emotions, in order to control psychological, physiological and behavioral reactions that might suddenly appear during a stressful event. A common cognitive-behavioral approach to achieve these goals is Stress Inoculation Training (SIT) [6-8]. SIT consists of short, structured training that make people aware of the transitive nature of stress [9, 10]. SIT also focuses on emotion and maladaptive behavior management, and on developing coping skills through imaginative exercises and simulations. SIT has already been tested in many studies related to performance anxiety in school, specifically in students and teachers [11-13]. The core innovation of the present research is to test a SIT-based self-help protocol implemented using new technologies.

SIT is based on a three-phase intervention. The first phase is *conceptualization* and promotes a transactional model of stress. *Skills acquisition and rehearsal* is the second step in the SIT protocol and helps people increase their coping skills. The last step is *application and follow through*, which helps the participants apply the acquired coping skills to real contexts. The patient is "inoculated" in a stressful but controlled environment to verify the efficacy of the treatment.

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1. Aim

The SIT three-step structure was used to create a new, technology-supported protocol to teach students to manage exam anxiety, to learn different relaxation exercises and to enhance their coping strategies.

The protocol sessions are structured as follows:

Sessions 1 & 2 - conceptualization phase: in a relaxing virtual environment (VE), a narrative voice guides the participants through learning about some common psycho-physiological reactions to a university exam;

Sessions 3 & 4 – skill acquisition and rehearsal: a narrative voice presents coping strategies and relaxation exercises that students can use to relax themselves and to manage their anxiety before an exam;

Sessions 5 & 6 – application and follow through: a stressful VE (a university classroom) is presented to the participants to evaluate if they are able to manage the stressful event (a university exam) in a controlled setting.

The aim of this study is to test this new protocol for short-term effects in stress management and for multimedia content effectiveness in emotion regulation. The five-minute multimedia session is supported by different media: UMTS mobile phone, DVD, Mp3 player and audio CD. Specifically, the protocol is aimed at teaching participants how to manage exam anxiety, and to enhance the students' coping strategies and muscular relaxation competencies. The ethics board committee approved this study.

1.1. Hypotheses

We hypothesized that:

H1: Reduction in State Anxiety would be significantly larger in students in the experimental groups than in students in the control group;

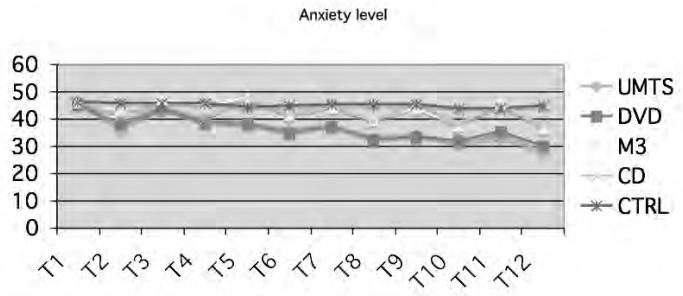
H2: Increase in relaxation level would be significantly larger in students in the experimental conditions than in the students in the control group.

1.2. Method

Seventy-five female university students aged 20-23 years old (M= 20,86 ± 1,27) participated in the study. In a 5x2 mixed design, participants were randomly assigned to one of the five levels of experimental condition (video and audio content on mobile phone, UMTS; video and audio content on dvd, DVD; only audio content on mp3 player, M3; only audio content on audio cd, CD) or to the control condition (Ctrl); participants were also tested before and after each one of the 6 sessions. After signing informed consent forms, participants were asked to view the multimedia content in the evening and to complete two questionnaires. The STAI questionnaire (*State Trait Anxiety Inventory*) was used to assess anxiety level [14], and the Vas (*Visual Analogue Scale*) [15] to assess relaxation level. The intervention lasted six days. On the seventh day the students took the real exam.

1.3. Results

Hypothesis 1. A Repeated Measure Anova was calculated to verify the effectiveness of the SIT protocol on decreasing anxeity. Data suggest the protocol effectiveness in time: anxiety level decreases significantly from the beginning to the end of the treatment (Graph 1).

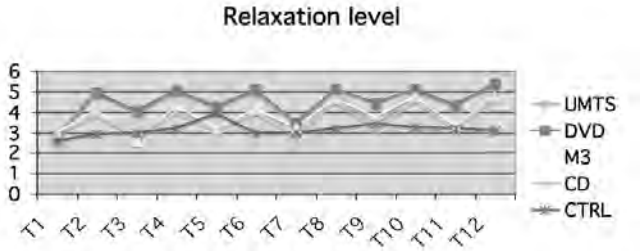


As shown in the Graph 1 and in Table 1, the UMTS and DVD conditions showed a significant decrease in anxiety level in comparison to the CTRL condition and the audio-only conditions (M3 and CD).

TIME	FACTOR	F	Sig.	POST HOC		
				Cond	Conf	Sig
T1-T2	Time x Condition	72,034	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T3-T4	Time x Condition	36,039	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T5-T6	Time x Condition	11,099	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T7-T8	Time x Condition	10,435	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T9-T10	Time x Condition	7,998	<.001	CTRL	UMTS	<.01
					DVD	<.01
					M3	<.05
					CD	<.05
				UMTS & DVD	M3	<.05
					CD	<.05
T11-T12	Time x Condition	7,870	<.001	CTRL	UMTS	<.01
					DVD	<.01
					M3	<.05
					CD	<.05
				UMTS & DVD	M3	<.05
					CD	<.05

Table 1: Stai State Questionnaire.

A Repeated Measure Anova was calculated to verify the effectiveness of the SIT protocol in increasing relaxation. Data suggest the protocol effectiveness in time: a significant relaxation level increase (assessed by Vas Questionnaire) was found from the beginning to the end of the treatment (graph. 2).



Specifically, as shown in the graph and in Table 2, the audio/video conditions (UMTS and DVD) reported a significant decrease in anxiety level compared to the CTRL condition and the audio-only conditions (M3 and CD).

TIME	FACTOR	F	Sig.	POST HOC		
				Cond	Conf	Sig
T1-T2	Time x Condition	9,472	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T3-T4	Time x Condition	7,854	<.001	CTRL	UMTS	<.01
					DVD	<.01
					M3	<.05
					CD	<.05
T5-T6	Time x Condition	10,598	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T7-T8	Time x Condition	10,310	<.001	CTRL	UMTS	<.05
					DVD	<.05
					M3	<.05
					CD	<.05
T9-T10	Time x Condition	10,220	<.001	CTRL	UMTS	<.01
					DVD	<.01
					M3	<.05
					CD	<.05
T11-T12	Time x Condition	10,203	<.001	CTRL	UMTS	<.01
					DVD	<.01
					M3	<.05
					CD	<.05

Table 2: Vas Questionnaire

1.4. Discussion

The goal of this study was to test the short-term effects of an innovative multimedia and technology-supported self-help, anxiety management training program for students. Results suggest the effectiveness of the SIT protocol implemented through new media, in a self-help protocol based on a clinical intervention. In particular, data showed the effectiveness of the protocol (relaxing narrative and coping strategies techniques) in anxiety management and in relaxation induction in time. Significant differences were found from the beginning to the end of the treatment and among different conditions. Data suggested that the multimedia contents proposed are effective in emotion regulation in a student sample; in particular, related to anxiety level, the audio/video format is more effective than the audio-only format in the emotion induction procedure.

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Virtual Reality Exposure on Nicotine Craving

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Abstract. Several forms of treatment for nicotine dependence that combine the classical smoking cessation strategies with new Virtual Reality (VR) exposure techniques to smoking-related cues are in development. In this line, the main goal of our study was to develop a virtual platform in order to induce cravings in smokers. Sixty undergraduate students were randomly assigned to two different virtual environments (high-arousal cues and low-arousal cues). Both environments were based on a three-room apartment with commercial music playing and virtual characters interacting in a social event. The assessment was carried out before and after exposure through psychophysiological activation and self-report data for craving and nicotine dependence levels. No statistical differences were observed between smokers and non-smokers in psychophysiological activation. As far as self-report data is concerned, smokers revealed a significant increase in craving after the VR exposure to high arousal environments. Overall results were in line with previous studies suggesting the use of virtual environments as a tool for the existing smoking cessation programs.

Keywords. Virtual Reality, nicotine craving

Introduction

Smoking is a major cause of premature death and according to the World Health Organization (WHO), smoking addiction is a global health problem that affects about a third of the world population. Smoking can be related to various chronic diseases [1] and to specific forms of cancer, namely, lung cancer [2]. In Portugal, the Health National Plan (DGS) estimated that smoking was responsible for 85% of lung cancer mortality, whereas 9% of deaths related to cardiovascular diseases was attributed to smoking behavior.

In this way, several forms of treatment were developed that combine pharmacological and psychological approaches. In a cognitive and behavioral rationale, exposure therapy was first developed for the treatment of anxiety disorders. Cues are used to elicit anxiety levels with the use of visual or auditory cues in case of anxiety disorders, whereas for addictive behaviors, these cues are used in order to elicit cravings. For craving intervention on nicotine dependence Drobes et al. [3] have suggested that exposure to tobacco-related pictures or movies can help to elicit cravings in smoking dependent subjects.

As an alternative to classical exposure therapy, the use of Virtual Reality Exposure (VRE), despite being in its infancy, is not a novel technique in psychology. In fact, for more than a decade, Virtual Reality (VR) has been used to treat patients with acrophobia [4], arachnophobia [5], claustrophobia [6] and fear of flying [7], among other pathologies. However, the use of VRE for substance abuse is a less studied topic compared to anxiety disorders. For example, Lee et al. [8] developed a virtual environment (VE) with smoking cues to elicit craving. The VE consisted of a virtual bar with several smoking cues (e.g. cigarettes, ashtray and smoke). A sample of 22 participants was randomly assigned to two different exposure conditions (i.e. virtual exposure and exposure to pictures related to smoking behaviors). Overall results suggested that VRE can be more effective in eliciting cravings than other forms of exposure. Another study has supported these previous findings. Bordnick et al. [9] also claimed that VRE with smoking cues can increase cravings to a greater extent than VRE with neutral content. Previous studies [10, 11] have also indicated a significant increase in cravings for smoking cues in VRE, but in this later study the authors used a sample of casual smokers. These authors suggested that even within a non-clinical sample, cravings can be elicited with VRE, allowing health promotion interventions in earlier stages of nicotine dependence.

Given the social relevance of addictive behaviors, our main goal was to develop and test the application of a new virtual platform to elicit nicotine cravings. The assessment of this application was carried out using several

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different measures, such as subjective (self-reports for craving and nicotine dependence level) and peripheral measures for heart rate and skin conductance level. Based on previous findings [9-11] regarding the use of VRE to elicit cravings in smokers, our intent was also to explore the possible relation to craving, presence and autonomic activation during the exposure to tobacco cues, since these can be considered as important outcomes of craving during the VRE to tobacco-related cues.

1. Method

1.1. Sample

The sample consisted of 60 undergraduate students (16 males and 44 females) with an average age of 21.68 years old (SD = 4.04). The participants were randomly assigned from a university campus in which 32 (53.3%) were smokers and 28 (46.7%) were non-smokers. This study was approved by the ethics committee, and all participants signed consent forms prior to the study.

1.2. Measures

Presence Questionnaire (PQ [12]); Simulator Sickness Questionnaire (SSQ [13]); Questionnaire of Smoking Urges (QSU [14]); Fagerstrom Test for Nicotine Dependence (FTND [15]); PNS (peripheral nervous system) sympathetic activation (Heart rate and Skin Conductance Level (SCL)).

1.3. Procedure

Two different VR environments (high-arousal cues and low-arousal cues) were developed by the Laboratory of Computing Psychology from the University Lusófona de Humanidades e Tecnologias in Lisbon, Portugal. The 3-D modeling was performed using the 3-D Max (Autodesk) while world interaction and animation was carried out through Unity v.2.6 (Unity Technologies). The main difference between the two conditions was related to presence of smoking activation cues. Both environments were based on a three-room apartment with a bathroom, kitchen, bedroom and a living room with commercial music playing and virtual characters interacting during a social event. However, in the high-arousal cues environment there were also smoking cues like cigarettes and tobacco packages, video clips with smoking cues playing in a LCD, whereas in the low-arousal cues environment all smoking related cues were removed.

The experiment was carried out in a soundproof room from the Laboratory of Experimental Psychology at the University Lusófona de Humanidades e Tecnologias. Each subject was informed of the purpose of the study and agreed to participate. After agreement, the subjects filled out self-report measures for presence (PQ-F), cybersickness (SSQ) and nicotine craving (QSU; FTND) and were connected to electrodes for heart rate and SCL monitoring. The experimental session started with written instructions on the computer screen, followed by the calibration and a training trial (which were not part of the stimulus material). Following practice, each subject (smoker or non-smoker) was randomly assigned to high-arousal or low-arousal environments. Participants were seated at approximately 60 cm from the screen and were instructed to explore the virtual apartment for five minutes and to pay attention to all details in the environment. After finishing the exposure and interaction with the VR scenario, each participant, in a second assessment, was asked to rate presence and cybersickness levels, as well as nicotine craving levels. During the VRE psychophysiological data were acquired using a sampling rate of 500 Hz and further analysed with the AcqKnowledge software v.3.8 (Biopac System, Inc). Analyses started with a visual inspection of heart rate and SCL signals in order to remove the registry artifact. One minute of baseline was considered for both measures.

2. Results

Distributions for each variable were tested for normality using the Kolmogorov-Smirnov statistic (Lilliefors). Non-parametric tests were carried out for non-normal distributions ($Z > 1.96$).

2.1. Time Since Last Cigarette Between High-arousal and Low-arousal Groups

In order to ensure that smoker participants in the high-arousal exposure meet the same conditions as those of the neutral cues environment, several comparisons were performed between these two conditions. The time period since the last cigarette smoked was controlled in the self-report protocol. Mann-Whitney statistic showed no statistical significant differences ($U = 125.000$; $p > .05$) between time since last cigarette for smokers that engaged in the high-arousal and those that performed the low-arousal environment. These data showed no differences between groups in this baseline condition suggesting that the initial craving levels could be similar between those two conditions.

2.2. Nicotine Dependence in Smokers Between High-arousal and Low-arousal Groups

For nicotine dependence level assessed with the FTND, a t test for independent samples showed that smokers in the high-arousal conditions did not differ ($t (59) = .331$; $p > .05$) from smokers that engaged in low-arousal conditions.

2.3. Differences in Craving Levels Between Assessments in Function of Smoking Behavior and Arousal Conditions

In order to study craving levels assessed by self-reports from QSU before and after VR exposure, non-parametric statistic with Wilcoxon test for two related samples was performed. Data indicated that VRE to high-arousal cues can elicit a significant increase ($Z = -2.692$, $p < .01$) on craving level from initial ($M = 3.29$, $SD = 1.14$) to final assessment ($M = 4.19$, $SD = 1.45$). However, regarding the exposure to low-arousal environment, no significant differences between initial and final assessment were registered ($Z = -1.336$, $p > .05$).

2.4. Differences Between Smokers and Non-smokers in VR Related Variables

To evaluate presence levels in smokers and non-smoker during the VR exposure to high arousal cues condition, t tests for independent samples were carried out for each dimension of presence and cybersickness. The results revealed no significant differences in presence ($t (30) = .806$; $p > .05$) and cybersickness ($U = 82.500$; $p > .05$) dimensions between smokers and non-smokers in high-arousal environments.

2.5. Differences Between Smokers and Non-smokers in Heart Rate and SCL During the VRE

Both heart rate and SCL were calculated by the difference to baseline and reflect the variation in relation to the baseline level. In order to test if there were differences between smokers and non-smokers during the exposure to smoking cues, comparisons were performed for heart rate ($t (25) = .420$; $p > .05$) and SCL ($U = 99.000$; $p > .05$). These data showed no significant differences in psychophysiological activation between smokers and non-smokers during the exposure to high-arousal cues.

3. Discussion

In line with previous studies, our results indicated that nicotine cravings can increase with the presentation of VR environments. However, this was true only for smokers when exposed to smoking cues, which are in agreement with our initial purpose suggesting that the exposure to tobacco or smoking related cues in a virtual environment can elicit nicotine craving in smokers. These data concur with previous results [9-11]. In agreement with Shiffman et al. [16] the exposure to smoking cues would promote stimulus control in several ways. One approach is based on classical and operant conditioning theories, where extinction may occur when conditioned stimuli lose their capacity to elicit a response in the absence of unconditioned stimuli. During the exposure to those stimuli it is possible to systematically desensitize those participants and simultaneously provide coping skills for the addictive behaviors.

Nicotine dependence level and time period since the last cigarette consumed were also controlled in order to ensure similar study conditions among smokers that were exposed to high and low arousal environments. Thus, it is reasonable to assume that the distinction between smokers that were exposed to high arousal and low arousal cues are not related to differences in the baseline condition.

Although our study involved a new VR application in the context of health promotion or smoking cessation programs, overall results are in line with previous studies suggesting that the virtual exposure to arousal cues capture attentional resources in smokers and can elicit craving in those subjects. However, the lack of significant differences between smokers and non-smokers in autonomic activation is intriguing and unexpected concerning some previous findings. For example, Rosenthal et al. [17] studied autonomic activation in cocaine dependent participants with heart rate and SCL and found an increased psychophysiological activation after the VRE to cocaine cues. These measures are derived from the peripheral nervous system and are considered to be sensitive to different emotional states. In our study, the required hand and arm movements during the VR navigation task may have affected the recording of electrical measures derived from skin conductance and cardiac action potentials. In order to control possible artifacts derived from electromyography, hand and arm movements should be kept to a minimum and the non-dominant hand should be preferred for electrodermal recording.

In summary, the use of VR environments as a cue exposure technique (CET) is of major interest since these environments gather all ecological aspects and naturalness of real world situations. The use of VEs as exposure techniques can be considered as a tool for use in existing tobacco cessation programs, where self-control, stimulus control and improvement of strategies for coping with smoking related stimulus or situations are used.

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Interactive and Passive Virtual Reality Distraction: Effects on Presence and Pain Intensity

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Abstract. The current study explores the effects of interactive versus passive Virtual Reality (VR) distraction on the sense of presence and pain intensity. Sixty-eight healthy students (mean age 21.8, *SD* = 4.3) underwent two consecutive cold-pressor trials (subject's hand immersed into 6 ºC water as long as possible, with a time limit of five minutes), one without VR and another providing a VR distraction "Surreal World." Participants were randomly assigned to an interactive VR distraction condition, where a number of interactions with the environment were possible, or to a passive VR distraction condition, where they were also exposed to the surreal world, but instead of interacting with the virtual environment, they watched the navigation generated by another participant assigned to the interactive condition. After the VR cold-pressor trial, each subject provided ratings of pain intensity and rated the degree to which they had felt "present" in the virtual environment. Results showed that most of the participants who experienced the interactive VR distraction reported less pain intensity relative to the no-VR trial. However, in the passive VR condition, only 5.9% of participants showed a decreased level of pain intensity relative to the no-VR trial. Also, the amount of presence reported was significantly higher during the interactive VR distraction and correlated negatively with pain intensity scores.

Keywords. Virtual Reality distraction, presence, interaction, pain intensity

Introduction

Several studies have shown that Virtual Reality (VR) distraction may be a useful tool for clinicians who work with a variety of pain problems [1]. Furthermore, emerging laboratory research has tried to systematically isolate and examine the active elements of effective VR-assisted distraction interventions. For example, some controlled studies suggest that the magnitude of VR analgesia is related to VR presence levels [2-4]. Another relevant variable that has been studied is the active or passive character of technology-assisted distraction. The available literature suggests that patients are likely to benefit more from interactive, rather than passive, distraction [5, 6].

In the present study, some participants manipulated an interactive VR distraction environment ("Surreal World") while performing a cold-pressor task (subject's hand immersed in 6°C water for as long as possible, with a time limit of five minutes). Others were exposed to the same environment, but they were unable to interact with it (passive observation condition). We predicted that the interactive VR distraction condition would result in higher presence ratings and concomitantly lower pain intensity than the passive VR distraction condition. Also, the amount of VR presence reported was expected to be negatively and significantly correlated with the amount of pain reduction in VR.

1. Method

1.1. Participants

Participants were undergraduate psychology students who were awarded course credits for participation. Exclusion criteria were cardiovascular disease, hypertension, metabolic dysfunctions, pregnancy, Raynaud's disease, epilepsy,

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mental disorders, chronic pain conditions, diseases producing neuropathic pain, and the use of pain/anti-inflammatory medications in the four hours prior to the study. Participants were also instructed to refrain from alcohol or other drugs on the day prior to the study.

The sample consisted of 68 students (52 women, 16 men) between 19-36 years old (mean age 21.8, *SD* = 4.3). All participants provided written informed consent prior to enrolment in the study. The study was approved by the Ethics Committee of the University of Barcelona.

1.2. Apparatus and Measures

The cold-pressor apparatus consisted of a plastic tank (34 x 34 x 16 cm) filled with cold water that was used as the pain stimulus by the submergence of the hand. The water temperature was maintained at 6°C.

Hardware: The stereoscopic environment was displayed using two BARCO ID R600 projectors controlled by a computer (Pentium IV, 3.00 GHz; 2.00 GB RAM; NVIDIA Quadro Fx 4500, 512 Mb ddr3, graphics card). StereoGraphics Corp polarised 3-D glasses were also used. The stereoscopic color image was projected on a 2.43 x 1.82 m screen with a resolution of 1024 x 768 pixels. The distance between the subject and the screen was 2 m. Auditory effects were delivered through a multi-channel system of five speakers.

Software*:* The virtual environment (VE) was modeled and animated with D Studio Max 8. Adobe Photoshop 7 was used to create the different textures of the models. Virtools 3.5 (Educational Version) was used to program physical and visual effects, such that the participant could interactively manipulate the VR environment

Two measures were taken for the purposes of this study. Pain intensity was measured with a 0-10 visual analogue scale (VAS) [7] (where the participant was asked to rate pain intensity when the hand was removed from the cold water). The *Igroup Presence Questionnaire* (IPQ) [8] was used to measure the degree of presence elicited by the VE used in the experiment. The total score was used to enable analyses of presence as a single construct.

1.3. VR Intervention, Design and Experimental Conditions

A mixed between-within-subjects experimental design was used. Participants were randomly assigned to one of two VR experimental conditions: interactive VR distraction or passive VR distraction. In the interactive VR condition, a number of interactions with the objects in the VE were possible. In the passive condition participants were exposed to the same environments, but instead of interacting with the VE, they watched the navigation generated simultaneously by another participant assigned to the interactive distraction condition.

All subjects participated in two consecutive cold-pressor trials, one using VR (active or passive) and one without. In each trial the experimenter told the participants that they had to immerse their non-dominant hand in the cold water up to the wrist, palm-side down, and to leave their hand open (non-fisted). The study required them to keep their hand in the cold water as long as possible, although they were reminded that they were free to terminate the trial at any time. For safety reasons the maximum permitted duration of immersion was five minutes, although participants were unaware of this. The order of the trials was counterbalanced. The VE consisted of a “Surreal World” with auditory and visual stimuli based on art images designed to surprise the participant with unreal objects that challenge the laws of physics. Figure 1 shows two pictures of what subjects saw in the “Surreal World.”

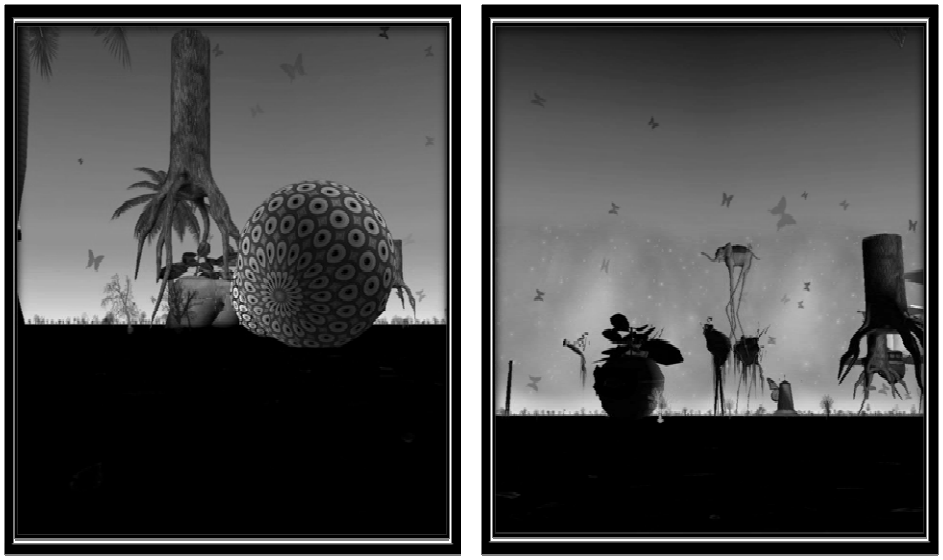

Figure 1. Pictures of what subjects saw in the "Surreal World"

2. Results

Most of the participants (73.5%) who experienced the interactive VR distraction reported less pain intensity relative to the no-VR trial, X^2 (1, N = 34) = 7.5, $p < .01$. However, in the passive VR condition, only 5.9% of participants showed a decreased level of pain intensity and the change did not reach statistical significance, X^2 (1, N = 34) = .47, $p = .49$.

Overall, the ratings of presence (as measured by the IPQ) were medium (M = 3.1, SD = 1.1, range of scores 0-6). As predicted, participants reported a greater sense of presence during interactive VR distraction, M = 3.5, SD = 1.0, compared with the passive VR condition, M = 2.7, SD = 1.2, t (66) = 3.0, $p < .005$.

Finally, the relationship between presence and pain intensity in VR conditions was assessed using Pearson product-moment correlation coefficients. The amount of VR presence reported correlated significantly and negatively with pain intensity, r (68) = -.29, $p < .05$.

3. Discussion

These findings offer additional support to previous research that suggest that multisensory and interactive distraction is more likely to be effective in diverting attention away from pain sensations than passive methods of distraction [5, 9, 10]. Specifically, previous studies [5, 11] have shown that the effects of distraction on children's cold-pressor pain tolerance were significantly enhanced when the distraction task also included greater demands for central cognitive processing. However, to the best of our knowledge, the present study is the first one showing the differential effect of interactive VR distraction compared to passive VR distraction in a different pain measure, i.e. pain intensity and using a sample of adult participants. Overall, findings would suggest that VR distraction that incorporates an active cognitive processing component is the most effective in increasing pain tolerance and reducing pain intensity in both adults and children.

Recent studies focused on the critical components of effective VR distraction have also evaluated whether using a VR head-mounted display helmet enhanced the effectiveness of videogame distraction for children experiencing cold-pressor pain [6, 12]. The results of these studies indicate that simply adding "high tech" equipment to a distraction task does not necessarily make the intervention more effective. These data, joined to the above mentioned findings concerning the tremendous potential of interactive VR distraction, suggest that efforts to

improve the effectiveness of VR distraction interventions must not solely focus on immersive technology. Taking into account present data, it seems even more relevant to design VR environments which enhance presence and incorporate an active cognitive processing component. Of course, further research is needed on this crucial topic.

Acknowledgements

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Evolution of Smoking Urge During Exposure Through Virtual Reality

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Abstract. The use of Virtual Reality (VR) could be a useful tool for the improvement of Cue Exposure Therapy (CET) for smoking cessation. Nevertheless, it is necessary to know the appropriate parameters of exposure in order to develop efficacious treatment programs. This study was conducted to analyze the pattern of tobacco desire in a sample of smokers exposed to VR. Results showed that the environments were able to generate two different patterns of craving response. These results could contribute to determine exposure parameters when using VR technology in CET.

Keywords. Virtual Reality, cue exposure therapy, craving pattern, smoking

Introduction

Cue Exposure Therapy (CET) is a behavioral approach to drug dependence based on the classical conditioning model [1]. This treatment involves extinction procedures in which addicts are repeatedly exposed to drug related cues with the aim of decreased reactivity [2].

CET can be applied through several modalities of exposure. Specifically, in smoking research, various modalities, including videos, imaginary procedures and *in vivo* presentations of cues have been used. Virtual Reality Exposure Therapy (VRET) provides another alternative over traditional methods of exposure [3]. In the specific field of nicotine dependence treatment, VRET has some advantages [4]: VRET can simulate several "real" situations related to drug use, proximal and distal cues related to cigarette use can be simultaneously presented and the patient can re-experience the situation as many times as necessary. Thus, the use of VR within smoking cessation programs could be a good approach [5].

Substance abuse treatment based on CET requires gradual exposure to contexts with cues that had been previously associated with cigarette use. Furthermore, exposure has to be based on an individual pre-established hierarchy that provides the order in which each subject will be exposed throughout the sessions. This will depend on the level of reactivity for each item of the hierarchy, starting from the less reactive item and gradually increasing in difficulty.

Despite evidence that smokers increase their subjective craving levels during exposure to smoking-related cues [6, 8], previous studies did not clearly define how the pattern of craving is increased and how the exposure must be conducted until cravings decrease. Thus, it is necessary to analyze how cravings change during exposure with well-controlled investigations in order to determine the specific parameters of exposition for each item of the hierarchy. The present study aimed to analyze the pattern of subjective craving increase in a sample of smokers exposed to Virtual Reality (VR) environments with smoking-related cues.

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1. Method

1.1. Participants

Forty-six regular cigarette smokers were recruited with the snowball sampling method starting from pre- and post-graduate psychology students from the University of Barcelona. The sample was comprised of 26 males and 20 females who smoke from 10 to 30 cigarettes per day. Inclusion criteria were: a minimum smoking rate of 10 cigarettes per day and subjects that were 18 or older. Exclusion criteria were: being involved in a smoking cessation treatment, having severe health problems related to smoking, matching DSM-IV diagnosis of dependence for other substances other than nicotine and having a current severe psychiatric disorder such as anxiety disorders, mood disorders, schizophrenia and other psychotic disorders. All participants signed informed consent forms and the ethics board approved the study.

1.2. Instruments

The virtual environments (VEs) that we used reproduce two everyday life situations where people usually smoke: *having lunch at home and having breakfast at home.* Environments were presented through a VR head mounted display (5DT HMD 800 Series) with tracker sensors. To allow interaction with objects and avatars during the exposure a standard mouse was used. Each environmental exposure was six minutes long. Tobacco craving was assessed with a self-reported visual analogue scale (VAS) from 0 to100 points.

1.3. Procedure

This study presents secondary analyses from a previous study aimed to assess the capability of eight VEs to elicit tobacco craving [9]. For the present study, we selected the environments that trigger the highest (having lunch at home) and the lowest (having breakfast at home) craving levels in that study. The lunch environment represents a living room where the subject and two other people are having lunch. Interactions with food, drink, coffee and a TV are used, and conversation between the two avatars is related to smoke and tobacco. Several stimuli like cigarettes, lighters and ashtrays are present and one of the avatars smokes. The breakfast environment starts in one bedroom and an adjacent bathroom. Interactions with an alarm clock, lights, faucet and shower in the bathroom are used. Beside the bedroom, there is a living room where the subject has already prepared breakfast. The subject can have breakfast, turn on the TV or the radio, and also several stimuli related to tobacco use are present, both in the bedroom, as well as in the living room. In this environment, the subject is alone, with no avatars present. All subjects were exposed to both environments in random order in the same session.

Before the experiment, all subjects were asked to smoke one cigarette to match nicotine levels among participants and also to avoid ceiling effects. A brief description of what they could do in the environment was given to the subjects to ensure that navigation would be as interactive as possible.

Participants were asked to rate their desire to smoke though a VAS built in the environment ranging from 0 (no desire) to 100 (intense desire). Participants had to rate their craving level before the exposure to each of the environments and every minute during navigation.

1.4. Statistical analysis

Pre- and post-exposure craving values were compared to determine the ability of both scenes to increase craving. At the same time, with the aim to assess differences between both environments in craving level increases, an experimental craving value was computed for each scenario with the next formula: (post-exposition value – pre exposition value). Differences between pre- and post-exposure craving values, and also between experimental craving across the environments, were carried out with paired- samples t test.

In order to describe the evolution of craving during the exposure to each scenario, the average of craving rates before and during exposure across VR environments was conducted.

2. Results

Differences between pre- and post-exposure mean craving values were statistically significant for both environments: having breakfast at home from pre-exposure (M= 35.89, SD= 23.00) to minute 6 (M= 47.66, SD= 28.42), t (43) = -4.287, p<.0005; having lunch at home from pre-exposure (M= 38.61, SD= 24.76) to minute 6 (M= 50.66, SD= 27.18), t (43) = -6.41, p<.0005. On the other hand, no significant differences in the experimental craving value were obtained between the breakfast at home environment (M= 11.77, SD= 18.21) and the lunch at home environment (M= 12.04, SD= 12.46), t (43) = 0.94, p= .926.

Figure 1 shows the evolution of craving response for the pre-exposure assessment and six times, one per minute, during the interactions with the scenes. Despite no differences being found between both scenes when we analyze experimental craving, we can recognize two different patterns of evolution of craving for tobacco use. The lunch at home scene was the environment that triggered the most desire and generated a quick response of desire that remains consistent after the second minute. On the opposite side, the breakfast at home scene was the environment that triggered the least amount of desire and, as we can see, craving increased gradually during the exposure and the highest level was obtained in the last minute.

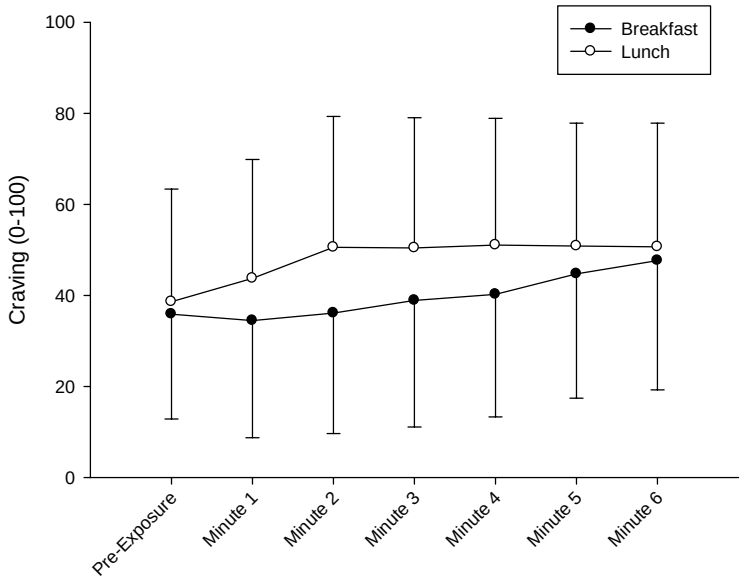

Figure 1. Evolution of craving levels during exposure to *having lunch at home and having breakfast at home* environments

3. Conclusions

Previous research has demonstrated that addicts' desire to use tobacco increases when smoking-related cues are available [4, 9, 11], but these studies have not provided enough information about the evolution of smoking cue craving during exposure. Our research aimed to examine the evolution of subjective craving experienced during exposure to VEs related to tobacco use.

The results of the present study revealed two different patterns of craving responses when a smoker is exposed to different VR environments with smoking-related cues. As shown in the results section, those environments that are strongly associated with tobacco use and trigger more cravings produce a rapid increase of desire after the first minutes of exposure and stabilized thereafter. On the other hand, those environments that are less associated with smoking behavior produce a gradual increase of the craving response, remaining consistent until the end of exposure. These results can be explained for two complementary reasons: First, the specific smoking-related stimuli (proximal cues) in each environment are qualitatively different. In the lunch environment, but not in the breakfast

scene, there is an avatar that smokes that can act as a strong social trigger for craving to smoke. Future studies should determine if any specific stimuli induces higher levels of craving than others, and also how subjects explore the environments in terms of temporal course and its relation with craving increases. An eye tracker system could contribute to a better understanding of these issues. Secondly, the environments represents two scenes that are qualitatively different from a distal point of view. Most smokers use cigarettes after lunch so this context is easily related with tobacco use for any subject, but only those people with a higher dependence smoke during the first hours of the morning [12], so more time may be necessary to be affected by specific cues. Future research should determine the relation between nicotine dependence or other individual variables and the pattern of craving response in different environments.

Enhancing knowledge about the evolution of craving response as a function of the environment and also individual characteristics is essential to delimit exposure parameters if our objective is to develop effective programs for smoking cessation under the CET paradigm. Furthermore, CET is often accompanied by other active techniques that work against anxiety or cravings, such as deep breathing. If the therapist can predict the patient's response during exposure, better training or indication can be provided about how and when the deep breathing has to be done.

Despite a range of exposure tools that have been used for CET, VR offers a variety of benefits for the use of CET for substance use disorders. This study provides an example on how the exposure through VR system can elicit different patterns of response and its knowledge can contribute to a more effective application of these procedures.

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Virtual Reality Exposure in Patients with Eating Disorders: Influence of Symptom Severity and Presence

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Abstract. The aim of this study was to examine the influence of several modulating variables on subjective discomfort experienced by patients with eating disorders while exposed to virtual environments that were emotionally significant for them. Severity of symptoms and sense of presence were analyzed. Both variables influenced the level of subjective discomfort during the exposure to virtual environments.

Keywords. Virtual Reality, eating disorders, subjective discomfort

Introduction

Virtual Reality (VR) is a useful technology for body image disturbance assessment and treatment [1, 2]. Nevertheless, the successful use of VR in therapeutic interventions requires eliciting the same degree of anxiety as produced in the real-life situation [3, 4]. Previous studies assessed the capability of VR environments to provoke responses of anxiety and depression in participants with eating disorders (ED) [5, 6]. These studies showed that ED patients felt more anxiety, assessed with the STAI-S [7], and a more depressed mood, assessed with the CDB [8], in VR environments where they had to eat high-calorie food (both alone in the kitchen and in a restaurant with other people) and in VR environments simulating social situations, specifically, talking with friends in a swimming-pool. In contrast, controls showed similar responses in all situations [5, 6]. Given the capability of VR environments to produce emotional responses in ED patients, the aim of this study was to explore whether possible modulating variables, such as symptom severity and sense of presence, may influence the level of subjective discomfort experienced by ED patients in the VR environments. In this study presence was understood as the "sense of being" in the virtual environment (VE), that is to say, the feeling that the VE was the dominant reality and was experienced by the users as a place they visited [9].

1. Method

1.1. Participants

Seventy-one patients diagnosed with eating disorders (49 women with anorexia nervosa and 22 women with bulimia nervosa) participated in the study. All of them were in treatment at different hospitals and private clinics in Barcelona, Spain. Participants were volunteers and gave informed consent. The mean age of patients was 19.65 (*SD* = 4.98) and their mean Body Mass Index (BMI) was 19.70 (*SD* = 3.17). There were no significant age differences between AN (*M* = 19.27, *SD* = 5.39) and BN (*M* = 20.50, *SD* = 3.88) patients. However, the BMI of patients with AN (*M* = 18.22, *SD* = 1.75) was significantly lower (t = -6.58, p<.001) than the BMI of BN patients (*M* = 23, *SD* = 3.19). The study was approved by the ethics committee.

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1.2. Assessment

- Subjective discomfort: Measured with a visual analogical scale (0-100)
- Sense of presence: Measured with a Spanish translation of the Presence Questionnaire (PQ) [9]
- ED symptoms: Measured with the Eating Attitudes Test-26 (EAT-26) [10]

1.3. Procedure

Tests were administered in two stages. In the first stage, participants were requested to fill in the EAT-26 and were measured and weighed in order to obtain their BMI. In the second stage, participants were exposed to the VEs. Since patients with ED are known to experience anxiety while eating and in social situations, we considered the variable food (no food, low-calorie food, and high-calorie food) and the variable people (no other people present and other people present) when developing the VEs. The combination of the two variables gave arise to a repeated measures design (2x3) with six conditions: The neutral room (with no food and no other people present), the kitchen with low-calorie food and no other people present, the kitchen with high-calorie food and no other people present, the restaurant with low-calorie food and other people present, the restaurant with high-calorie food and other people present, and the swimming-pool (with no food and other people present). Both in the restaurant and the kitchen, participants had to eat the virtual food by clicking on it with the mouse. Both in the restaurant and in the swimming-pool, participants were immersed in a social situation where they chatted with friends. First, participants visited the neutral VE and both subjective discomfort (SUD) and sense of presence were assessed. Then, the five experimental VEs were randomly administered. Experienced subjective discomfort and sense of presence were assessed again in the interval between the presentations of each experimental VEs.

2. Results

ED patients showed significantly higher levels of subjective discomfort in the kitchen with low-calorie food (F [5, 71] = 25.79, $p< .001$, $\eta 2 = 0.27$), the kitchen with high-calorie food (F [5, 71] = 200.40, $p< .001$, $\eta 2 = 0.74$), the restaurant with low-calorie food (F [5, 71]= 54.12, $p< .001$, $\eta 2 = 0.44$), the restaurant with high-calorie food (F [5, 71]= 148.30, $p< .001$, $\eta 2 = 0.68$), and the swimming-pool (F [5, 71] = 101.07, $p< .001$, $\eta 2 = 0.60$) compared to the neutral room. High-calorie environments and social situations produced the highest levels of subjective discomfort.

We also explored whether the presence of possible modulating variables influenced the results. Symptom severity and sense of presence were analyzed. BMI was introduced as a covariate in the analyses. The sample was divided into three equal groups according to the scores obtained on the EAT-26: mild (n = 24, scores from 0 to 16), moderate (n = 23, scores from 17 to 46), and severe (n = 24, scores from 47 to 71) symptomatology. A repeated measure analysis of variance 3 x 6 was conducted. The simple effect of symptom severity (F [2, 71] = 27.17, $p< .001$, $\eta 2 = 0.45$) was significant (Figure 1). Patients with severe symptomatology showed a higher subjective discomfort in all the environments compared to patients with moderate symptoms. Likewise, patients with moderate symptoms showed a higher subjective discomfort than patients with mild symptoms in all the environments. The interaction between the VE and the severity of symptoms was significant in the high-calorie kitchen, the low-calorie restaurant, the high-calorie restaurant, and the swimming-pool (Table 1). The group with severe symptoms showed the greatest disparity between discomfort experienced in these situations and the neutral room.

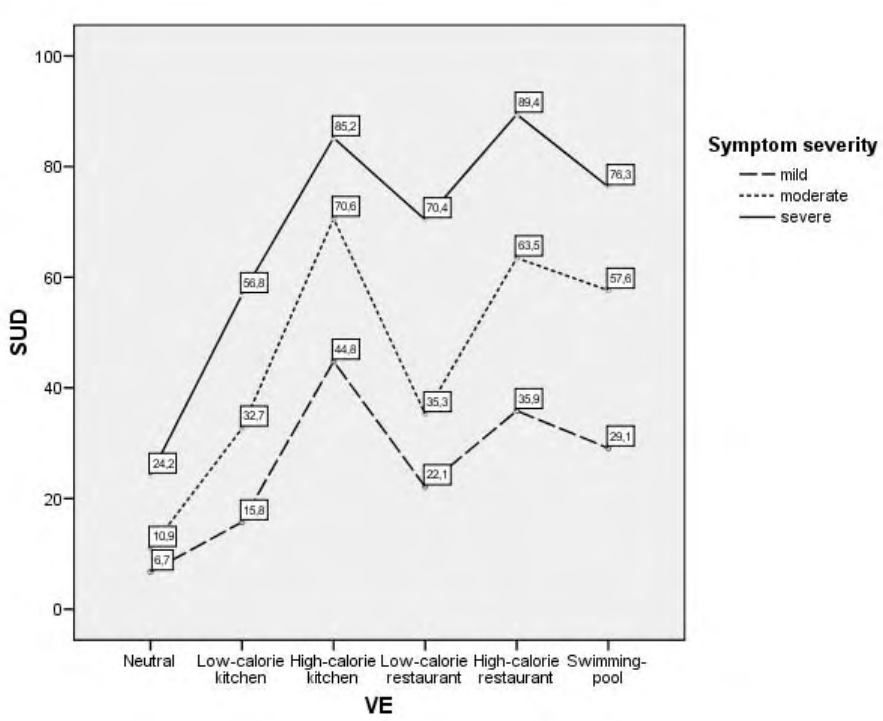

Figure 1. SUD means obtained by mild, moderate and severe ED patients in each VE.

Similar results were found when analyzing the sense of presence. We divided the sample into three equal groups: low sense of presence (n = 23, scores from 6 to 25.8), moderate sense of presence (n = 24, scores from 26 to 31.3), and high sense of presence (n = 24, scores from 31.5 to 38.7). The simple effect of the sense of presence was significant (F [2, 71] = 3.79, p= .028, $\eta 2$= 0.10). ED patients with high sense of presence showed the highest levels of subjective discomfort in all situations but the neutral room (Figure 2). Patients with a moderate sense of presence showed higher levels of discomfort in the neutral environment than patients with a high sense of presence.

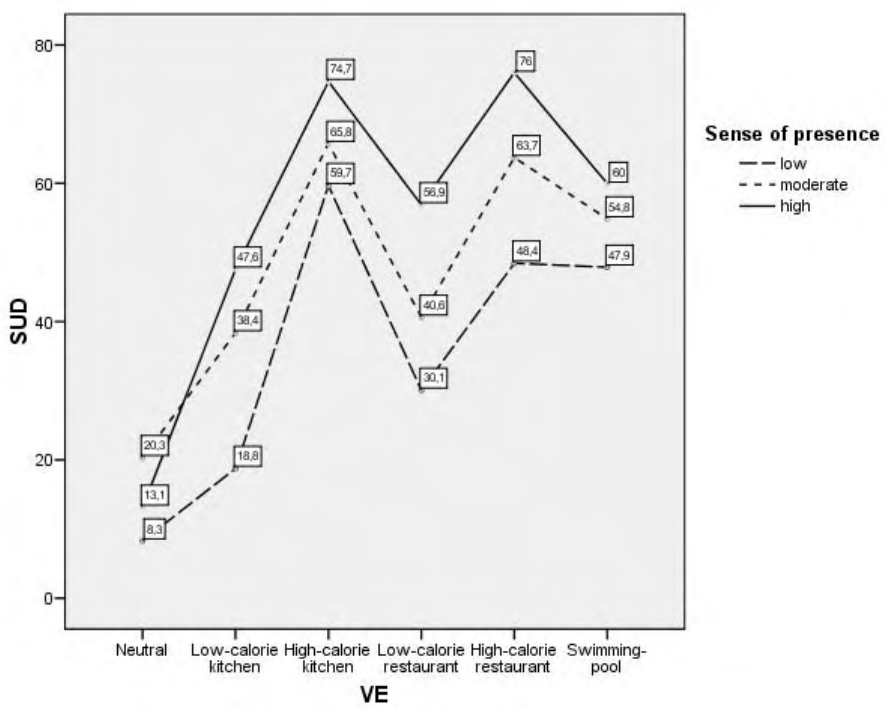

Figure 2. SUD means obtained by patients with low, moderate, and high sense of presence in each VE.

Furthermore, the interaction between presence and VE was significant in the kitchen with low-calorie food, the restaurant with low-calorie food, and the restaurant with high-calorie food (Table 1). The high presence group showed the greatest disparity between discomfort experienced in these situations and the neutral room.

Table 1. Interactions in repeated measures analysis 3 (mild vs. middle vs. severe symptoms) x 6 (VEs) and the repeated measures analysis 3 (low vs. moderate vs. high presence) x 6 (VEs)

VE	Severity			Presence		
	F	*p*	*η2*	*F*	*p*	*η2*
Low calorie kitchen – Neutral room	2.66	.07	.07	3.01	.056	.08
High calorie kitchen – Neutral room	4.19	.019	.11	1.63	.20	.05
Low calorie restaurant – Neutral room	5.88	.004	.15	4.09	.021	.11
High calorie restaurant – Neutral room	7.92	.001	.19	3.31	.042	.09
Swimming pool – Neutral room	5.65	.005	.14	0.78	.459	.02

3. Conclusions

As previously reported in different studies [5, 6], exposure to VEs produced changes in ED patients' mood. High-calorie environments and the swimming-pool elicited the highest levels of subjective discomfort. Moreover, emotional reactions to VEs differed according to the severity of the ED symptomatology and the sense of presence experienced during the exposure to VR. Patients with severe symptoms reacted more strongly than patients with mild and moderate symptoms. This difference was stronger in situations where participants had to eat the virtual high-calorie food (both in the kitchen and the restaurant) and in the swimming-pool. Refusing to eat high-calorie food and avoiding some social situations, such as eating when other people are present and exposing the own body to the scrutiny of others, are characteristic symptoms of eating disorders. Consequently, ED patients with severe symptoms are especially sensitive to these situations.

Also, higher levels of presence were related to higher subjective discomfort. Presence refers to the sensation of "being there" [11] experienced by users when being exposed to a VE. A higher sense of presence usually reflects a more realistic and intense experience of the simulated situation, and consequently, should be related with a stronger emotional reaction of participants. As expected, patients who reported a higher sensation of "being there" showed higher discomfort in the experimental VEs. In a previous study [5] we exposed 30 ED patients to six similar virtual situations. The sense of presence reported by participants was very low and had no significant effect on their mood. Then, we hypothesized that a higher sense of presence could be achieved by increasing the levels of immersion and interaction in the VEs. In the present study we used more interactive environments, where avatars speak to the participants and perform several actions. We assume that improving the environments and increasing the sample have both contributed to enhancing the effect of the variable presence in this study.

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Virtual Reality to Study Responses to Social Environmental Stressors in Individuals With and Without Psychosis

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Abstract. A Virtual Reality (VR) environment was created to study psychotic symptoms in patients and non-patients. Participants' task was to find five virtual characters that each had a small number label on his or her chest. The density and ethnic appearance of the virtual characters in the bar was controlled. For a non-patient group (N=24), results showed a significant main effect for density on participants' physiological responses, their behavior, reported level of discomfort, and their ability to remember place and location of the numbered avatars. The avatar's ethnicity had a significant effect on non-patients' physiological responses. Comparison between two patients and non-patient group showed differences in physiological responses, behavior and reported level of discomfort.

Keywords. Virtual Reality, psychosis, social scene, psychotic, paranoia, exposure

Introduction

Psychosis is a mental condition whereby people have delusions or prominent hallucinations. Core symptoms include paranoid delusions, ideas of reference and social anxiety. Psychotic individuals can experience fear because they believe that others intend to harm them. In subclinical severity, paranoia and social anxiety are also prevalent in the general population, which makes it useful to study these symptoms both in patient and in non-patient populations. One key variable in understanding psychosis is the social environment. Epidemiological studies have shown high rates of psychotic disorders in densely populated urban environments, and among immigrants who live in neighborhoods with a low proportion of ethnic minorities, likely reflecting the causal influence of environmental risk factors [1]. Recreating the social environment in Virtual Reality (VR) has been put forward as a means to study psychotic symptoms [2]. Paranoid thoughts and anxiety are elicited by social and interpersonal stimuli such as eye contact, speaking, gestures, etc. In this study we manipulate two potential social environmental stressors: population density and ethnic appearance of an avatar group in a bar setting. The study focuses on the feasibility of this technology in this context and therefore falls into the Technology Element category of the Mental Health Computing Research Model [3].

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Figure 1. Bar world

1. Method

Individuals could freely navigate through the bar consisting of an indoor and outdoor setting (Figure 1). Potential stressors that could be set were: (1) the ethnic proportion of the avatar group, either mainly white-European or mainly North-African; and (2) the density of the avatars in the bar, either between seven and nine or between 34-38 avatars. To engage the people with these avatars the system randomly gave five of these avatars a number, visible on their clothing, which participants had to find. During this task the navigation behavior with a Logitech Chillstream Gamepad was automatically recorded. Participants wore an Emagin Z800 3D Visor with a resolution of SVGA 800x600 24 bit, with 40 degrees diagonal Field of View, and built-in 3DOF tracker. Physiological data was collected with a Mobi8 from TMSi with Xpod Oximeter for heart rate (HR) measurement, and galvanic skin response (GSR) sensor with two finger electrodes. The study analyzed the average distance maintained to avatars, HR (variability), GSR as behavioral and physiological indicators of paranoia, anxiety and/or (social) stress. Participants were a white, Dutch, non-patient group consisting of university staff and students, including four females and 20 males, with an average age of 29 years old (*SD* = 9.2); and two Dutch male patients, 36 and 25 years old, who completed technical and vocational training for 12-16 year-olds and for 16-18 year-olds. Both patients were white Dutch. Patient A had a DSM IV diagnosis of delusional disorder. Patient B was diagnosed with a schizoaffective disorder. They were eligible for this study because they both had paranoid delusions and delusions of reference at referral to the mental health clinic. At the time of the experiment, they had mild symptoms. The experiment was set up with a 2 by 2 within-subjects design for the two factors of the avatar group (ethnicity and density). Participants were informed in detail about the experiment. After they signed the informed consent form, as a baseline measurement for GSR, a three-minute neutral physiological measurement was taken, where participants sat in a chair. After this, participants had a training session in which they navigated through the VR world and looked for the numbered avatars. Once this was completed, participants were exposed to the four experimental conditions, with a maximum of three and a half minutes each for the non-patient group and four minutes for the patients. After each exposure participants were asked to write the positions and the numbers of the five avatars on a map. The experiment of the non-patient group was conducted in a university lab, while the two patients participated at the mental health clinic.

2. Results

Table 1 shows the results of the non-patient group and patient A and B. To reduce variance caused by individual differences, the GSR in micro Siemens (µS) values (δ) were set against mean GSR value of the neutral (β) phase ((δ - β) / β), whereby an increase indicates an increase in moisture level. Participants' navigation behavior was analyzed by looking at the mean distance between their location in the VR world and a visible avatar within a two-meter radius. To study the size of the area explored in the bar, the mean of the Euclidean Distance Matrix (EDM) was calculated, which was based on participant's position sampled every five seconds. The effects for ethnicity and density was analyzed in a series of MANOVAs with repeated measures conducted on the data of the non-patient group. Compared to low density conditions, in the high density conditions: fewer locations (F(1,23) = 7.07, p. = 0.014) and numbers (F(1,23) = 10.47, p. = 0.004) were correctly remembered of the labeled avatars; self-reported subjective unit of discomfort (SUD) was higher (F(1,23) = 5.24, p. = 0.032); SD of the heart rate was larger (F(1,23) = 10.09, p. = 0.004); average distance towards an avatar was smaller (F(1,23) = 4.86, p. = 0.038) in a two-meter radius of a visible avatar. Compared to white-European avatars, in the conditions with a majority of North-African avatars, the SD of heart rate was larger (F(1,23) = 4.70, p. = 0.041) and SD of galvanic skin response was larger (F(1,22) = 4.54, p. = 0.044). The beat-to-beat SD is often taken as a

measure of heart rate variability (HRV). A reduction in HRV indicates an increase in cognitive or emotional strain [4]. SD, however, does not consider temporal distance between successive heartbeats as is calculated with the square root of mean squared difference of successive (RMSSD) HR measurement. A MANOVA with repeated measures on RMSSD HR, however, found no significant effects for ethnicity or density. Figure 2 shows HR and GSR of a participant in the non-patient group. For him, the VR worlds with a majority of North-African avatars resulted in higher overall fluctuation in his HR and GSR compared to the VR worlds with a majority of white-European avatars. As an exploration, the data obtained from the two patients were compared with a series of one-sample *t*-tests with the means of the non-patient group. Compared to the mean of the non-patient group the overall trends across the conditions for these two patients were that they positioned themselves more closely to visible avatars in a two-meter radius. Individual ANOVAs on the samples (0.1s) of the distance towards a visible avatar of the two patients in the high-density conditions showed, for patient A, significant main effects for avatar's gender ($F(1, 8283) = 23.85$, $p. < 0.001$) and for avatars' ethnicity ($F(1, 8283) = 69.08$, $p. < 0.001$), as well as a two-way interaction effect ($F(1, 8283) = 100.48$, $p. <0.001$). As Figure 3 shows, patient A kept a greater distance towards the North-African female avatars. A similar analysis for patient B only showed that this patient's distance was significantly ($F(1, 8151) = 6.04$, $p. = 0.014$) smaller towards the North-African avatars than towards the white-European avatars.

Table 1. Mean (SD) of non-patient group and results of patient A and B.

	White-European (own ethnicity)		**North-African (other ethnicity)**	
Measure	**low density**	**high density**	**low density**	**high density**
Location correct				
M (*SD*)	3.6 (1.3)	2.8 (1.5)	3.7 (1.6)	3.1 (1.3)
Patient A / B	3* / 2**	3/ 4**	3* / 4	2** / 2**
Labels correct				
M (*SD*)	3.9 (1.3)	3.3 (1.5)	4.3 (0.9)	3.5 (1.4)
Patient A / B	4 / 3**	4* / 3	3** / 4	2** / 2**
SUD from 1 to 10				
M (*SD*)	1.75 (1.00)	2.04 (1.16)	1.92 (1.02)	2.21 (1.18)
Patient A / B	8** / 4**	7** / 4**	6** / 3**	8** / 5**
HR in bmp				
M (*SD*)	82 (11)	83 (11)	83 (11)	83 (11)
Patient A / B	101** / 113**	102** / 110**	99** / 110**	103** / 109**
SD HR in bmp				
M (*SD*)	3.39 (0.78)	4.08 (1.49)	3.93 (1.33)	4.21 (1.24)
Patient A / B	2.48** / 2.83**	5.09** / 2.97**	4.01 / 4.98**	3.42** / 2.83**
RMSSD HR in bmp				
M (*SD*)	1.31 (0.19)	1.33 (0.30)	1.29 (0.17)	1.32 (0.29)
Patient A / B	1.11** / 1.07**	1.35 / 1.18*	1.20* / 1.45**	1.10** / 1.11**
GSR in % to neutral				
M (*SD*)	0.68 (0.57)	0.69 (0.62)	0.64 (0.68)	0.65 (0.57)
Patient A / B	0.59 / 0.88	2.67** / 1.61**	0.84 / 2.29**	1.72** / 2.46**
SD GSR in µS				
M (*SD*)	0.24 (0.31)	0.24 (0.21)	0.26 (0.25)	0.34 (0.34)
Patient A / B	0.09* / 0.26	0.23 / 0.51**	0.22 / 0.30	0.20 / 0.23
Distance avatar in m				
M (*SD*)	1.29 (0.08)	1.28 (0.08)	1.32 (0.11)	1.26 (0.07)
Patient A / B	- / 1.20**	1.25 / 1.28	1.28 / 1.18**	1.16** / 1.18**
EDM in m				
M (*SD*)	6.35 (0.96)	6.89 (1.01)	6.49 (1.51)	6.96 (1.15)
Patient A / B	- / 5.22**	5.98** / 6.12**	5.19** / 5.65*	8.12** / 7.55*

** p. < 0.05; ** p. < 0.01*

Furthermore, the EDM results (Table 1) seem to suggest that the two patients covered a smaller area than the non-patient group, on average. The opposite, however, was the case in the high density/North-African condition where both patients covered a significantly larger area than the non-patients, on average. Table 1 also shows that the patients' heart rates were higher, they sweated more, and their SUD score was higher. Except for patient B in the low density/North-African condition, the RMSSD HR scores were smaller compared to the non-patient group suggesting an increased level of cognitive or emotional strain.

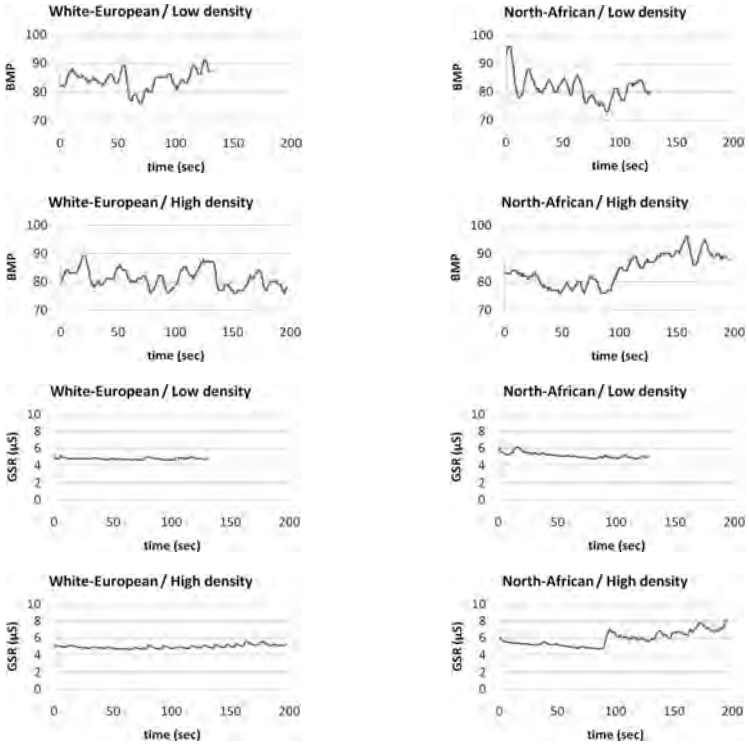

Figure 2. Heart rate and relative galvanic skin response of a non-patient

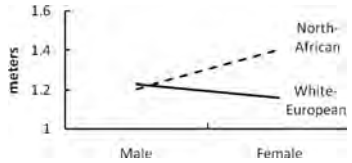

Figure 3. Distance between Dutch male patient (A) and visible avatars with different gender and ethnicity

3. Conclusion and Discussion

Results of the non-patient group seem to indicate that an increased population density and an increased proportion of avatars with other ethnicity are associated with a larger number of fluctuations in physiological arousal, and more subjective distress when population density increased. The latter, however, seems likely to have coincided with an increase in the degree of task difficulty as well. The fluctuation in the physiological responses might be a reaction towards the various stimuli (i.e. avatars) non-patients engaged and disengaged with as they progressed through the VR world. This seems to validate the VR world, and confirm earlier reports on physiological responses towards ethnicity of an avatar [5]. The VR world seems to have had a larger effect on the two patients. Their physiological arousal and subjective distress level was higher. Furthermore, in three of the four conditions, they seem to cover a smaller area of the bar. Interestingly, however, they approached the avatars more closely. More research is needed to see if these observations can be generalized across patients and to investigate in more detail if the observed behavioral and physiological patters indeed reflect paranoia and social anxiety. The result also shows the possibility for individual analyses of the behavior towards various types of avatars, such as gender, and ethnic appearance of avatars.

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Validation of a Neuro Virtual Reality-based Version of the Multiple Errands Test for the Assessment of Executive Functions

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Abstract. The purpose of this study was to establish ecological validity and initial construct validity of the Virtual Reality (VR) version of the Multiple Errands Test (MET) (Shallice & Burgess, 1991; Fortin et al., 2003) based on the NeuroVR software as an assessment tool for executive functions. In particular, the MET is an assessment of executive functions in daily life, which consists of tasks that abide by certain rules and is performed in a shopping mall-like setting where items need to be bought and information needs to be obtained. The study population included three groups: post-stroke participants (n = 5), healthy, young participants (n = 5), and healthy, older participants (n = 5). Specific objectives were (1) to examine the relationships between the performance of three groups of participants in the Virtual Multiple Errands Test (VMET) and at the traditional neuropsychological tests employed to assess executive functions and (2) to compare the performance of post-stroke participants to those of healthy, young controls and older controls in the VMET and at the traditional neuropsychological tests employed to assess executive functions.

Keywords. Virtual Reality, executive functions, Multiple Errands Test (MET), daily life tasks, NeuroVR

1. Deficits in Executive Functions and the Virtual Multiple Errands Test

Deficits in executive functions [1, 2] have, as the most common causes, neurological conditions including frontal lobe damage due to traumatic brain injury, pervasive central nervous system (CNS) damage such as stroke [3] and those with specific pathologies such as Parkinson's disease (PD). The assessment of executive deficits is traditionally performed through paper and pencil tasks such as the Stroop Test, the Wisconsin Card Sorting Test (WCST), the Tower of London test (TOL), the Progressive Matrices and Elithorn's Labyrinth, but there are also tools which represent situations which similar to daily life tasks, such as the Behavioral Assessment of Dysexecutive Syndrome, the Dysexecutive Questionnaire (BADS & DEX) [4] and the *Multiple Errands Test (MET)* [2]. The MET is an assessment of executive functions in daily life originally developed by Shallice and Burgess specifically for use with high functioning patients and adapted into the simple version [5] and the hospital version [6]. It is performed at a real shopping mall or in a hospital environment and involves the completion of various tasks of different complexity levels (e.g. buy a small brown loaf of bread as compared to discovering a currency exchange rate), rules to adhere to and a specified time frame. After the tasks and the rules have been explained, patients are able to plan and choose the sequence of actions needed to complete the tasks. The executive functions stimulated are numerous, from the ability to plan a sequence of actions, to problem solving, to cognitive and behavioral flexibility. The tester follows the participant, recording different kinds of mistakes. It is a "real-life" multitasking test requiring the

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execution of very common daily actions, and so, it has good ecological validity [7], as well as good psychometric properties [8]. The assessment of executive functions in real-life settings has the advantage of giving a more accurate estimate of the patient's deficits than is possible within laboratory conditions [9], but it is also time-consuming since patients must be taken to the setting where the assessment will be carried out and should be able to walk independently in order to perform the assessment [10]. For this reason, the use of *simulated environments*, perceived by the user as comparable to real world objects and situations, can overcome the limits of the traditional MET, by maintaining its several advantages [11]. In addition to a first version of the Virtual Multiple Errands Test (VMET) developed by Rand, Rukan, Weiss and Katz [9] as an assessment tool for executive functions within the Virtual Mall (VMall) developed by Weiss et al. in 2004, we developed another VR-based MET using the NeuroVR software, a free VR platform based on open-source software.

Figure 1. A screenshot of the virtual supermarket

2. Method

The MET procedure was modified according to the structure and the features of the system involved in the study. In particular, subjects were instructed to buy items following a defined shopping list and to obtain information (e.g., the closing time of the supermarket) following specific rules (e.g., not to go into the same aisle more than once). While completing the MET procedure, specific variables were measured as the outcome measures: the *time of execution*, *total errors*, *inefficiencies*, *rule breaks*, *strategies*, *interpretation failures* and *partial tasks failures* (e.g., maintained sequence of the task, self corrected upon errors made during the task, no evidence of perseveration or sustained attention throughout the sequence of the task).

The virtual environments employed in the study present two different scenarios: a food market, for the training in navigation and of object selection and a supermarket, which is larger and more complex, for the experimental phase. The subject-environment interaction was based on semi-immersion (scenes were visualized on a 15-inch PC screen) and objects were selected using a wireless joy-pad.

A total of 15 participants in three groups were included in the study, including five post-stroke individuals and 10 healthy people in two age groups. The *five stroke participants* ranged in age from 50-70 years old (mean age=59.60 years, std.dev=9.236; mean number of school years=12 years, std.dev.=4.18; MMSE=28.17, std.dev.=1.39). In addition, *10 healthy participants* volunteered to participate in this study including *five young* participants with an age range between 20-30 years old (mean age=26, std.dev=2.12; mean number of school years=17.40, std.dev.=1.34; MMSE=30, std.dev.=.00) and *five older participants* with an age range between 50-70 years old (mean age=56.40 years, std.dev=4.93; mean number of school years=13 years, std.dev.=.00; MMSE=28.69, std.dev.=.67). All groups were fully independent in activities of daily living and instrumental activities of daily living. The stroke participants were recruited from the Stroke Unit of Istituto Auxologico Italiano and were selected according to the severity of impairment. The ethics committee approved the study and all participants signed informed consent forms. Patients were excluded from the study based on severe cognitive impairment (MMSE<19), severe motor impairment (Barthel index [cut-off≥45/100], Stroke scale and the National Institute of Health Stroke Scale (NIHSS), auditory language comprehension difficulties (Token Test within the Brief Neuropsychological Examination, Token Test<26,5), object recognition impairments (Street Completion Test<2,25), spatial hemi-inattention and neglect, as assessed by the Star Cancellation Test within the Behavioral Inattention Test, excessive state and trait anxiety (State and Trait Anxiety Index>40) and excessive depression state (Beck Depression Inventory>16). Besides the VMET, participants also underwent an exhaustive neuropsychological assessment with the aim to obtain an accurate overview of their cognitive functioning in order to be compared with the performance on the experimental test. In particular, the following neuropsychological tests were employed: the Brief

Neuropsychological Examination (ENB) and the Test of Everyday Attention (TEA), Stroop Test, Iowa Gambling Task and Dysexecutive Questionnaire (DEX) to assess different executive functions.

3. Results

Data analyses were carried out using SPSS for Windows, version 17.0. Due to the small group sample size non-parametric statistics were used, specifically, Pearson correlation coefficients to examine the relationships between the various scores of the neuropsychological tests employed to assess executive functions and the outcome measures of the VMET for each group separately, while the Kruskal-Wallis procedure was used for the comparison of the scores of the same tests between the post-stroke participants and both groups of healthy controls.

The main correlations between neuropsychological tests and the variables of the VMET emerged in each group of participants are provided in the following tables.

Table 1. Correlations for patients.

	Time (VMET)		**Total errors (VMET)**		**Rule Breaks (VMET)**	
	r	***p***	**r**	**p**	**r**	**p**
Attention shift test (TEA)	.90	.037	.96**	.00		
Incompatibility test (TEA)			-.95	.014		
Go/NoGo test (TEA)					.90	.037
DEX					-.99	.00

Table 2. Correlations for adult control group.

	Inefficiencies (VMET)		**Interpretation errors (VMET)**		**Strategies (VMET)**		**Rule breaks (VMET)**		**Time (VMET)**	
	r	***p***	**r**	**p**	**r**	**p**	**r**	**p**	**r**	**p**
Disadvantageous deck (IGT)	.947	.014								
Incompatibility test (TEA)			-.889	.044						
Visual exploration (TEA)					1	.00				
Go/NoGo test (TEA)							.975	.005		
Interference Test Stroop									.900	.032

Table 3. Correlations for young control group.

	Time (VMET)		**Interpretation errors (VMET)**		**Inefficiencies (VMET)**		**Rule breaks (VMET)**		**Strategies (VMET)**	
	r	***p***	**r**	**p**	**r**	**p**	**r**	**p**	**r**	**p**
Exploration test (TEA)	.90	.037								
Divided attention test (TEA)			-.89	.044						
Sustained attention test (TEA)					.895	.040				
Working memory (TEA)							.894	.041		
Visual exploration (TEA)									1	.000

Table 4. Kruskal-Wallis and Mann-Whitney tests.

	Kruskal-Wallis H Chi-square (p)		Mann-Whitney
Time (V-MET)	6.080	(.048)	Patients < Adults < Youngs
Inefficiencies (V-MET)	6.395	(.041)	Youngs < Adults < Patients
Rule breaks (V-MET)	5.862	(.05)	Youngs < Adults < Patients
Mean Intermodal Comparison (TEA)	7.220	(.027)	Patients < Adults < Youngs
Mean Flexibility (TEA)	11.06	(.004)	Patients < Adults < Youngs
Mean Spatial Incompatibility (TEA)	7.233	(.027)	Patients < Adults < Youngs

According to the Kruskal-Wallis and Mann-Whitney tests, Table 4 shows main results.

4. Discussion and Conclusions

The ecological validity of the VMET has been demonstrated by significant correlations between the VMET and some tests employed for the measurement of executive functions within the experimental groups. For example, correlations with the Test of Everyday Attention or for patients, the correlation between rule breaks in the VMET and the Dysexecutive Questionnaire (DEX). As for the adult control group, other important results were correlations with the Stroop Test and the Iowa Gambling Task. The lack of correlation between the VMET and the Stroop Test in patients and young control groups could be interpreted as referring to the fact that VMET protocol has no conflicting tasks: perhaps, adding announcements in the supermarket which interrupt the main task. Finally, significant differences among groups emerged from the Kruskal-Wallis procedure. The direction of these differences was as expected: for example, patients are less efficient and commit a higher number of rule breaks than the other two groups.

Concerning possible conclusions, results support the ecological validity of the VMET as an assessment tool of executive functions. Moreover, it was able to differentiate between two age groups of healthy participants and between healthy and post-stroke participants, thus demonstrating that it is sensitive to brain injury and aging. However, further psychometric data on temporal stability are needed, and further research using the VMET as an assessment tool with larger groups and use in additional populations is also recommended.

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A Comparison of Text and Technology Based Training Tools to Improve Cognitive Skills in Older Adults

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Abstract. Research has indicated that use of cognitive skills training tools can produce positive benefits with older adults. However, little research has compared the efficacy of technology-based interventions and more traditional, text-based interventions which are also available. This study aimed to investigate cognitive skills improvements experienced by 40 older adults using cognitive skills training tools. A Solomon 4 group design was employed to determine which intervention demonstrated the greatest improvement. Participants were asked to use the interventions for 5-10 minutes per day, over a period of 60 days. Pre and post-tests consisted of measures of numerical ability, self-reported memory and intelligence. Following training, older adults indicated significant improvements on numerical ability and intelligence regardless of intervention type. No improvement in self-reported memory was observed. This research provides a critical appraisal of brain training tools and can help point the way for future improvements in the area. Brain training improvements could lead to improved quality of life, and perhaps, have financial and independent living ramifications for older adults.

Keywords. cognitive training, gerontology, brain training, cognitive decline, human-computer interaction

Introduction

Declines in cognitive function over the adult life span have been found in both cross-sectional and longitudinal studies for a variety of tasks, abilities, and processes [1]. If these cognitive declines can be prevented or avoided, a greater proportion of elderly individuals may be able to live independently for a longer period of time, thus reducing pressure on family and state resources. Bjorklund and Bee [2] report that individuals who exercise cognitive processes through activities like playing chess, bridge or doing crossword puzzles can help to preserve these cognitive processes. Bell et al. [3] found that when older adults aged 65-94 years old were provided with cognitive skills training (memory, reasoning, and speed of processing) the effects could be seen even at a two-year follow up. Bell et al. also suggest that these improvements may reduce the eventual decline of cognitively demanding everyday functioning across these groups. Other researchers [4, 5] have demonstrated that older adults can respond well to cognitive training interventions and that cognitive decline is not universal or pervasive [6]. Wilson, Scherr, Schneider, Tang and Bennett [7] carried out annual clinical evaluations on more than 700 elderly people for up to five years. They found that more frequent participation in cognitive activity was associated with reduced incidence of Alzheimer's disease, with a cognitively inactive person being 2.6 times more likely to develop Alzheimer's disease than a cognitively active person. This association remained after controlling for past cognitive activity, lifespan socioeconomic status, and current social and physical activity. Frequent cognitive activity was also associated with reduced incidence of mild cognitive impairment and less rapid decline in cognitive function [7].

Various "brain-training" games have become available in recent years, with one of the most popular being "Dr. Kawashima's Brain Training" for the Nintendo DS Lite console. However, there has been little research to date comparing the efficacy of such technologically based interventions with more traditional, text-based interventions which are also available.

The aim of this research was to investigate the effect of cognitive skills training tools on intelligence, self-reported memory and numerical ability in older adults, and to investigate the difference between using a text-based cognitive skills training tool and a technologically based cognitive skills training tool. The following hypotheses were investigated:

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H1: The use of cognitive skills training tools will result in a significant improvement in numerical ability, self-reported memory and intelligence.

H2: The use of text-based cognitive skills training tools will result in a difference in change in numerical ability, self-reported memory and intelligence compared with the technological based cognitive skills training tools.

1. Method/Tools

This study examined changes in cognitive skills experienced by forty older adults using cognitive skills training tools. A Solomon four group design was employed to determine which intervention demonstrated the greatest improvement among older adults while controlling for the effects of pre-testing.

1.1. Participants

Participants were recruited from a number of social organizations for older people. The gender and age of participants are indicated in Table 1.

Table 1. Total age and gender of participants.

	Frequency	Percent	Mean Age	St. Dev	Range
Female	25	62.5	73.3	5.0	65-83
Male	15	37.5	73.4	6.0	65-87
Total	40	100	73.3	5.3	65-87

Eligible participants were randomly allocated to either the technological or text-based intervention, with or without pretesting. A description of the demographic characteristics of the participants in each of the four groups is provided in Table 2. There was a higher drop-out rate for participants who did not complete pre-tests, and so these groups are under-represented in the sample.

Table 2. Age, gender and number of participants per group.

Condition	N	Female N	Male N	Mean Age	St. Dev	Range
Technology Intervention – no pretest	4	1	3	70.7	.5	70-71
Text Intervention – no pretest	7	5	2	72.0	3.8	65-76
Technology Intervention – with pretest	14	10	4	73.7	5.3	65-81
Text Intervention – with pretest	15	9	6	74.3	6.6	65-87

1.2. Materials

A technological and text-based intervention, screening questionnaires (to determine previous use of the interventions), consent and debrief forms and a number of pre- and post-tests were sourced and created. The technological intervention consisted of the temporary provision of a Nintendo DS Lite Games Console and a copy of the game Dr. Kawashima's Brain Training: How Old is Your Brain? The text-based intervention consisted of a similar alternative developed by the same neuroscientist – Kawashima's "Train Your Brain: 60 Days to a Better Brain" [8]. Screening questionnaires and consent forms were developed. Pre-tests and post-tests consisted of a short test of numerical problem-solving abilities, the Wechsler Abbreviated Scale of Intelligence (WASI) and The Memory Assessment Clinics Self-Rating Scale (MAC-S). All participants signed informed consent forms and the ethics committee approved this study.

1.3. Procedure

Participants were screened to ensure that they were not already familiar with the intervention materials (specifically the book, game and console used in the study). Pre-tests were completed on those participants assigned to both pre-test conditions. Participants assigned to the technological intervention were provided with a Nintendo DS Lite console and a copy of the game "Dr Kawashima's Brain Training." Participants assigned to the text-based intervention were provided with a copy of a cognitive training workbook also developed by Kawashima [8], which uses similar techniques to the technological intervention. Participants were instructed on the use of the interventions, and were then asked to use the intervention tool for 5-10 minutes per day for a period of 60 days. Post-tests were carried out with all participants.

2. Results

2.1. Numerical Ability Test

A one way between-subjects ANOVA was conducted and indicated that there was no statistically significant difference between the pretested and non-pretested groups on the Numerical Ability Test (NAT) post test score: ($F(3,36) = 0.294$, $p = .829$, partial $\eta^2 = 0.24$). A 2*2 within-subjects ANOVA design was employed to investigate if the presence of a pre-test combined with the intervention category resulted in a difference in post-test scores on the Numerical Ability test, and no significant differences were found: $F(1,13) = 0.640$, $p=.438$, partial $\eta^2 = 0.04$. However, there was a significant difference between the pre-test and post-test scores on the Numerical Ability Test irrespective of which intervention was used: $F(1,13) = 36.13$, $p < 0.0005$, partial $\eta^2 = 0.735$, with the posttest scores showing significant improvement. There was no significant interaction between either intervention on NAT scores: $F(1,13) = 0.537$, $p = 0.477$, partial $\eta^2 = 0.040$.

2.2. Self-reported Memory

A one way between-subjects ANOVA was conducted and indicated that there was no statistically significant difference between the pretested and non-pretested groups on the MAC-S post test score: ($F(3,36) = 0.341$, $p = .795$, partial $\eta^2 = 0.28$). A 2*2 within-subjects ANOVA design was employed to investigate if the presence of a pre-test combined with the intervention category resulted in a difference in post-test scores on the MAC-S, and no significant differences were found: $F(1,13) = 0.051$, $p=.825$, partial $\eta^2 = 0.004$. There was no significant difference between the pretest and posttest scores on the MAC-S irrespective of which intervention was used: $F(1,13) = .287$, $p = 0.601$, partial $\eta^2 = 0.022$. There was no significant interaction between either intervention on MAC-S score: $F(1,13) = 0.018$, $p = 0.896$, partial $\eta^2 = 0.001$.

2.3. Intelligence

A one way between-subjects ANOVA was conducted and indicated that there was no statistically significant difference between the pretested and non-pretested groups on the WASI post test score: ($F(3,36) = 0.951$, $p = .426$, partial $\eta^2 = 0.073$). A 2*2 within-subjects ANOVA design was employed to investigate if the presence of a pre-test combined with the intervention category resulted in a difference in post-test scores on the WASI, and no significant differences were found: $F(1,13) = 0.172$, $p=.685$, partial $\eta^2 = 0.01$. However, there was a significant difference between the pretest and posttest scores on the WASI, irrespective of which intervention was used: $F(1,13) = 6.142$, $p = 0.028$, partial $\eta^2 = 0.32$, with the post-test scores showing significant improvement. There was not a significant interaction between either intervention on WASI Total scores: $F(1,13) = 0.19$, $p = 0.892$, partial $\eta^2 = 0.01$.

3. Conclusion

Following training, older adults demonstrated significant improvements on both intelligence and numerical ability, regardless of intervention type. These results support the validity of brain training as an aid to cognition. There was no significant improvement in self-reported memory. This may be due to the self-report nature of the measure used, and a more objective measurement of memory may have shown different results. There was no significant difference in improvement between the two types of intervention, suggesting that either type of intervention is suitable for aiding cognition in older adults. This may be due to the similarity of the training tasks involved in each tool. The implication of this finding is that older adults are not disadvantaged by preference for either the technological or text-based tool. This research provides a critical appraisal of the brain training tools and can help point the way for future improvements in the field. Brain training improvements could lead to improved quality of life, and perhaps have financial and independent living ramifications for older adults. Further research could be conducted using a longitudinal design to investigate the use of brain training tools in old age.

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SECTION III

ORIGINAL RESEARCH

Healthcare 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

PsychLog: A Personal Data Collection Platform for Psychophysiological Research

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Abstract. In this paper we introduce PsychLog (http://www.psychlog.com/), a mobile experience sampling platform that allows real-time collection of psychological, behavioral and contextual data for research and clinical applications. The mobile platform allows administering self-report questionnaires to collect user's quality of experience in its various cognitive, affective and motivational dimensions. The researcher can schedule the administration of the questionnaires by setting a trigger, which can be launched at specific times or randomly during a day. A wireless electrocardiogram (ECG) equipped with an accelerometer allows monitoring levels of activity and heart rate information. PsychLog is freely available for Windows mobile and its open-source code can be configured to meet specific experimental or clinical requirements. Here, we provide an overview of the system and its future developments.

Keywords. ecological momentary assessment, wearable sensors, electrocardiogram, accellerometer, smartphones

1. Introduction

1.1. Experience Sampling

Recently, there has been growing interest towards the use of experience sampling procedures in research and the clinical setting. Experience sampling method (ESM), also known as ecological momentary assessment (EMA), is a naturalistic observation technique that allows capturing subjects' experience and activities in real-life contexts [1]. The procedure requires participants to fill out multiple brief questionnaires about their current activities and feelings by responding to random alerts throughout the day. Usually, ESM form contains open-ended questions about situational variables such as place, activities performed, social context, and subjective variables investigating the quality of experience in its various cognitive, motivational and affective components. Thanks to its flexibility and the possibility of adapting the questions to the goals and motivations of the researcher, ESM has been used with adolescent and adult populations for decades to understand areas such as mood, social interactions and time use; this approach has also proven to be helpful in the clinical context, i.e., to define therapeutic interventions that are optimally suited for an individual patient [2]. In this paper, we present the design and implementation of a smartphone-based ESM platform, designed for research and clinical applications in mental health. In the first section, we present related work on computerized versions of this procedure. Next, we provide an overview of the system and its ongoing application in the field of momentary stress assessment.

1.2. Computerized Experience Sampling Procedures

In the past, ESM-based studies have been mainly done via paper and pencil measures. However, in the last decade computerized versions of this technique have been introduced, which allows collecting data by handheld electronic devices. Computerized experience sampling procedures have several advantages over pen-and-paper approaches. For example, they allow the researcher to precisely control the timing of self-report administration; to objectively control compliance rates; and to reduce the chance of human error when managing the data [3-4]. Further,

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computerized experience sampling procedures can take advantage of recent advances in computational perception and sensing technologies to automatically detect events that can trigger data collection. For example, the Context-Aware Experience Sampling tool, developed by Intille and colleagues [5], offers the possibility to gather information from study participants only in particular situations that are detected by sensors connected to a personal digital assistant. A recent evolution of this approach is the MyExperience platform, which has been developed to run on smartphones in order to take advantage of the increasing number of sensors included in these devices. MyExperience supports 50 built-in sensors including GPS, GSM-based motion sensors and device usage information [6].

2. Overview of the PsychLog System

PsychLog (http://www.psychlog.com/) is a mobile experience sampling platform that allows the collection of psychological, physiological and contextual information in naturalistic settings. The system consists of three main modules: the *survey manager* module, the *sensing/computing* module and the *visualization* module.

The *survey manager* application allows configuring, managing and administering self-report questionnaires. Surveys are used to collect participants' feedback on his/her quality of experience in its various cognitive, affective and motivational dimensions. The researcher defines the schedule of self-reports by setting a trigger. Triggers can be launched with a fixed schedule or randomly during the day. If the researcher chooses a fixed schedule, also called *interval-contingent sampling* [7], participants make their reports at fixed times throughout the day. With a variable schedule, also known as *signal-contingent sampling* [8], observations are taken at random times throughout the day. The researcher defines the probability for the trigger event by entering a value between 0 (never) and 1 (always). When the trigger goes off, the user hears a beep and a notification message is displayed. When an item is displayed on the screen, the participant can: a) move to the next question (by clicking on the “next” button); b) step back to the previous question (by clicking on the “previous” button), or c) skip the question.

The *sensing/computing* module allows continuous monitoring of heart rate and activity data acquired from a wireless electrocardiogram (ECG) equipped with a three-axial accelerometer. The wearable sensor platform (Shimmer Research™) includes a board that allows the transduction, amplification and pre-processing of raw sensor signals, and a Bluetooth transmitter to wirelessly send the processed data. Sensed data are transmitted to the mobile phone Bluetooth receiver and gathered by the PsychLog computing module, which stores and processes the signals for the extraction of relevant features. ECG and accelerometer sampling intervals (epochs) can be fully tailored to the study’s design. During each epoch, signals are sampled at 100 Hz, filtered and analogue-to-digital converted with 12-bit accuracy in the ±3 V range, and R-R intervals are extracted through a dedicated algorithm [9]. R-R intervals are transformed to a tachogram, i.e., the series of R-R interval durations as a function of the interval number, and linearly interpolated at a fixed frequency. The data are further linearly detrended and high-pass filtered to eliminate fluctuations. For each sequence, HRV power spectra are calculated, selecting the number of segments, the points of each segment and the percentage of overlap, by means of fast Fourier transform [10-11]. This information can be correlated with the movement information obtained from the accelerometer and self-reported feelings and activities. In this way, it is possible to investigate the relationship between behavioral, psychological and physiological variables, as well as to monitor their dynamic fluctuations over time.

Finally, the *visualization* module allows plotting ECG and acceleration graphs in real time on the mobile phone’s screen. This feature is useful either for monitoring the ECG data or for checking the functioning of the ECG sensor apparatus. Self-reports and sensors data are stored on the mobile phone’s internal memory, in separate files, for off-line analysis. Data are stored as .dat (supported by most data analysis programs), .txt and .csv format.

3. Conclusions and Future Steps

The PsychLog software is freely available for Windows mobile 6.5 and its open-source code can be configured to meet specific experimental or clinical requirements. Although PsychLog is less sophisticated than other applications, such as Context Aware Experience Sampling or MyExperience, it does not require programming skills and can be run on relatively low-cost smart phones running Windows mobile. The application is currently being deployed in a

field experiment designed to measure concurrent stress and physiological arousal within subjects' typical daily environments and activities. It is expected that combining ESM self reports with ambulatory HRV monitoring will provide a feasible, high time resolution method to determine autonomic arousal and identify physiological correlates of momentary stress.

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The Development of the SWEAT Questionnaire: a Scale Measuring Costs and Efforts Inherent to Conducting Exposure Sessions

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Abstract. For decades, empirical studies have shown the effectiveness of exposure techniques when used in cognitive-behavioral therapy (CBT) treatment for anxiety disorders. A few studies are now suggesting that using Virtual Reality (VR) may be an effective way to conduct exposure and overcome some of the limitations of *in vivo* exposure. The aim of this study is to validate the Specific Work for Exposure Applied in Therapy (SWEAT) questionnaire that measures costs and efforts required to conduct *in vivo* and *in virtuo* exposure. A total of 265 exposure sessions (*in vivo* = 140; *in virtuo* = 125) were rated by experienced psychologists. Reliability analysis revealed three main factors in the construct of the SWEAT questionnaire. Results also showed that conducting exposure in VR is less of a burden and more readily adapted to the patients' needs than *in vivo*.

Keywords. Virtual Reality, exposure, psychometric measure, social anxiety, CBT

1. Introduction

For decades, empirical studies have shown the effectiveness of exposure techniques when used in cognitive-behavioral treatment (CBT) for anxiety disorders [1-6]. A few studies are now suggesting that using Virtual Reality (VR) may be an effective way to conduct exposure (also called *in virtuo* exposure) and overcome some of the limitations of *in vivo* exposure [7, 8]. For example, one significant limitation of the traditional *in vivo* exposure is the challenge faced by therapists to recreate adequate and controlled social exposure situations (e.g., audience to conduct the exposure, control over people's reactions, appropriate situations for exposure). VR overcomes these barriers, in addition to providing a treatment that is more enticing, and allows the client to interact with a phobic scenario in the safety and confidentiality of the office. A recent study also suggests that the advantages of using *in virtuo* exposure may be to not only provide a more effective treatment option (as least, given the currently available virtual environments), but to provide a treatment that is more flexible and cost-effective for therapists [9].

The aim of this study is to validate an instrument that measures specific costs and efforts required to conduct exposure sessions called the *Specific Work for Exposure Applied in Therapy* (SWEAT) questionnaire. The Cyberpsychology Lab of Université du Québec en Outaouais (Canada) developed and used this instrument, rated by therapists after each exposure session, in order to systematically assess the costs (e.g., the salary of the confederate audience used for exposure) and practical efforts (e.g., time spent going to the cafeteria with the patient, finding appropriate stimuli) required to conduct exposure in the treatment of social anxiety.

2. Method

A total of 265 individual exposure sessions (*in vivo* = 140 and *in virtuo* = 125) were rated by four experienced therapists immediately after the exposure session during a 16-week CBT treatmentprogram. A total of 39 adults

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receiving a DSM-IV-TR principal diagnosis of social anxiety (mean age = 37.9; 71.8% female) participated in this study, and after signing the consent form, were randomized in three treatment conditions (this study is part of a broader project): (1) CBT with *in vivo* only exposure (n=16); (2) CBT with *in virtuo* only exposure (n=14); (3) CBT with combined exposure techniques (both *in vivo* and *in virtuo*) (n=9).

3. Results

3.1. Development of the Scale

Originally, the questionnaire contained 16 items but four items were dropped since they were based on qualitative answers, and one item was dropped because it correlated poorly with the corrected item-total (-0.02, ns). The SWEAT questionnaire is now composed of 11 items scored for analyses (see Appendix).

3.2. Psychometric Properties

First, the internal reliability coefficient of the SWEAT was good, with a Chronbach's alpha of .83. Also, an exploratory factor analysis was performed on the SWEAT Questionnaire. The Kaiser-Meyer-Olkin measure of sampling adequacy was .75, confirming the dataset was adequate for a principal component factor analysis. A three-factor solution was established based on the "minimum eigenvalue" of one criterion. This choice was supported by the scree test, the interpretability of the factor solution and unclear patterns of factor loadings for alternative two-factor and four-factor solutions. Factor loadings were interpreted after a varimax rotation (see Table 1 for loadings). Factor 1 explained 39.78% of variance and consisted of items 1, 4, 6, 7, 8, 9 and described the challenge of fine-tuning the exposure exercise. Factor 2 (17.44% of variance explained) consisted of items 10, 11 and expressed the burden imposed on the therapist to prepare and conduct the exposure session. Factor 3 explained 12.56% of variance and was made of items 2, 3, 5; it captured the value of time required to plan and conduct the exposure. The correlation between the total score and each factor was significant ($p<.001$), with $r = .88$, .62 and .41 for Factor 1, Factor 2 and Factor 3, respectively. The correlations between each factor were significant (all $p<.01$) and varied from .18 to .26. For scoring, a total score can be rated with the sum of all items (value 0 to 6 each, for a maximum of 60) and a total score is also available for each factor (see Figure 1).

Table 1. Factor analysis of the SWEAT questionnaire.

SWEAT - Items	Factor 1 "Fine-tuning"	Factor 2 "Burden"	Factor 3 "Time"
8: Number of people involved	.95		
9: Costs related to exposure	.91		
7: Confidentiality compromised	.86		
6: Time constraints	.82		
4: Difficulty to access/use stimuli	.68		
1: Time searching for exposure stimuli	.43		
11: Efforts to conduct exposure were a burden		.91	
10: Difficulty to conduct exposure		.91	
2: Time to go to exposure situations			.79
3: Difficulty to access/use location of exposure			.73
5: External constraints			.61

Note. Loadings below .42 are omitted.

3.3. Comparison In Vivo Versus In Virtuo

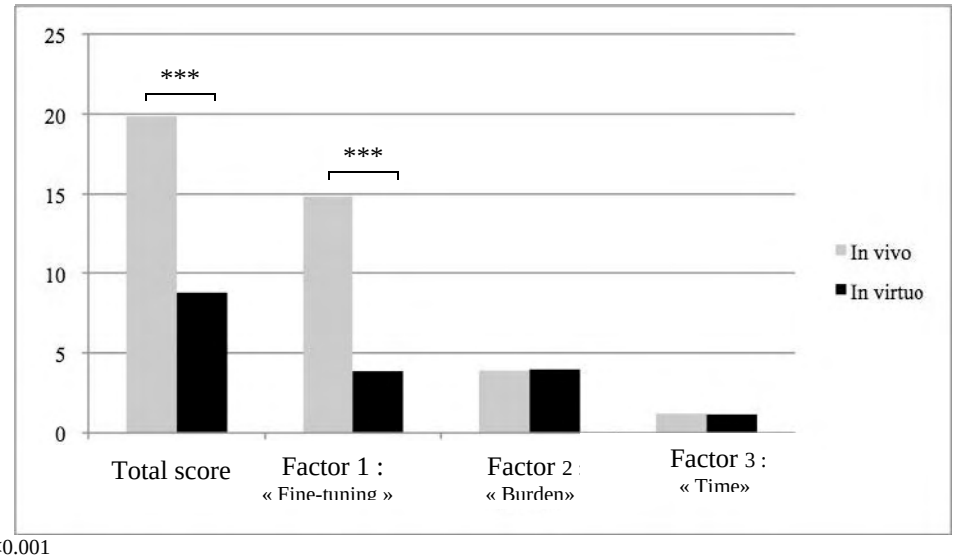
The total non-recurrent cost for the 23 patients who received at least one of the 125 *in virtuo* exposure sessions was established at 0.0 $ and the total of non-recurrent costs for the 25 patients who were involved in at least one of the 140 *in vivo* sessions was established at 2 232.45$. A non-parametric Mann-Whitney analysis was performed (due to lack of variance in one condition) and was significant [$U = 2125$, $p < .001$].

Results on the total score and the subscales of the SWEAT (see Figure 1) were compared with Student t-tests for sessions involving *in vivo* and *in virtuo* exposure. This analysis revealed that *in virtuo* exposure sessions required less effort to surpass burden constraints (e.g. confidentiality issues, schedule constraints, etc.) [SWEAT total score, $t_{(199)} = 11.01$, $p<.001$] refining our understanding by looking at the subscales revealed that the significant difference was specific to how cumbersome exposure *in vivo* exposure was [Factor 1, $t_{(170)} = 15.04$, $p<.001$].

4. Conclusion

The SWEAT is proposed as a new measure to document the efforts, burden, costs, time and constraints inherent to conducting exposure in therapy sessions. The original pool of item was developed during discussions with clinicians and, after being put to the test, the number of items was reduced and some of the rating scales (e.g., exact time spent to search for stimuli and prepare the exposure, exact cost of each exposure session) modified to produce categories allowing to sum each item and report a total score.

Figure 1. Means and standard deviations total and factor scores and t-tests comparing the SWEAT total and factors scores for *in vivo* versus *in virtuo* sessions.



Note. *** = p<0.001

The final instrument taps on three factors describing how difficult it may be for a therapist to set up and conduct exposure sessions: the burden for the therapist, the difficulties in fine-tuning the exposure and time constraints. The scale was developed with the hope of being used with any type of exposure stimuli, but its validation was conducted with patients suffering from social phobia. The exposure stimuli were both *in vivo* and *in virtuo*. The cost generated by an exposure stimulus was estimated for each specific session as opposed to the recurrent inclusion costs (e.g., VR software and hardware, furniture, silly hats used for exposure) because the value of a fixed asset depends on how frequently a piece of equipment is used. For example, our data suggest that the return on the investment for a virtual audience, as opposed to taking up staff members' time, become profitable after about 140 exposure sessions if both hardware and software were purchased for 2 200$.

Among the limitations of this study, we must point out that data collection was performed in only one research lab, in French and with social anxiety-related exposure stimuli. Further studies should also assess convergent and divergent validity.

Nevertheless, the comparison between the different modalities of exposure revealed clear advantages for therapists of using VR over real-life situations such as mock audience, going to washrooms wearing a silly hat or going out to a restaurant.

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APPENDIX

Specific Work for Exposure Applied in Therapy (SWEAT) Questionnaire

This questionnaire must to be filled immediately after the exposure session you conducted with your patient. Indicate your answer by marking an "X" in the appropriate value on to 0-6 points scale under each item. Please take in consideration the intermediate levels in each scale. For example; if your answer is "a bit", the second box on the left is probably appropriate. If your response is "considerably" (but not totally), the fifth box should be used. Note that the plural form of stimuli is used to reflect the possibility of more than one stimulus being used during a session.

Stimuli used for exposure : _____

1. How much time (in seconds) did you spend searching and preparing the exposure stimuli (social situations, virtual environments, looking on Internet or on a map, etc.) for this exposure session?

   |_____|_____|_____|_____|_____|_____|_____|
   0 1-120 121-240 241-360 361-480 481-600 601 or +

   Specify the exact number of seconds: ____

2. How much time (in seconds) did you spend going to the location targeted for exposure (bar, cafeteria, bridge, remote location on the highway, etc.) for this exposure session?

   |_____|_____|_____|_____|_____|_____|_____|
   0 1-120 121-240 241-360 361-480 481-600 601 or +

   Specify the exact number of seconds: ____

3. To what extend did you have difficulties to access and use the physical location (room, necessary permission, elevator, etc.) required for the exposure session?

   |_____|_____|_____|_____|_____|_____|_____|
   0 1 2 3 4 5 6
   NOT AT ALL MODERATELY TOTALLY

4. Did you have difficulties to access and use the stimuli (recruit people, virtual environments, snake, etc.) required for the exposure session?

   |_____|_____|_____|_____|_____|_____|_____|

0 1 2 3 4 5 6
NOT AT ALL MODERATELY TOTALLY

5. To what extend did the exposure session was influenced by external constraints (weather, costs, unpredictability of the stimuli, etc.)?

|_____|_____|_____|_____|_____|_____|_____|
0 1 2 3 4 5 6
NOT AT ALL MODERATELY TOTALLY

6. To what extend did the exposure sessions was influenced by time constraints (duration, time of day, etc.)?

|_____|_____|_____|_____|_____|_____|_____|
0 1 2 3 4 5 6
NOT AT ALL MODERATELY TOTALLY

7. To what extend was confidentiality compromised by this exposure session?

|_____|_____|_____|_____|_____|_____|_____|
0 1 2 3 4 5 6
NOT AT ALL MODERATELY TOTALLY

8. Excluding you and the patient, how many people were involved to realize this exposure session?

|_____|_____|_____|_____|_____|_____|_____|
0 1 2 3 4 5 6 and more

9. Document the costs related to this exposure sessions and specify their source (employees other than you, material, driving, etc.) :

|_____|_____|_____|_____|_____|_____|_____|
0$ 1-10$ 11-20$ 11-30$ 31-40$ 41-50$ 51$ or more

Specify the expenses, their exact value and do not include fixed costs (e.g. purchase of material) :
_____
_____

10. In general, to what extend did you find it difficult to conduct the exposure during this session?

|_____|_____|_____|_____|_____|_____|_____|
0 1 2 3 4 5 6
NOT AT ALL MODERATELY TOTALLY

11. To what extend did the efforts required to conduct this exposure session bothered you as a therapist?

|_____|_____|_____|_____|_____|_____|_____|
0 1 2 3 4 5 6
NOT AT ALL MODERATELY TOTALLY

Control Over the Virtual Environment Influences the Presence and Efficacy of a Virtual Reality Intervention on Pain

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Abstract. The main aim of this study is to investigate whether the control the user has over a virtual environment (VE) influences the sense of presence. A secondary purpose is to explore the relationship between Virtual Reality (VR) presence and pain tolerance during a cold-pressor experience. Ninety-four participants underwent two consecutive cold-pressor trials, one without VR exposure and the other providing a VR stereoscopic figure used as a symbolic representation of the sensation of pain. Participants were randomly assigned to an interactive condition in which they could actively manipulate the VR figure to achieve a pleasant, tranquil environment (analogous to no-pain situation) or to a passive intervention, in which they observed the changes in the VR figure. Results showed that the amount of VR presence reported was significantly higher in the interactive condition. Participants had a higher pain tolerance during both VR conditions than in the no-VR trial, with a greater increase in pain tolerance from the non-VR trial in the interactive condition. Presence scores correlated significantly and positively with pain tolerance scores. We discuss the importance of VR interaction and control over the VR environments used in VR pain interventions designed to increase cognitive control over pain.

Keywords. virtual reality, presence, interaction, pain tolerance

Introduction

One aspect of Virtual Reality (VR) analgesia that has been hypothesized to contribute to its effectiveness is the degree to which the individual feels "present" in the virtual environment (VE) [1, 2]. In the VR literature, the concept of presence is very broad and has a variety of definitions and meanings. From a pragmatic point of view, several characteristics of VR have been proposed to enhance presence, such as the vividness of the VE, the rate of update in the VE, the field of view, the amount of control the individual has over the VE, head tracking, localized sound, or the extent to which the users can experience similar emotions to those felt in a real-world setting [3-5]. In the field of VR for pain management, the study of the degree of control the user has over the VE seems particularly relevant. Evidence suggests that enhancing a sense of pain control may help explain the effectiveness of VR for pain management [6].

This study evaluated the effects of two different VR interventions that may influence the degree to which participants feel "control" over the VE: an interactive intervention, in which they actively search for the correspondence between the pain experienced during a cold-pressor trial and a VR stereoscopic figure which they can gradually manipulate to achieve a pleasant, tranquil environment (analogous to a no-pain situation); and a passive intervention, in which participants passively imagine the correspondence between the pain experienced and the changes in the VR figure. Based on the VR literature, both VR conditions were expected to result in greater cold-pressor pain tolerance than the no-VR condition. However, the active condition was expected to result in higher presence ratings and concomitantly higher pain-tolerance than the passive condition.

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1. Method

1.1. Participants

Participants were undergraduate psychology students, who were awarded course credits in exchange for their participation. Exclusion criteria were cardiovascular disease, hypertension, metabolic dysfunctions, pregnancy, Raynaud's disease, epilepsy, mental disorders, chronic pain conditions, diseases producing neuropathic pain, and the use of pain/anti-inflammatory medications in the four hours prior to the study. Participants were also instructed to refrain from alcohol or other drugs on the day prior to the study.

The final sample consisted of 94 participants (84 women, 10 men) aged between 19-31 years old (mean age 22.38, *SD* = 2.27). All participants provided written informed consent prior to enrolment in the study. The study was approved by the Ethics Committee of the University of Barcelona.

1.2. Apparatus and Measures

The cold-pressor apparatus consisted of a plastic tank (34 x 34 x 16 cm) filled with cold water that was used as the pain stimulus by the submergence of the hand. The water temperature was maintained at 6 °C.

Hardware: The stereoscopic environment was displayed with two BARCO ID R600 projectors controlled by a computer (Pentium IV, 3.00 GHz; 2.00 GB RAM; NVIDIA Quadro Fx 4500, 512 Mb ddr3, graphics card). StereoGraphics Corp polarized 3-D glasses were also used. The stereoscopic color image was projected onto a 2.43 x 1.82 m screen with a resolution of 1024 x 768 pixels. The distance between the subject and the screen was 2 m. Auditory effects were delivered through a multi-channel system of five speakers.

Software*:* The VE was modeled and animated with D Studio Max 8. Adobe Photoshop 7 was used to create the different textures of the figure. Virtools 3.5 (Educational Version) was used to program physical and visual effects so that the participant could interactively manipulate the VR environment

Two measures were registered for the purposes of this study. The total duration of cold water exposure in seconds was recorded as pain tolerance. The *Igroup Presence Questionnaire* (IPQ) [7] was used to measure the degree of presence elicited by the VE used in the experiment. The total score was used to allow analyses of presence as a single construct.

1.3. VR Intervention, Design and Experimental Conditions

A mixed between-within-subjects experimental design was used. All subjects participated in two consecutive cold-pressor trials, one using VR and one without. The order of the trials was counterbalanced. The VE consisted of a stereoscopic figure that appeared in the center of the screen with a black background. The environment was designed to be an experience that was analogous to the pain felt during the cold-pressor task. The initial appearance of the figure was modeled according to certain sensory descriptors (e.g. burning, cutting, sharpness, stabbing, stinging) from the McGill Pain Questionnaire [8]. Following these descriptors, the initial appearance of the figure was constructed as an irregular sharp-edged polygon, mainly in hot colors (i.e. yellow and red). This figure was presented together with an unpleasant sound (a tone of 600 Hz at 80 dB). In the no-VR condition the VE was substituted by a black screen.

Participants were randomly assigned to one of two VR experimental conditions: interactive or passive. In the interactive VR condition, participants were told they could gradually manipulate the initial environment to achieve a pleasant, tranquil environment (analogous to a situation involving no pain) using the mouse. This pleasant environment contained a spherical shape composed mainly of cold colors (blue and white), combined with a quiet sound produced by a generative music engine. Participants in the passive VR condition were told they would see how the initial environment could change into a pleasant, tranquil environment. Thus, they were exposed to the changes in the VR figure generated simultaneously by the participant assigned to the active condition. The participants were separated by a folding screen so they could not see each other.

2. Results

Overall, the ratings of presence (as measured by the IPQ) were medium (M = 2.9, SD = 1.2, range of scores 0-6). As predicted, participants reported a greater sense of presence when they actively manipulated the VR figure, M = 3.3, SD = 1.1, compared with passive contemplation of the VR, M = 2.6, SD = 1.2, t (92) = -3.1, $p < .005$.

No-VR pain tolerance scores ranged from 15.16 to 300.00 s, with a mean of 140.32 s, (SD = 113.54 s). VR pain tolerance scores ranged from 11.23 to 300.00 s, with a mean of 184.40 s (SD = 115.61). Overall, participants were able to tolerate cold-pressor pain longer during VR- trials than during the trials without VR, t (93) = -4.62, $p < .001$. Regarding the pain tolerance scores obtained in the interactive and the passive condition, 57.4% of the participants in the interactive VR condition increased tolerance compared with 48.9% of the participants in the passive VR condition. The increase in pain tolerance from the non-VR trial in the interactive condition was statistically significant, t (46) = -4.82, $p < .000$. However, the increase in the passive condition did not reach statistical significance.

Finally, the relationship between presence and tolerance in the VR conditions was assessed using Pearson product-moment correlation coefficients. The amount of presence reported correlated significantly and positively with pain-tolerance scores, r (94) = .3, $p < .01$. However, this was not the case within the two VR conditions.

3. Discussion

These results are consistent with other laboratory pain studies which have shown that VR technology can increase pain tolerance in healthy adults undergoing experimentally induced pain [9, 10]. More importantly, this study has proved that an interactive VR intervention has a stronger impact on pain tolerance than a passive VR intervention. These findings would extend the established idea to the VR field that active coping strategies and greater perceived control over pain are associated with better pain-related outcomes [11-13]. However, we cannot unambiguously attribute the VR effects to the increased cognitive control over pain. Further studies are needed in order to systematically investigate the mechanisms underlying this VR intervention and to better establish the difference with the typical use of VR as a distraction tool.

As predicted, participants reported a greater sense of presence when they actively manipulated the VR figure than in the passive condition. These data provide further evidence that VR interaction can enhance the sense of presence [3-5]. However, these results contrast with a recent study which explored the effects of a VR-distraction intervention consisting of playing an auto racing videogame from either a first-person or a third-person point of view [14]. In that study, although participants reported a greater sense of presence during the first-person condition than in the third-person, presence ratings were not significantly related to cold-pressor pain tolerance. This inconsistency may be due in part to the different kind of coping strategies that can be trained using VR technology. Inducing a strong sense of presence may be more important in VR interventions intended to control a VR figure representing pain as a means of practicing coping skills. It seems worthwhile to further research the specific psychological mechanisms associated with VR and to promote this body of work.

Acknowledgements
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Affective Reactions to Visually Masked Stimuli within a Virtual Environment

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Abstract. Within perceptual psychology, visual masking describes a process whereby the presentation of one image, the mask, affects the conscious perception of another, the target. Given the right conditions the target can effectively be rendered invisible. There is a dearth of research into the effects of visually masked stimuli within virtual environments, particularly with regard to affect psychology. Of the two studies presented here, the first study was used to establish the efficacy of visual masking using three dimensional, masked objects. Usually, mask and target stimuli are co-planar, with no internal depth disparity. This study found that visual masking is possible within a virtual space using target objects with internal depth disparity. The second study investigated affect driven, choice reactions to three dimensional, masked facial expressions. This study also found an effect, specifically an unconscious bias to navigate away from angry, masked faces and towards smiling, masked expressions. These two studies form a foundation for a wider project: using visual masking within a virtual environment for mood induction, primarily as a cybertherapeutic aid.

Keywords. visual masking, affect psychology, virtual environments, cybertherapy

Introduction

Under certain conditions the rapid, repeated presentation of a "masking" image can be used to prevent conscious perception of a "target" image [1]. In visual masking research both targets and masks are usually planar and co-planar. Prior research has shown that perceived *external* depth disparity between target and mask can result in an inhibition of masking [2]. There is a lack of work which uses targets with *internal* depth disparity, such as those found within a virtual environment (VE). The first study addresses this.

Where facial expressions are used as targets, reactions occur both in preference behavior [3] and facial muscles [4]. It can be argued that such non-conscious, *affective* processing occupies a similar functional domain to psychotherapy. There is a lack of research into masked facial expressions within a VE. The second study looks at this. It builds on the first study's conclusion that non-planar, polyhedral structures with internal depth disparity can be used as targets by using virtual faces with such a structure. Choice behavior reactions to the imperceptible, virtual facial expressions were measured and an effect found.

A further possibility is raised of positive mood induction using visual masking techniques. Harnessing such effects may prove useful for future, cybertherapeutic interventions, perhaps running in conjunction with more conventional therapies.

1. Two Experiments

Both experiments used a desktop set-up with a Samsung SyncMaster 2233RZ monitor, stereoscopic Nvidia 3-D Vision with an Nvidia GeForce 260 chip set graphics card and a quad core PC with 4Gb RAM. The software platform used was the Unreal Engine3.

Pilot trials indicated some parameters needed for visual masking of non-planar virtual objects to occur. As increasing depth disparity *between* target and mask leads to binocular unmasking [2], both were placed on approximately the same depth plane. Also, various surface material combinations showed that the best results came

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when the target and mask had the same material. A digital camera was used to photograph the screen at a high speed to show that the target objects were being rendered.

The same VE was used for both experiments. The VE was composed of a series of rooms; at the end of each were two doors (see the third image in Figure 1). The participants were allowed time to become familiar with the VE and keyboard arrow navigation controls. The target objects were displayed for between 11-16ms, followed by the mask shown for 500ms and finally neither for 500ms. This cycle repeated continuously. The visibility of doors which masked no objects (only found in Experiment 1) oscillated synchronously with their masking neighbor. Both studies received ethics board approval from the University College London.

2. Experiment 1

The aim of the first experiment was to establish if the masking effect could be made to work within a stereoscopic VE. It tested the imperceptibility of masked target objects and whether these objects could influence choice behavior, even if unseen.

Figure 1. A masked object from Experiment 1, a masking door, VE view and two faces from Experiment 2.

2.1. Methods

Twenty-two people were recruited for the experiment, drawn from the UCL psychology subject pool, posters and word of mouth. All participants signed informed consent forms. The experiment was within-subjects in design.

The non-planar target objects were five innocuous, yet complex, objects such as domestic or mechanical items. For this study, faces or other organic forms were avoided as object types. Each of the objects had an approximately equal internal depth disparity in the axis perpendicular to the virtual door plane. The objects and the doors all shared the same surface material. This was found to be important in pilot trials. The objects each sat on approximately the same depth plane as the doors.

On a provided form the participant indicated if they perceived any object and the object type in front of each set of doors from an illustrated list of 10 possible objects. They then demonstrated which of the two doors, left or right, they thought to be masking the object by navigating through it and onto the next room. The participant was asked to move briskly through the series of rooms. The experimentally manipulated factor was which door, left or right, each object was aligned with. The correct door choice total for each participant was therefore the dependent variable. The masked objects were placed an equal number of times on each side, in a randomized order, in order to control for any navigational biases within the VE.

Both the experimental and control conditions consisted of 14 rooms each. The experimental condition consisted of the VE with masked objects, and the control condition used the same VE, but without any objects. Everything else was the same for both conditions. Each participant completed both conditions in a randomized order from participant to participant.

It was hypothesized that target objects would not be perceived but, where target objects were claimed to be seen, they would mostly not be identified correctly for type. Also, the position of target objects would be detected non-consciously.

2.2. Results

Excluding the control condition, the forced choice answers were as follows: none of the few objects that participants claimed to have seen were identified correctly. Of the rest, those claimed as unseen, 31 out of 308 (roughly one in ten) were identified correctly. This is to be expected by chance, as participants had ten object types to choose from.

The positional awareness data were analyzed on SPSS as a paired sample t test: the experimental condition dependant variable mean was 7.9 ±2.1sd; the control condition mean was 6.2 ±1.7sd; p=0.008 (two tailed) and Cohen's D = 0.2. No order effects were evident but a slight navigation bias was evident particularly with the control: 152 experimental right door choices, 156 experimental left door choices; 167 control right door choices, 141 control left door choices.

The results support the hypotheses that the objects were unseen, but participants were non-consciously aware of their positions. This indicates that visual masking was working within the VE.

3. Experiment 2

This second experiment replaced the domestic objects from the first with non-planar faces, but this time both doors were masking these objects. Also, a potential modulator, conflict apprehension, was introduced.

3.1. Methods

Twenty-one people were recruited for the experiment, drawn from the same sources as the first experiment. All participants signed informed consent forms. This experiment was within-subjects in design with two independent factors: one factor, facial expression, had three values; the other, conflict apprehension, had two.

The target facial meshes were non-planar objects displaying one of three expressions: either smiling, angry or neutral. See Figure 1 for examples of neutral and angry faces. Prior to the experiment, it had been established by a pilot trial that the facial expressions could be understood appropriately, at least consciously. Each of the target objects had an approximately equal internal depth disparity on the axis perpendicular to the virtual door plane. The face objects all shared the same surface material, the same one as the masking door, and sat on approximately the same depth plane as the mask and each other.

The conflict apprehension modulating factor was embedded within the instructions given to the participants and had two values: conflict and non-conflict. The conflict narrative attempted to induce a need to avoid conflict – this was done by asking participants to imagine that they had a low health score and they needed to avoid any encounters within the environment (there were none) and move as briskly as possible. The non-conflict instructions were that they merely had to move as briskly as possible through the environment to the end of the task. The instructions for each of these modulation conditions were matched as closely as possible in length and complexity.

As they navigated through each room, the participants moved through whichever doorway they preferred into the next room. This was repeated for a series of target/door combinations in a series of rooms through which the participant was asked to move briskly. The conflict condition, discussed below, consisted of 24 rooms, as did the non-conflict condition.

Each facial expression was displayed an equal number of times on each side within each condition, although in a randomized order, controlling for navigational bias. Each participant experienced both conflict and non-conflict set-ups, in a randomized order.

As each choice was made, either the left or right door, this was noted automatically in the software. The choice scores of individual participants were aggregated to form the groupings of Table 1. The facial expression score depicted the amount of times a particular expression was chosen by movement through those particular doors.

Table 1. Choice score groupings.

Non-conflict condition	Conflict condition
Smiling score	Smiling score
Angry score	Angry score
Neutral score	Neutral score

Each of the two conflict conditions had 24 rooms. All expressions could therefore achieve a maximum potential score of 16 in each of the conflict conditions.

There were several hypotheses for Experiment 2: there will be an overall significant variance between door choice scores for facial expressions, collapsing across both conflict conditions; there will be a significant variance between the conflict conditions; contrasts will be significant between smiling, angry and neutral face scores, biased towards smiling and away from angry.

3.2. Results

Repeated measures ANOVA for two independent variables was used to determine whether or not there was any significant variation between the expression groups against the modulating factor. It was assumed a higher score for one expression constitutes a preferential bias towards that expression and away from the other two. The door choice means were: non-conflict Smiling mean 8.7 ±2.0sd; non-conflict Angry mean 6.9 ±1.7sd; non-conflict Neutral mean 8.4 ±2.3sd; conflict Smiling mean 8.2 ±1.8sd; conflict Angry mean 7.5 ±1.4sd; conflict Neutral mean: 8.3 ±1.5sd.

For the overall variance between Smiling, Angry & Neutral scores $p=0.0034$, partial eta-squared (a conservative measure) for facial expression was 0.18. No order effects were found. Contrasts showed no significant difference between Smiling and Neutral, but Angry was significantly lower than the other two. The conflict apprehension modulation factor showed no significant effect.

The first (overall difference) hypothesis was supported. The second (conflict apprehension) was not supported. The contrast hypotheses were generally supported, although no significant difference was found between Smiling and Neutral.

4. Discussion and Conclusion

The control condition scores were below chance and not at chance, as would be expected. This could be accounted for by an intermittent navigation bias. The objects were evenly distributed so the doors on each side would mask an equal number of objects and no objects. A navigation bias [5] acting intermittently may, by chance, affect scores enough to give the result found. It is unlikely, though, that the slight bias found would greatly affect the significant gap between the conditions, particularly since the experimental condition was less affected. Experiment 1 therefore, does indicate that a form of visual masking is possible using non-planar targets within a VE.

What both experiments do show together is that not only it is possible that non-planar masking in a VE works but, further, it can be used to elicit affect driven response. The second experiment showed a good response difference between expressions, particularly angry and smiling. We know that people can respond in similar ways to computer generated facial expressions and real expressions [6] and indeed the human brain shows a similarity of response [7]. We now have evidence to support that this is also true for virtual expressions processed non-consciously in a VE. The effects in both experiments were comparatively small and more work is needed to see if they can be amplified and perhaps invoked across more people.

The results are encouraging enough to justify using these techniques for mood induction. Future research is needed to move from an affect driven response to affect induction, specifically positive mood induction and to address the further problem of the often short lived nature of such induction.

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Virtual Reality and Exercise: Behavioral and Psychological Effects of Visual Feedback

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Abstract. We herein report an experimental study examining the potential positive effects of Virtual Reality (VR) feedback during an indoor bicycling exercise. Using a regular bike coupled to a VR system, we compared conditions of no VR feedback, VR feedback and VR feedback with the presence of a virtual coach, acting as a pacer. In VR feedback conditions, we observed a decreased level of perceived exertion and an increased level of enjoyment of physical activity, when compared to a regular exercise situation (no VR feedback). We also observed a shift in the subjects' attentional focus, from association (in the absence of VR feedback) to dissociation (in VR feedback conditions). Moreover, the presence of a virtual coach in the VR environment triggered a systematic regulation of the (virtual) displacement speed, whose relationship with perceived enjoyment and exertion require further work.

Keywords. virtual coach, bicycling, enjoyment, attentional focus, exertion

Introduction

Recently, numerous Virtual Reality (VR) apparatuses, coupled to a traditional indoor cycling device, have been developed, in the aim of augmenting exercise involvement and adherence in the general population [1]. The main hypothesis behind the use of a VR-exercise apparatus was that such a system, through auditory and visual feedback, might divert the participant's attention from unpleasant bodily sensations linked to exercise (i.e. muscular pain, increased breathing), delay the onset of boredom-fatigue and increase the time spent exercising [2]. According to scholars [2, 3], VR effects on exercise might be related to a shift from an internal (e.g. focusing attention on internal sensations) to an external (e.g. focusing to external distracting stimuli) attentional focus, correlatively decreasing perceived exercise exertion and increasing exercise enjoyment and performance for moderate intensity levels.

However, to date, only a handful of studies have tested the effect of VR-exercise apparatuses on changes in attentional focus, performance, and/or enjoyment [2, 4-9]. In a recent study [10], Mestre and colleagues showed that VR feedback appeared to have a dissociative role on participants' attentional focus during bicycling exercise. However, adding music to video feedback appeared to be necessary to maintain participants' long-term commitment to the task, and to favor exertion, but not sufficient to promote long-term enjoyment. It appears that the type of sensorial feedback provided by a VR-exercise system might have a decisive role, concerning its behavioral and psychological effects. In the present experiment, we focused on the role of visual feedback; in particular, we tested the role of the presence of a virtual coach in the virtual environment (VE) on performance, perceived exertion, attentional focus and physical activity enjoyment, among participants engaged in a bicycling exercise performed at a moderate intensity. The ethics committee approved this study.

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1. Experimental Design

1.1. Apparatus

The experimental setup consisted of a stationary bike installed in front of a projected display screen and connected to a computer on which the Tacx® Trainer VR software controlled a virtual cyclist on an indoor racing circuit (traditional oval velodrome, 400-meter lap). During the exercise, the software controlled the effort feedback sent to participants through a pad fixed on the rear wheel (Figure 1, left). The software also recorded the participant's pedaling speed via an optical detector placed on the same device. Lastly, the software used the participant's pedaling speed to control the displacement speed of his/her avatar in the VE (Figure 1, right). The participant's performance (instantaneous speed, power, pedaling frequency, heart rate) was recorded by the system for off-line analysis.

Figure 1. Left: The participant was pedaling on a standard stationary bike connected to a computer running the Tacx ® VR software. The computer was connected, via USB, to a pad, fixed to the real wheel of the bike. This pad had two functions. First, after calibration, it measured the bicycle's rear wheel rotation, hence, directly controlling the virtual cyclist's displacement speed in the virtual world. Secondly, it opposed, a variable resistance to the participant's pedaling effort through an electromagnetic brake. In our case, using an indoor circuit, the resistance level was kept constant. Right: Representation of the participant's avatar (center of the picture). In one experimental condition (see below), a second avatar was present in the VE (right of picture), acting as a virtual coach (or pacer).

1.2. Procedure

During a preliminary session, six healthy participants (between 19-25 years of age) were tested (without VR feedback). They were asked to maintain a moderate exercise intensity level for an average duration of 15 minutes. More specifically, they were asked to maintain a stable and minimal heart rate of 110 beats per minute (bpm) throughout the exercise (with reference to the age range of the participants). Pedaling speed and heart rate were monitored (using a Polar electro S410 heart rate monitor connected to the VR software) and displayed (in numerical format) to the participant. Each participant's average speed during this preliminary exercise was used as a reference in subsequent sessions. Subsequently, on a weekly basis, participants carried out three experimental sessions. During each session, every participant successively exercised in three conditions, randomly distributed across participants (to avoid order effects). During these sessions, the participants were asked to cycle 25 laps on the 400-meter indoor track at a moderate intensity level (similar to the preliminary session).

In a first condition (condition 1: No feedback), no feedback (except the resistance feedback) was provided. In a second condition (condition 2: VR feedback), participants were immersed in the VE. In a third condition (condition 3: Virtual coach), they had to follow a virtual coach, acting as a pacer, whose speed was calibrated to each participant's performance (average speed) during the preliminary session. Finally, at the end of each session, participants were asked to fill out questionnaires measuring perceived exertion (Borg scale), physical activity enjoyment (PACES scale) and attentional focus (association-dissociation scale).

2. Results

2.1. Performance (Virtual Speed)

All participants were easily able to achieve the task (at a moderate intensity level). Statistical analysis of individual data (using two-way analysis of variance with session and feedback condition as independent factors) failed to reveal any significant difference ($p>0.05$) in average speed between the three sessions, suggesting that participants were able to maintain regular exercise intensity throughout the sessions. Also, no significant effect of the feedback conditions was observed on average speed. However, this lack of effect might have been related to the fact that each participant had a different reference speed (as assessed during the preliminary session and represented by the virtual coach in condition 3).

From individual data, we thus derived a speed bias, defined as the difference (in km/h) between the participant's average speed during a session and his/her reference speed. Statistical analysis failed to reveal any significant effect of sessions. However, a significant effect of feedback conditions was observed [$F(2,10)=4.20$, $p<0.05$]. Average speed bias was equal to 0.8 km/h (SD=0.85), 0.62 km/h (SD=1.05) and 0.19 km/h (SD=0.29), for conditions 1, 2 and 3, respectively. Post-hoc analysis revealed that the VR feedback condition (2) did not differ from the No feedback condition (1). However, adding a virtual coach (condition 3) had a significant reduction effect on speed bias, as compared to conditions 1 and 2. In other words, in the absence of visual feedback, participants tended to overshoot their reference speed. The reasons for this effect require further investigation. Adding a VE (condition 2) did not have a significant impact on behavior. However, a virtual coach (acting as a pacer) enabled the participants to better approximate their reference speed.

Finally, we tested for a possible effect of the experimental conditions on speed variability, by analyzing speed variation between laps. We did not find any significant effect, suggesting that visual feedback does not have a clear effect on speed regulation. However, analyses on a smaller timescale are certainly required. To summarize these results, it appears that the virtual coach acted as expected, but that VR feedback alone did not seem to have a significant effect on the participants' behavior.

2.2. Perceived Exertion

Results from the Borg perceived exertion scale [11], ranging from 6 (no exertion) to 20 (maximal exertion), revealed a significant feedback condition effect [$F(2,10)=4.75$, $p<0.05$]. Average values of perceived exertion were equal to 10.7 (SD=1.5), 10 (SD=1.4) and 9.5 (SD=1.4), for condition 1, 2 and 3, respectively. Post-hoc analysis suggested that VR feedback led to a reduced perception of exertion, as compared to the absence of VR feedback. However, the size of this effect was modest and perceived exertion was always "low" (as measured on the 6-20 scale). It would be interesting to test more intensive exercise levels with these conditions. Finally, no session or interaction effects were observed ($p>0.05$), suggesting that these effects were stable over sessions.

2.3. Attentional Focus

Attentional focus was assessed using a 10 cm visual analog scale [12], ranging from 0 (maximal association: focusing on internal stimuli) to 10 (maximal dissociation: focusing on external stimuli)]. Data analysis revealed a significant feedback condition effect [$F(2,10)=35.56$, $p<0.001$]. Average values on this scale were equal to 3.47 (SD=1.8), 6.97 (SD=1.7) and 8.04 (SD=1.1) for condition 1 (no feedback), 2 (VR feedback) and 3 (Virtual coach), respectively (Figure 2). Post-hoc analysis indicated the dissociative role of VR feedback, with a further gain attributed to the virtual coach (all comparisons were significant at the .05 level). Finally, no session or interaction effects were observed ($p>0.05$), suggesting that these effects were stable over sessions.

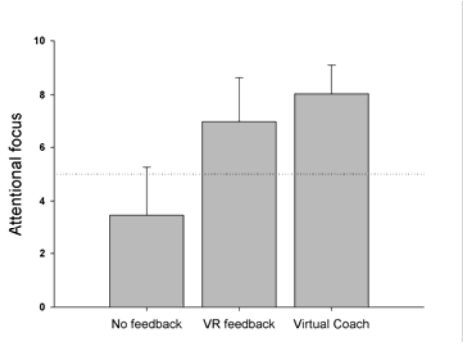

Figure 2. Effects of the three feedback conditions on attentional focus – the horizontal dotted line is the virtual frontier between association and dissociation

2.4. Physical Activity Enjoyment

Physical activity enjoyment [13] was measured using Likert scales (ranging from 1 to 7). For each participant, answers to the 18 seven-point bipolar items were averaged into a global score. Data analysis revealed a significant feedback condition effect [$F(2,10)=13.24$, $p<0.01$]. Average values on this scale were equal to 3.54 (SD=1.22), 4.97 (SD=.69) and 5.45 (SD=.68) for condition 1 (No feedback), 2 (VR feedback) and 3 (Virtual coach), respectively (Figure 3). This result clearly indicates the positive role of VR feedback and Virtual coach on physical activity enjoyment, with greater gain associated with the virtual coach (all comparisons were significant at the .05 level). Moreover, a significant session effect was observed [$F(2,10)=4.88$, $p<0.05$], with average values equal to 5.04 (SD=1.09), 4.53 (SD=1.12) and 4.39 (SD=1.34) for session 1, 2 and 3, respectively. This result suggests that, beyond feedback condition effects, physical activity enjoyment tended to be (slightly) reduced over time (longer term investigation is required). Finally, no interaction effect was observed.

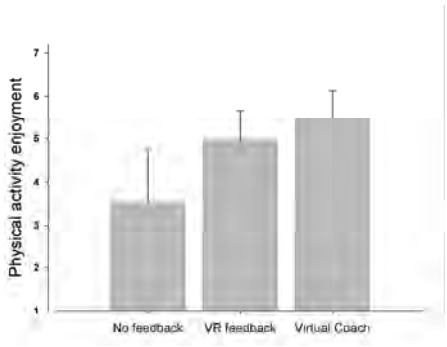

Figure 3. Effects of the three feedback conditions on physical activity enjoyment

3. Conclusions

In line with previous work [10], the present study suggests that VR feedback promotes a dissociative attentional focus, acting as a "*distractor*" from the exercise intensity, at least for moderate exercise. It also suggests that a virtual coach, present in the VE acting as a pacer delivering contextual information about the target intensity level, further increases exercise enjoyment, while enabling the participant to regulate his/her displacement speed around an average target speed. It might be relevant to refer the positive effects of the virtual coach to the two dimensional model proposed by Stevinson and Biddle [14], crossing direction of attention (internal vs external attentional focus) and task relevance. In that conception, beyond the fact that VR-exercise system feedback would promote an external focus of attention (distracting the participant from bodily sensations), a virtual coach, being relevant to the task,

would decrease perceived exertion and increase both enjoyment and exercise regulation. However, the relationship and the causality chains between these parameters in a VR-exercise setting requires further investigation. In this context, a VR-exercise apparatus appears to be a useful tool, whose effects have to be tested at various exercise intensity levels (attentional focus being obviously related to exertion [15]), and with various VR feedback.

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Telepresence Experienced in Videoconference Varies According to Emotions Involved in Videoconference Sessions

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Abstract. Previous studies have linked telepresence to the strength of the therapeutic relationship experienced during telepsychotherapy. This finding comes as a surprise for many people who have been involved in a teleconference meeting, where telepresence is often considered weak. The aim of this study is to (re)evaluate the impact of emotional engagement on telepresence. Participants were randomly assigned to one of the two conditions: (a) emotionally charged verbal exchange first (followed by a more neutral verbal exchange), or (b) emotionally neutral verbal exchange first (followed by an emotionally charged verbal exchange). A distraction task was performed between the two verbal exchanges in videofoncerence. Results showed that verbal exchanges involving stronger emotions increase telepresence. These results may explain why telepresence is so high in telepsychotherapy.

Keywords. sense of presence, videoconference, emotional engagement

Introduction

Using videoconference to deliver psychotherapy (i.e., telepsychotherapy) is receiving more and more empirical support. Studies showed a high level of satisfaction from patients involved in telepsychiatry [1-3] and the therapeutic alliance and bond between the patient and the therapist appear to be very good [4, 5, 6]. For example, Allard et al. [5] assessed the strength of the therapeutic alliance using two measures of alliance, one developed from a pan theoretical perspective (the Working Alliance Inventory) and one developed from a psychodynamic perspective (the California Psychotherapy Alliance Scales). Both measures were administered after the first, the fifth and the last therapy session of a cognitive behavior program delivered in face-to-face and in videoconference to 45 patients suffering from panic disorder with agoraphobia. In order to reduce social desirability, patients mailed their completed questionnaires directly to the provincial board of psychologists and were reassured that their answers would only be known to their therapist after the study. And to reduce the risks of potential contamination of alliance ratings by treatment success, the authors focused on data gathered after the fifth therapy session. Their results showed that working alliance was very high in both face-to-face and videoconference, with differences between the two conditions that were very small (eta-squared below .03) and far from being significantly different.

An examination of treatment processes with the same sample as Allard et al. [5] further revealed that the strength of the alliance is mediated by the feeling of presence in telepsychotherapy [7]. Telepresence can be defined as the illusion of being *there, in* the therapy room *with* the other person [8, 9] and, although it seems important in telepsychotherapy, most people involved in a videoconference meeting do not report feeling substantially present. One possible explanation would be the role of emotions experienced during verbal interactions in videoconference sessions. Emotions and presence are correlated [10] and psychotherapy sessions are usually fuelled by emotionally relevant content, while business meeting are usually less emotionally charged. The role of emotions in telepresence has been previously examined [11], but is now explored more thoroughly. This study aims to assess the impact of the intensity of emotional engagement on the feeling of telepresence.

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1. Methods and Tools

A total of 20 participants enrolled in the study, but two were excluded due to failures to perform the experimental task. The study's sample was composed of 18 participants aged between 20-56 years old. More than half of the participants were women (60%) and were recruited on the university campus. Before the videoconference session, participants were informed about the aims of the research and signed a consent form. They then completed two questionnaires evaluating their immersive tendencies and comfort toward telecommunications in order to describe the sample and statistically control for the impact of these variables if differences would occur after randomization. They were requested to list five personal positive life events that occurred to them in the last six months and to place them in a hierarchical order according to the degree of pleasure experienced during that event.

Participants were randomly assigned to one of the following two conditions: (a) emotionally charged verbal exchange first (followed by a more neutral verbal exchange), or (b) emotionally neutral verbal exchange first (followed by an emotionally charged verbal exchange). In the emotionally charged verbal exchange, participants were asked to discuss the most positive life experience they had listed for 15 minutes over videoconference. In the emotionally neutral verbal exchange, participants were asked to discuss the most neutral life experience on their list for 15 minutes over videoconference. Following each discussion, participants were asked to fill out two questionnaires assessing presence and the intensity of their current emotions. A distraction task was assigned between each discussion where patients were requested to cross the letter "e" each time it occurred in a three-page article on relaxation.

The experiment was conducted in two separate rooms in the research lab. In room A, the participant was seated in a psychologist's office, four feet away from a 32-inch television and a Tandberg Vision 2500 videoconference system. A female experimenter (different from the one who welcomed the participant, went through the ethics procedures and handed out the questionnaires) was in room B and discussed using a similar videoconference system with the participant. Both systems were linked at 384 kbits per second using six ISDN lines.

The Immersive Tendencies Questionnaire [9] and the Distance Communication Comfort Scale [12] were administered at the start of the experiment. The Brief Mood Introspection Scale [13] was used as a manipulation check using the three positive mood items (happy, joyful, energetic). The dependent variable was the Telepresence in Videoconference Scale [14], which is composed of eight items and has a Cronbach's alpha of .84.

2. Results

The descriptive statistics for the sample are reported in Table 1. Paired t-tests did not find any statistical differences between both conditions after the random assignment.

Table 1. Descriptive statistics (standard deviation) for participants in both conditions.

	Emotionally charged session first	Emotionally neutral session first	Statistics
Age	26.63 (8.5)	26.80 (11.22)	$t_{(16)} = .04$, ns
Gender	75% females	60% females	$X^2_{(1)} = .45$, ns
Immersive Tendencies Questionnaire	72.63 (11.21)	74.6 (14.7)	$t_{(16)} = 0.31$, ns
Comfort with distance communication in videoconference	39.38 (12.58)	45.78 (9.39)	$t_{(15)} = 1.2$, ns
Comfort with distance communication in videoconference	38.13 (7.95)	43.22 (5.78)	$t_{(15)} = 1.52$, ns
Comfort with communication in face-to-face	49.0 (9.3)	53.22 (5.52)	$t_{(15)} = 1.16$, ns

Table 2. Descriptive statistics (standard deviation) for mood state and telepresence after each experimental session of discussion in videoconference.

	Emotionally charged session first		Emotionally neutral session first	
	1st session	2nd session	1st session	2nd session
Positive mood	18.88 (5.41)	16.13 (5.94)	20.8 (3.91)	21.6 (4.77)
Telepresence	49.13 (15.15)	45.31 (11.22)	60.0 (18.26)	63.05 (20.36)

As a manipulation check, the impact of discussion on mood was assessed after both videoconference sessions (see Table 2). A repeated measures ANOVA confirmed the change in positive mood [interaction $F_{(1,16)} = 4.64$, $p < .05$; no significant main effect of Time and Condition]. A 2 Times X 2 Conditions repeated measures ANOVA was performed of the telepresence measure. Both the Time [$F_{(1,16)} = .07$, ns; partial eta squared = .004], and Condition [$F_{(1,16)} = 3.27$, ns; partial eta squared = .17] main effects were not significant. As expected, results on the Time by Condition Interaction revealed a clear impact of the emotional content of the discussion on the feeling of presence [$F_{(1,16)} = 5.42$, $p < .05$].

3. Discussion

Mood inductions techniques are effective ways to manipulate participant's effective states [15] and their impact on the feeling of presence experienced during an immersion in Virtual Reality (VR) has been studied [16]. This appears to be the first experimental study on mood and (tele)presence experience in videoconference sessions. Our results confirmed that experimentally manipulating the emotional valence of the verbal exchanges between two people meeting in a videoconference has a direct impact on the subjective feeling of presence. These results are consistent with findings in the field of VR [17], where an emotionally charged environment led to a stronger feeling of presence than a neutral one.

The significance of these results is to offer a potential explanation as to why presence, and the working alliance, is so strong in telepsychotherapy. Based on the personal experience of authors and therapists involved in telepsychotherapy [e.g., 5, 6], conducting a business meeting or attending a class in a videoconference session usually does not lead to such a strong impression of presence compared to psychotherapy sessions. Our results suggest that emotionally charged discussions favor telepresence and contribute to the strong feeling of presence experienced in telepsychotherapy. Replication of these results with a negative mood, which is more similar to what is experienced in telepsychotherapy, and a larger sample, would give more weight to this conclusion.

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Online Social Networking Amongst Teens: Friend or Foe?

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Abstract. The impact of Internet communication on adolescent social development is of considerable importance to health professionals, parents and teachers. Online social networking and instant messaging programs are popular utilities amongst a generation of techno-savvy youth. Although these utilities provide varied methods of communication, their social benefits are still in question. This study examined the relationship between online social interaction, perceived social support, self-esteem and psychological distress amongst teens. A total of 400 participants (M_{age} = 14.31 years) completed an online survey consisting of parametric and non-parametric measures. No significant relationship was found between online interaction and social support. Time spent interacting online was negatively correlated with self-esteem and psychological distress. While previous research has focused on young adults, this study examines the impact of online social networking on emerging teens. It highlights the need for continued caution in the acceptance of these utilities.

Keywords. adolescents, online social networking, psychological wellbeing

Introduction

With over 500 million users connecting every day, online social networks are transforming the nature and process of human relationships. Traditional social interaction is now replicated online as a result of increased Internet access, particularly amongst youth. The Internet has come to represent not only an informational tool, but also a space where teens can offer and receive support [1]. Online social networking sites (SNS) such as Facebook and MySpace have vastly augmented the ability of individuals to interact, regardless of demographic or geographic restrictions [2]. The popularity of these utilities, combined with their ability to bridge offline and online connections, creates a unique context for exploring the changing nature of adolescent socialization and the implications for their wellbeing.

In adults, recent studies have demonstrated that online social networking does not lead to closer emotional relationships offline [3]. It has also been found that time spent on SNS is not related to individual wellbeing [4], or an increase in social network size [5]. Whilst SNS develop social capital [6] and encourage self-disclosure [7], these utilities also provide a space for negative interactions. Declining or ignoring friend requests and ranking the importance of friends through site applications were found to be detrimental to offline relationships [8]. Interpersonal relationships may also be subjected to increased jealousy and distrust as a result of SNS activity [9]. These findings highlight both positive and negative experiences associated with the use of online SNS.

With previous research focusing on young adults and above (18+), little is known about the impact of online social interaction on younger teens (13-16). Adolescent self-esteem can be affected by the tone of feedback received from online social profiles [10]. However, the effect on social support is unknown. Adolescence is a crucial developmental phase where meaningful friendships begin to emerge. Teens experiment with various social behaviors and experience different emotional responses than those of older adolescents and adults [11]. The aim of this study is to explore the effect of online interaction on social support, self-esteem and psychological distress amongst emerging adolescents. It was hypothesised that online social interaction would have no effect on social support, but would be negatively correlated with self-esteem and psychological distress.

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1. Method

1.1. Sample and Procedure

A total of 400 participants (54.8% female; M_{age}= 14.31 years, SD = 1.16 years) completed an online survey under the supervision of a researcher. Some questions were relevant to only a subsample, therefore *n* varies for different analyses. The study received ethics approval from the University of Sydney Human Research Ethics committee.

In this sample, 76.8% of participants (*n* = 181) had private access to the Internet. The home was the main location of Internet access (80.3%) and there was an average of 2.88 (SD: 1.60) computers in each household. A total of 73.7% rarely or never asked for their parent's permission before accessing the Internet.

1.2. Measures

The online survey consisted of three psychometric measures including the Multidimensional Scale for Perceived Social Support (MSPSS) [12], Self-Esteem scale [13] and the K6 for psychological distress (K6) [14]. It also included questions relating to Internet use and activity. The MSPSS is a 12-item scale that divides into three scores relating to the source of social support including family, friends and significant other. It is answered on a seven-point scale ranging from very strongly disagree (1) to very strongly agree (7). Rosenberg's Self-Esteem questionnaire is a uni-dimensional, self-reported scale. Consisting of 10 items, questions are answered on a four-point scale ranging from "strongly agree" (3) to "strongly disagree" (0). The K6 scale was used to measure how frequently (during that past 30 days) participants experienced symptoms of non-specific psychological distress. Using a five-point scale, answers range from "all of the time" (1) to "none of the time" (5).

2. Results

Table 1 shows the psychometric properties of the self-reported outcome measures.

Table 1. *Psychometric Properties of the Self-reported Outcome Measures.*

Variable	*n*	*M*	*SD*	α	Range		Skew
					Potential	Actual	
MSPSS							
Family	377	21.17	6.00	.91	4-28	4-28	-1.16
Friend	377	21.58	5.60	.92	4-28	4-28	-1.35
Sig. Other	377	21.87	5.89	.92	4-28	4-28	-1.34
Total	377	64.62	15.37	.94	12-84	12-84	-1.50
Self-Esteem	371	19.04	4.91	.85	0-30	0-30	-.259
Psychological Distress	370	22.52	4.74	.85	6-30	6-30	-.818

As some variables were heavily skewed, Mann Whitney-U tests were used to compare males and females in their psychometric scores. Females reported significantly higher social support from significant others (*M*: 22.92, *SD*: 5.35) compared to males (*M*: 20.54, *SD*: 6.27) [$p < .001$]. Females also reported significantly higher levels of social support from friends (*M*: 22.86, *SD*: 4.57) compared to males (*M*: 19.98, *SD*: 6.33) [$p < .001$]. Males reported significantly higher levels of self-esteem (*M*: 20.06, *SD*: 4.86) [$p < .001$] and lower levels of psychological distress (*M*: 23.06, *SD*: 5.03) [$p < .05$]. Significant positive correlations were found between MSPSS total, self-esteem (r_s = .343, *n* = 370, $p < .001$) and psychological distress (r_s = .358, *n* = 370, $p < .001$). Significant positive correlations were also found between self-esteem and psychological distress (r_s = .622, *n* = 370, $p < .001$).

3. Internet Use and Online Social Networking

Participants used the Internet for an average of 2.53 (*SD*: 1.85) hours per day; 83.8% of participants rated their ability to use the Internet as "good or excellent." Online social networking (*n* = 198) was ranked as the most popular

Internet function alongside information searching (n = 144) and IM programs (n = 116). Educational programs were the least used function of the Internet (n = 8).

A total of 72.5% (n = 290) of participants reported using SNS. Amongst these users, Facebook was the most popular with 97.5% using this utility. On a typical day, participants visited their site up to 2.75 (*SD*: 3.94) times and spent an average of 63.39 (*SD*: 58.37) minutes networking. The primary use of SNS was keeping in contact with local friends (58.7%). Wall posts were the most popular function (29.9%) followed by chat (19.6%), status updates (13.5%), and photo viewing (12.8%). Without SNS, 66.5% said they wouldn't know less about their friends and 63.7% said they wouldn't have less contact.

When asked about their privacy settings, 75.5% had their profile on private or limited, 11% had a public profile, and 13.5% were unsure of their privacy settings. When asked how often unknown friend requests were accepted, 13.5% reported always, 37.7% sometimes, and 48.7% rarely or never. A total of 75.8% of participants said they would be uncomfortable with strangers accessing their site. The majority of participants (88.6%) had parental acknowledgement to use these sites, however, 6.8% did not know what their parents thought.

Users of online SNS (*M*: 21.39, *SD*: 5.63) reported significantly lower levels of social support from their family than non-users (*M*: 22.53, *SD*: 6.23) [p = .017]. There were no significant differences in other independent variables.

A significant negative correlation was found between time spent on SNS and self-esteem (r_s = -.146, n = 281, p <.05), as well as psychological distress (r_s = -.139, n = 281, p < .05). A significant negative correlation was also found between SNS visits and MSPSS for family (r_s = -.129, n = 280, p <.05). As shown in Table 2, multiple regression analysis was used to assess the ability of SNS time to predict levels of self-esteem. Of the 290 participants who used SNS, 96% answered questions relating to time spent on SNS, visits to SNS, MSPSS, self-esteem and psychological distress. Time spent on SNS and MSPSS were found to be the only significant predictors of self-esteem (R^2 = .087, F (2, 278) = 13.259, p < .001).

Table 2. *Predictors of Self-Esteem.*

Variable	*B*	*SE B*	*β*	95% CI
Constant	161.299	15.815		[130.166, 192.433]
MSPSS	.253*	.056	.258	[.142, .363]
SNS time	-.188**	.073	-.147	[-.332, -.044]
R^2	.087			
F	13.259			

Note 1: N = 281 CI = Confidence Interval. *p < .001 ** p < .05
Note 2: Distress was not entered as a predictor due to colinearity
Note 3: The same variables also predict distress (R^2 = .096, F (2, 278) = 14.736, p < .001).

4. Discussion

This study examined the use of online social networking in young adolescents. In particular, we focused on the relationship between self-esteem, psychological distress and time spent on SNS. Similar to past research, a high percentage of participants used SNS regularly. Unlike older users who may engage in SNS to "social search" for old friends and re-connect relations [15], participants in this study used SNS to interact with local friends that they see regularly. Despite frequent use, participants did not perceive online communication to be necessary to their social life [16]. Participants did not rely on SNS for development of friendships, but instead viewed SNS as an alternative method to mobile and face-to-face communication.

The results of this study identified a significant link between self-esteem, psychological distress and the use of SNS. Past research has found that self-esteem can be enhanced or decreased according to the nature of feedback received on social network profiles and how much time one spends on their own profile [17, 18]. As results identified time on SNS as a predictive variable for self-esteem, participants of this age may experience higher instances of negative feedback when compared to older users of SNS. This age group may spend more time browsing other individuals' profiles rather than spending time on their own. As the opportunity for feedback is minimal in this process, interaction with SNS may become detrimental to self-esteem. Future studies would benefit from focusing on the nature of feedback received by teens of this age and through what function of SNS it is received.

As research in this area is divided, it cannot be definitively shown that teens with low self-esteem and high distress seek out Internet interaction more often than their peers. Instead, the results of this study justify further research into the causal relationship between Internet interaction and lower psychological wellbeing [19]. Amongst children, Internet use is associated with social problems when it is used for communicative purposes [20]. Research has also found that frequent online communication by teens is positively related to compulsive Internet use within six months [21]. This indicates that the nature of Internet use, independent of user characteristics, may determine the psychological impact of Internet interaction.

This study highlights the contribution of social Internet use to the psychological wellbeing of young adolescents. Results suggest that spending large amounts of time online for social purposes may increase psychological distress and have a negative impact on self-esteem. However, this is an exploratory study. It is limited by the use of a convenience sample. Future research would benefit from incorporating teens with varied cultural backgrounds and different levels of education. In an age where technology has become omnipresent in the social lives of young people, this study emphasizes the need for serious consideration towards the unregulated use of online social utilities amongst teens.

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Perceived Stress and Life Satisfaction: Social Network Service Use as a Moderator

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Abstract. Social Network Service (SNS) has become a buzzword in recent media coverage with the development of the second generation of Web-based communities. In China, SNS has played an increasingly important role in its users' daily lives, especially among students. With a sample of 471 college students, we tested the direct relationship between perceived stress and life satisfaction using a regression analysis. Moreover, we found SNS use could buffer the negative effect of perceived stress. This study has practical implications on Internet users' SNS use.

Keywords. Social Network Service, perceived stress, life satisfaction, Internet

Introduction

Stress occurs when people face events or situations which are perceived as dangerous, either physically or psychologically, or when the physical and psychological limit of the organism is coerced and threatened. People in different phases in their lives have to face different kinds of stress and different amount of stresses. College students are in the adolescence phase of the life, which can be considered a turbulent time of normative developmental stress. Meanwhile, students are confronted with daily hassles including courses, social activities, career choices, and romantic relations, each of which will make them vulnerable to stress. Pierceall and Keim found that 75% of college student participants were classified as suffering from moderate stress, 12% from high stress, and only 13% suffering from a low amount of stress [1]. Therefore, we focused on the stress of college students in the present study.

Researchers have found that college students' academic performance will be negatively influenced by an increased amount of stress. Moreover, college students' stress has a negative impact on the students' well-being [2]. Perceived stress will also decrease life satisfaction, not only for younger adults (21-40 years old), but also for middle-aged (41-65 years old) and older adults (66 years old and above) [3]. This indicates that the impact of perceived stress on life satisfaction is robust across all of the life phrases. Moreover, perceived stress was found to be a better predictor of life satisfaction for younger adults when compared with middle aged and older adults [3]. Therefore, it is important to figure out how to interfere with this relationship to create a higher level of life satisfaction for those under pressure. Based on the above statements, we proposed that college students' perceived stress is negatively related to their life satisfaction (H1).

Social Network Services (SNS) have recently become popular in many countries around the world, including China. SNS is defined as a Web-based service that is based on certain meaningful and valuable relationships including friendship, kinship, interests and activities, etc. SNS allows individuals to network for a variety of purposes including presenting themselves, sharing information, building, maintaining, and even exploring relationships. We proposed that SNS use could help relax college students from real life stress because researchers have been focusing on the similarities and differences between online and offline relationships for a long time. Some researchers treated online communication, which includes limited social cues and detracts from face-to-face time with others, as less effective when compared to offline communications. However, more researchers believe that online and offline communication can be mutually beneficial. For example, some studies have found that computer-mediated interaction can supplement real-life interactions, and even exert positive influences on social capital and community interaction [4]. Due to the similarities between online and offline communication confirmed by many researchers, we thought that some unsolved problems or conflicts confronted by college students will be settled with

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the help of SNS, on which students could communicate with others more conveniently and freely. Furthermore, social capitals accumulated on SNS could offer support to help students solve their problems. Other services on SNS, such as blogs, photos and videos, may also help students since they can serve as entertainment.

Due to the beneficial role of SNS in college students' psychological state, we proposed that college students with differing degrees of SNS use and intensity would benefit differently. Specifically, for those who score lower on SNS use, perceived stress might negatively effect their life satisfaction since they may lack in actively seeking for a coping approach. However, for those who score higher on SNS use, it may be easier for them to communicate more easily and efficiently, gain social support, and relax themselves, which can be an effective way of scoping with stress. For these students, perceived stress could no longer predict their life satisfaction. Thus, we proposed that the relationship between college students' perceived stress and life satisfaction is moderated by SNS use. Specifically, the relationship will only be significant for those who score lower on SNS use (H2).

Method and Measurement

The population sample was selected from college students in Beijing who are users of Renren and Kaixin, the two most popular SNS in China. All participants signed an informed consent form and the ethics committee approved the study. We obtained 471 usable responses out of 500 (with a ratio of 94.2%), which could be used for final analysis. The demographic information of this sample is listed as follows: 48.8% were male and 51.2% were female participants ranging from 18-25 years old (average age is 20.58, *SD* = 1.09). Most of the participants were heavy users of SNS: the mean of years of SNS use is 1.61, with the range from 0 to 8 years.

We followed Ellison, Steinfield, and Lampe's approach and use scale of "SNS Use Intensity" to assess the variable of SNS use [5]. We used the "Perceived Stress" scale developed by Watts, Cohen and Toplis when measuring perceived stress [6], and "Life Satisfaction" scale developed by Fujita and Diener when measuring life satisfaction [7].

Hypotheses were tested using regression analyses following Baron and Kenny's approach [8].

Results

In Table 1, we present the descriptive statistics for all measures, including means, standard deviations, correlations, and inter-item reliabilities.

In regression analysis, our overall model was significant, $F(6, 470) = 3.34$, $p<.01$. The three control variables entered in the first step explained 1.1% of the variance in life satisfaction ($\Delta R^2 = .01$, $p=.15$). In the second step, perceived stress and SNS use were entered, explaining an additional 2.0% of the variance in life satisfaction ($\Delta R^2 = .02$, $p<.01$). Moreover, the perceived stress term was not significant (B=.-16, $p=.27$), and the SNS use term was significant (B=.19, $p<.01$), indicating H1 was not supported. In the final step, the interaction term was significant (B=.37, $p<.05$), explaining an additional 1.0% variance in life satisfaction ($\Delta R^2 = .01$, $p<.05$).

The simple slopes of perceived stress on life satisfaction were separately graphed. Recalculating participants' SNS use, we got above high levels (+1 SD) and below low levels (-1 SD) of SNS use. As shown in Figure 1, perceived stress was negatively related to life satisfaction for those with lower than average SNS use (life satisfaction = -.46**Perceived stress + 3.11), while the correlation between these two variables whose SNS use were above average was not significant (life satisfaction = .16Perceived stress + 3.11) as predicted. Therefore, H2 was supported.

Table 1. Means, Standard deviation, Correlations, and Alpha Reliabilities for all measures.

Measures	Means	*SD*	1	2	3	4	5	6
1. Gender	--	--	--					
2. Age	20.58	1.09	-.23**	--				
3. Year	1.61	1.07	.01	.03	--			
4. SNS	2.84	.84	.08	-.04	.25**	(.92)		
5. PS	1.86	.37	.03	-.04	.00	.10*	(.89)	
6. LS	3.28	1.13	-.03	.10*	.04	.13**	-.04	(.89)

Note. N=471. Alpha coefficient reliabilities appear in parentheses along diagonal. * $p < .05$, ** $p < .01$. Year, SNS, PS, and LS are short for years of SNS use, SNS use, perceived stress, and life satisfaction, respectively.

Table 2. Hierarchical Moderated Regression Results Predicting Life Satisfaction.

Variable entered	Step1	Step2	Step3
Step1:Control variables			
Age	.10*	.10*	.11*
Gender	-.02	-.04	-.02
Year	.04	.00	.00
Step2:Main effects			
Perceived stress		-.16	-.15
SNS use		.19**	.18**
Step3:Interaction			
Perceived stress× SNS use			.37*
R^2	.01	.03	.04
$\triangle R^2$	.01	.02**	.01*

Note. $N = 471$. Standardized regression coefficients are provided from each of the three steps. * $p < .05$, ** $p < .01$.

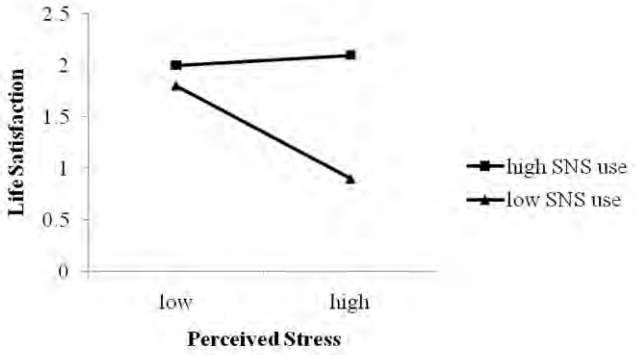

Figure 1. Simple slope analysis of the present study

Discussion and Conclusion

The present study failed to test the negative relationship between perceived stress and life satisfaction. However, the moderation effect of SNS use was tested as assumed. Therefore, we can find that the direct relationship was masked. The relationship between perceived stress and life satisfaction might be different depending on Internet users' SNS use.

However, our study suffers several limitations. First, all of the participants in our study were college students, so we should be cautious when generalizing our conclusions to all Internet users in China. Secondly, our study was based on a cross-sectional design, which means that the data might suffer from common method bias. However, despite the above concerns, we believe our model has certain implications and could be applied to understand SNS use.

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People Like Virtual Counselors That Highly-Disclose About Themselves

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Abstract. In this paper, we describe our findings from research designed to explore the effect of self-disclosure between virtual human counselors (interviewers) and human users (interviewees) on users' social responses in counseling sessions. To investigate this subject, we designed an experiment involving three conditions of self-disclosure: high-disclosure, low-disclosure, and non-disclosure. We measured users' sense of co-presence and social attraction to virtual counselors. The results demonstrated that users reported more co-presence and social attraction to virtual humans who disclosed highly intimate information about themselves than when compared to other virtual humans who disclosed less intimate or no information about themselves. In addition, a further analysis of users' verbal self-disclosure showed that users revealed a medium level of personal information more often when interacting with virtual humans that highly-disclosed about themselves, than when interacting with virtual humans disclosing less intimate or no information about themselves.

Keywords. virtual counselors, virtual humans, virtual agents, self-disclosure, co-presence, social attraction, rapport, anonymity, affective behavior, contingency, nonverbal feedback, psychotherapy

Introduction

The goal of our ongoing studies is to investigate the potential use of virtual humans as counselors in psychotherapeutic situations.

Researchers in clinical psychology argue that people like their counselors more when the counselors highly disclose intimate information about themselves as compared to when they lowly-disclose in face-to-face counseling interactions [13]. The literature suggests that self-disclosure is a pre-requisite for verbal psychotherapy [4]. Self-disclosure is enhanced when social connections between the client and therapist are strengthened by mutual self-disclosure [6,8], often explained by the reciprocity principle. In a human-computer interaction study, Moon [14] showed that interviewers' self-disclosure promoted interviewees' self-disclosure and attraction to a computer that served as an interviewer and displayed solely text with no images.

However, we do not yet know whether we can consistently achieve similar outcomes through the application of a counselor's self-disclosure in face-to-face psychotherapeutic interactions between real humans and virtual humans. Recent studies have shown that virtual humans can facilitate social interactions among people who have difficulty in forming social relationships, and that these patients' social skills can be developed by interacting with virtual practice [15]. In this type of interactions, virtual humans can provide high anonymity, maintaining communicators' privacy when they reveal intimate information about themselves [9].

Studies in virtual psychotherapy, however, have focused more so on short conversations in which virtual humans and schizophrenic patients introduce themselves to each other [7,12], rather than the counseling interaction between the virtual humans and the patients. Researchers found that patients positively responded to the affective expressions of virtual humans [7] and experienced an emotional connection with the virtual humans [12], as if interacting with a real human. In other studies, researchers explored the use of virtual humans as authorable virtual peers for children with autism spectrum disorder [15] or exercise counselors for people who want to promote their daily exercise [3]. In the study by Bickmore and his colleagues [3], the researchers found that users enjoyed

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communicating with a virtual human that talked about its created human life story compared to another human's created life story.

Although studies have explored users' engagement when interacting with virtual humans, few studies have investigated whether users like virtual human counselors who talk about themselves in counseling situations. No other study has explored whether a counselor's level of self-disclosure affects a person's social responses, including feelings of co-presence – feelings of connection and togetherness with partners – and social attraction – feelings of being attracted to partners – when he or she interacts with a virtual human as a counselor.

Therefore, we explored this subject by designing an experiment involving different levels of self-disclosure from virtual human counselors in an interview interaction. The virtual human counselor in this study disclosed information about itself using its individual back story as a programmed agent. We assumed that this approach would avoid some of the ethical controversy arising from the use of virtual human counselors employing made-up human back stories when communicating with real human users [2].

We formulated a research question: *Do users report greater feelings of co-presence and social attraction toward virtual humans who provide high levels of self-disclosure and intimate details compared to other virtual humans who disclose less intimate information or no information about themselves?* Additionally, we explored whether virtual humans' self-disclosure consequently enhanced users' verbal self-disclosure. This study was approved by the ethics committee.

1. Method[2]

The experimental design was a between-subjects experiment involving three conditions of self-disclosure: High-Disclosure, Low-Disclosure, and Non-Disclosure. The study featured an interview-style interaction between virtual humans (interviewers) and real human users (interviewees). In this interview interaction, virtual humans asked users ten questions requiring gradually increasing levels of intimate self-disclosure from the users [9,14]. The virtual human counselors shared some of their computer back story before asking the users each question. In the High-Disclosure condition, virtual counselors preceded all ten questions with their autobiographical computer back story (e.g., "I like to listen to what people say. I have lots of patience for listening, even if you have a lot to say. What characteristics of yourself are you most proud of?"). In other words, the virtual counselors revealed their individual back story more with higher intimacy in this condition. Similar to Moon's research [14], virtual counselors in the Low-Disclosure condition of this study preceded the first three questions telling their individual back story (e.g., "I was created about three years ago. How old are you?"), with low intimacy levels, while asking the rest of the questions without disclosing any individual information. In Moon's study, the first three questions and computer back stories of an interviewer were also introduced with low intimacy levels. In the Non-Disclosure condition, virtual counselors asked each question without revealing any information about themselves.

We measured users' feelings of co-presence and social attraction which were used in our previous study [10]. The Co-presence scale was constructed using Likert-type scale with an 8-point metric (1 = Very Little; 8 = Very Much or 1 = Very Unlikely; 8 = Very Likely) and composed of fourteen items (Cronbach's alpha = .87). The Social Attraction scale was constructed using Likert-type scale with an 8-point metric (1 = Strongly Disagree; 8 = Strongly Agree) and composed of the six items (Cronbach's alpha = .88). In addition, we analyzed users' verbal self-disclosure to find whether a virtual counselor's self-disclosure consequently increased users' self-disclosure. The intensity of users' self-disclosure was rated by two coders independently using Altman and Taylor's three-layer categorization scheme [1]: a peripheral layer (low intimacy), an intermediate layer (medium intimacy), and core layer (high intimacy). The results of Krippendorff's alpha [11] showed good inter-coder reliability between the two coders' disagreements: Alpha = .85; Do (Observed Disagreement) = 2485.35; De (Expected Disagreement) = 16846.55.

Fifty-seven people (53% women, 47% men) from the general Los Angeles area participated in this study. They were recruited using Craigslist.com and compensated for 75 minutes of their participation. On average, the participants were 31 years old (M = 30.68; SD = 10.08). The participants were randomly assigned to one of three experimental conditions. Participants were given instruction describing the counseling interview interaction. The interview questions were modified from ones used in Moon's study [14] to describe virtual counselors as computer programmed agents represented by a human figure (see the image (a) in Figure 1). In Moon's study an interviewer

[2] A full set of the measurement items and interview questions is available from the corresponding author.

was not represented by an image at all. Participants in all conditions viewed the virtual humans on a 30-inch Apple display that approximated the size of a real human sitting four feet away. They wore a lightweight close-talking microphone and spoke into a microphone headset. The monitor was fitted with a stereo camera system and a camcorder. To control for gender effects, two types of gender dyads were used in equal numbers in each experimental condition: male-male and female-female. The typical interaction was allowed to last about thirty minutes, but users were not informed of any specific time limitation.

We used the Rapport Agents [5] (see the image (a) in Figure 1) that presented timely nonverbal feedback (i.e. head nods and body shifts) as virtual counselors. The Rapport Agent generates listening behaviors of a virtual counselor by recognizing and responding to features of an interviewee's voice and upper-body movements [5] (see the image (b) in Figure 1). To generate speaking behaviors of the interviewer in all conditions, an experimenter controlled buttons that retrieved pre-recorded voice messages.

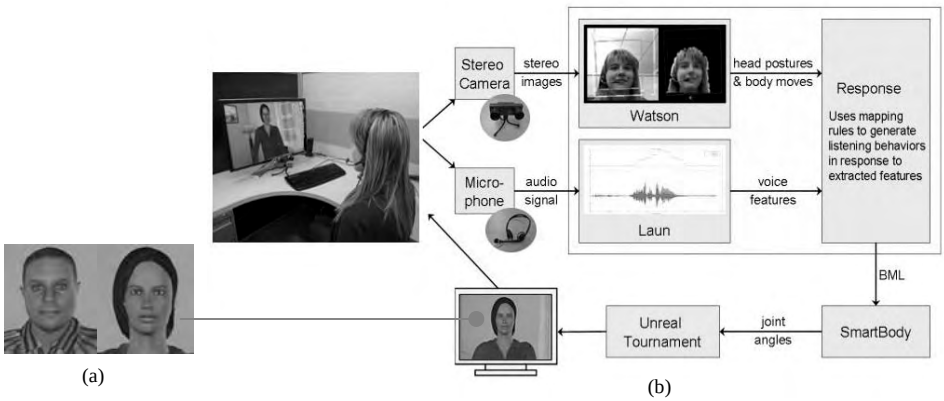

Figure 1. (a) Virtual humans (Rapport Agents: male & female) (b) System architecture of the Rapport Agent

2. Results

The between-subjects MANOVA analysis showed that users reported feelings of co-presence [$F(2,54) = 8.794$; $p = .000$; partial $\eta^2 = .246$] and being attracted to their partners [$F(2,54) = 5.479$; $p = .007$; partial $\eta^2 = .169$] more when they were interviewed by the virtual humans that preceded each interview question with high-disclosure about themselves than interaction with other virtual humans with low- or non-disclosure about themselves (see Table 1 and 2). The additional outcome of between-subjects MANOVA analysis for users' self-disclosure showed that users revealed a medium level of personal information more often when interacting with virtual humans that highly-disclosed about themselves, than when interacting with virtual humans disclosing less intimate or no information about themselves [$F(2,54) = 10.725$; $p = .000$; partial $\eta^2 = .284$]. For users' disclosing at either a high- or low-level, however, the level of the virtual human's self-disclosure ("high," "low" or "non") did not make a statistically significant difference.

Table 1. MANOVA with the independent variable Reciprocity and the dependent variable Co-presence (N = 57)

	High-Disclosure		**Low-Disclosure**		**Non-Disclosure**		***F***	η^2	***p***
	M	*SD*	*M*	*SD*	*M*	*SD*			
Co-presence	4.75	1.20	4.06	1.05	3.32	.890	8.794	.246	.000

Table 2. MANOVA with the independent variable Reciprocity and the dependent variable Social Attraction (N = 57)

	High-Disclosure		**Low-Disclosure**		**Non-Disclosure**		***F***	η^2	***p***
	M	*SD*	*M*	*SD*	*M*	*SD*			
Social Attraction	4.31	1.51	4.10	1.91	2.62	1.68	5.479	.169	.007

3. Conclusions and Discussion

We found that virtual counselors' level of self-disclosure, specifically a high level of self-disclosure, positively affected users' sense of co-presence and social attraction to virtual counselors, as well as users' medium level of self-disclosure. Based on the outcomes, we argue that clients are more likely to like virtual humans who precede interview questions with highly intimate information about themselves in a counseling interview interaction. This has been found in face-to-face counseling interactions with real human counselors. Our findings further imply that clients who feel co-presence with, and are attracted to, their virtual counselors may reveal more intimate information in counseling interactions. The outcomes of this study suggest a possibility of using virtual humans as counselors in psychotherapeutic situations.

Future work could explore combining other forms of virtual counselor feedback that was not investigated in this study – feedback such as facial expressions or verbally empathetic utterances. Such a study would no doubt reveal even more interesting effects of a virtual counselor's level of self-disclosure on users' perceived level of co-presence and social attraction, as well as users' self-disclosure. The outcome of future studies might explain the statistical insignificance of the virtual counselor's level of disclosure on highly-disclosing users found in this study.

Acknowledgements

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A Comparison of Client Characteristics in Cyber and In-Person Counseling

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Abstract. As cybertherapy diversifies into a wide variety of modalities, it is incumbent upon researchers and clinicians to determine the most suitable cybertherapy approach for clients. Suitability encompasses ethical considerations, client satisfaction, and treatment outcomes. The authors, working with an Employee and Family Assistance Program provider based in Canada, provided text-based e-mail counseling (cybercounseling) to clients across the country. Cybercounseling was accessible to clients through the same avenues as in-person counseling. Clients self-selected either cybercounseling or in-person counseling at intake. For the purposes of this study, data from 211 clients have been collected, including 105 online and 106 in-person clients. Client demographic data including age, gender, presenting problem, referral source and marital status were collected for each client. Comparing the cyber and in-person client data provides insights into the similarities and differences between cyber and in-person client groups.

Keywords. client characteristics, employee assistance, cybertherapy, cybercounselling, online counseling, e-counseling, e-therapy

Introduction

An ever-increasing diversity of technological systems is being used to deliver mental health services online. Cybertherapy can be provided in Virtual Reality (VR) worlds, multi-user domains with avatars, and may include physiological monitoring and even robotics. Online support groups via chat or e-mail, counseling via webcam and asynchronous e-mail counseling are perhaps the most common modalities.

Cybertherapy is a field that has seen significant growth in the past dozen years [1]. As trust in technology and an increase in Internet use becomes the norm, more and more clients are turning to cybertherapy [2].

With increasing diversity comes an increased duty to understand which service is best suited to each client. In the present study, we consider only one specific modality of cybertherapy: "cybercounseling" – defined here as counseling delivered via secure e-mail. The purpose of this study is to explore similarities and differences in client characteristics between online and in-person counseling clients. Our hypothesis is that there will be no significant differences between the two groups.

Ethical review was completed by the authors in accordance with the ethical requirements for research laid out by the Canadian Counselling Association and the Ontario College of Social Workers and Social Service Workers in which the two principle researchers are members. When clients consent to treatment they also consent to their data possibly being used for research and reporting pruposes in the future.

1. Literature Review

There is a growing body of literature in this field [3-10] and a recent study by the present authors [11] found no overall differences between face-to-face and online clients in terms of effectiveness and satisfaction.

Cybercounseling has been the subject of both quantitative studies [12, 13] and qualitative review analyses [14], but research comparing client characteristics of cyber and in-person clients is limited. DuBois [15] provided some

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early information about the characteristics of clients seeking cybercounseling in her online practice. The present study seeks to add to the literature by comparing the two client groups.

Barak et al. [1] used a meta-analysis approach to analyze 92 studies examining Internet-based psychotherapeutic interventions, which included a total of 9,764 clients. The mean weighted effect size was 0.53 (medium effect) for Internet-based interventions. This is similar to the average effect size in face-to-face therapy. The authors conclude that "Internet-based therapy on the average is as effective or nearly as effective as face-to-face therapy" [1, p. 30]. The study, however, did not report on client characteristics of online and in-person clients.

Client satisfaction with online counseling is influenced by the client's comfort and familiarity [16]. A recent study found that face-to-face counseling clients evaluated their experience more favorably than clients did online. However, counseling modality and traditional help-seeking attitudes, and modality and comfort with e-mail and interest in counseling services were found to be significantly correlated. The study is limited in its ability to generalize because it involved a homogeneous sample of college students.

Another study found anonymity, convenience and privacy were found to be the most common reasons for using cybercounseling services [17], and have been suggested as key advantages for cybercounseling [18]. It has been speculated that "people who are especially sensitive to the presence of others, who have experienced emotional trauma, social marginalization, or judgment from others may need to communicate without fear of a listener's first reaction" [17, p. 83].

Given that cybercounseling is one of the newest approaches in the field of psychotherapy [19], it is incumbent upon us to continue to investigate whether it is possible distinguish the clients for whom this approach is best suited and those for whom the approach is not. In the case of face-to-face counseling, the client-therapist relationship is known to be important in client satisfaction and treatment outcomes. But in the case of cybercounseling, in addition to the client-therapist relationship [3], the relationship with the technology is also an important factor, and may impact both client satisfaction and treatment outcome [11]. For example, previous research [11] has found that even some clients who express satisfaction with their online counselor and who experienced significant change as a result of the counseling were less than satisfied with the process. Matching client characteristics to the most appropriate modality is of primary concern for this emerging approach.

2. Method/Tools

PPC Worldwide Canada EAP Services Ltd. (PPC Canada, formerly Interlock EAP) is a Canadian Employee and Family Assistance Program provider. Worldwide Therapy Online Inc. (Therapy Online) began sub-contracting with PPC Canada to provide online counseling for their clients in April 2006. Only Therapy Online counselors provide online counseling and PPC Canada counselors provide face-to-face counseling, without overlap.

All prospective clients can contact PPC Canada by phone, e-mail, or by direct self-registration into cybercounseling and are screened by intake workers. Clients in cybercounseling receive the service from Therapy Online's Affiliate Counselors.

Client data is collected at intake. Client data were subjected to analysis by X^2 tests (alpha=0.05) [20]. Comparisons with referring person and presenting problem were also performed using X^2 tests.

3. Results

Raw data for each client group for all categories except presenting problem is shown in Table 1. Overwhelmingly, there were no significant differences between the two client groups. No differences were found between online and in-person clients for average age (X^2=0.31, df=1), gender (X^2=1.66, df=3), average service hours (X^2=0.05, df=1), or marital status (X^2=0.28, df=2). In addition, there were no significant differences between genders with respect to mean age (X^2=0.02, df=3) and service hours (X^2=0.03, df=1).

Significant differences between the two service modalities were found for only one presenting problem. Significantly more in-person than online clients presented needing to deal with grief (X^2=5.0, df=1). However, the number of clients with this issue was very small (N=5) and so this difference might not hold up in a larger study.

The other significant difference between the two groups was found in relationship to the referral source. Significantly more clients who sought cybercounseling refused to disclose their referral source than did clients seeking in-person counseling (X^2=8.26, df=1).

For both modalities the two most common presenting problems were couples issues (not including separation/divorce concerns) and work-related issues. Couples issues were most common (23 clients in each modality), followed by work-related issues (18 in-person and 17 online clients). In terms of referrals the most common type for both modalities was self-referral.

Table 1. Client characteristics for in-person and online groups.

Client Characteristic	In-person (N=106)	Online (N=105)
Gender		
Male	24	32
Female	82	73
Average Age (years)	44.5	39.4
Average Service Hours	4.7	5.4
Marital Status		
Single	3	5
Partnered/Married	19	29
Separated/Divorced	7	8
Unknown	77	63
Referral Source		
Doctor	2	1
Family Member	12	6
Friend	2	2
Co-worker	8	11
Self	73	56
Did not say	9	29

4. Conclusion

The data for this study was derived from the demographic data associated with a previous study that looked at whether there were differences between online and in-person clients in terms of counseling outcome or client satisfaction [11]. That study found no significant differences in outcomes or client satisfaction when comparing cybercounseling and in-person counseling clients. It was on the basis of these findings that we hypothesized that there would be no significant differences in client characteristics.

Concerns that those seeking online counseling differ significantly from those seeking in-person counseling have appeared in the literature [11, 15] and not without reason. The data in the present study make clear that the two groups were virtually identical.

The one difference noted was the higher level of refusal on the part of online clients to disclose their referral source. It is important to understand that this item was optional, whereas the other items were not. One possible explanation is that clients online experience a greater level of anonymity than in-person clients; despite the fact that the same identifying information (e.g. address, place of employment) is collected on both groups. This sense of anonymity is one component of disinhibition [21], an effect hypothesized to explain a variety of online counseling client behaviors [19]. If this is the case, then online clients, when give the option, may choose not to disclose identifying information.

Combining insights from this study and the comparison paper noted previously [11] it seems reasonable to conclude that cybercounseling is not only an effective counseling method, but is also an appropriate modality for typical clients seen in an EAP setting.

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Towards a Web 2.0 Based Software for the Design and the Facilitation of Cognitive Stimulation Workshops

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Abstract. Cognitive stimulation workshops (CSW) are recommended for elderly people with a decline in cognitive functions, for example, mild cognitive impairment. Information and Communication Technology (ICT) has the potential to enrich and facilitate preparation, facilitation and assessment of CSW interventions. We present the first steps of our co-design approach towards a Web 2.0 based software, called STIMULEE, for the design and the facilitation of CSW. Its achievement will provide novel therapeutic practices to our clinical partners.

Keywords. cognitive stimulation workshop, elderly people, mild cognitive impairment, Web 2.0, Information and Communication Technology

Introduction

In France, 16.7% of the general population are elderly people (aged 65 or more); this statistic will reach 26.5% by 2050 [1]. Aging is often accompanied by a decline in cognitive functions, especially in the case of dementia and Alzheimer's disease. The incidence for dementia is 19.4 for 1000 people; it increases with age [2]. Cognitive impairment related to aging and dementia has an immense social impact on elderly people, caregivers and family members, due to the loss of memory and communication of the elderly people [3].

Cognitive stimulation aims to apply strategies of rehabilitation for people with dementia by capitalizing on preserved skills and cerebral plasticity to stimulate encoding, consolidation and retrieval of information [4, 5]. Recent studies have shown the beneficial impact of such interventions for elderly people with mild cognitive impairment (MCI) [6] and mild-to-moderate dementia [7]. These studies are carried out during Cognitive Stimulation Workshops (CSW) that include about ten structured sessions and are directed by a facilitator, who may be a therapist.

Interactive multimedia and Web-based technologies have been used to develop tools for reminiscence therapy. The Computer Interactive Reminiscence and Conversation Aid (CIRCA) [8] employs generic and non-personalized media to stimulate conversation in reminiscent therapy sessions. Networked Reminiscence Therapy was designed for individuals with dementia by using photo and video sharing [9]. These studies confirm the interest in Information and Communication Technology (ICT) in the enrichment and the facilitation of cognitive stimulation approaches. These tools were participatory designed, or co-designed, by experts and various kinds of final users (caregivers, elderly people and their relatives) [10].

The aim of this paper is to present the first steps of our co-design approach towards a Web 2.0 based software for the design and the facilitation of CSW. Web 2.0 is a participatory Web platform where users can share, exchange, comment and interact with content [11]. This work is carried out during the STIMULEE project, which is funded in France by the General Directorate for Competitiveness, Industry and Services (DGCIS).

1. Method

In the context of our collaboration with STIMULEE partners and end users, we conducted observations of traditional CSW in Laval Hospital, Ernée Hospital and Montenay nursing home, in France. Our objective was to understand the process of CSW and the habits of their facilitators, as well as their needs in order to provide guidelines for the design of the STIMULEE service.

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Two observers (partners' members, one female and one male) participated in five various CSW in-care units in order to collect information about the process of the CSW and about the participants. There were two kinds of participants – facilitators and elderly people. The five facilitators (two female, three male) had a long practice of CSW and the elderly people were observed as five different groups (Figure 1). A description of the observed CSW is provided in Table 1. The observers led qualitative interviews based on questionnaires in order to collect information on habits, preferences and needs of both kinds of end users. Specific questionnaires were created for the caregivers and elderly people. Caregivers were asked to fill out a questionnaire with items related to cognitive stimulation practice, working methods (organization, roles, equipments, and environment), relationships with elderly people, and use of computers and interest in our project. Elderly people filled out a questionnaire about their feelings, motivation and interest in the CSW, family ties, tastes, hobbies and use of computers. All participants involved signed informed consent forms.

Figure 1. A Cognitive Stimulation Workshop (CSW)

Table 1. Description of the observed CSW.

	Ernée Hospital	**Ernée Hospital**	**Laval Hospital**	**Laval Hospital**	**Montenay nursing home**
Date	03/09/10	03/16/10	03/24/10	03/26/10	04/19/10
Type of CSW[1]	Memory	Semantic and memory	Cognitive Stimulation	Reminiscence	Memory
Number of caregivers	2 facilitators	1 facilitator	2 neuro-psychologists	1 neuro-psychologist	1 facilitator
Number of participants	10 F and 2 M	11 F and 2 M	7 F	2 F and 3 M	10 F and 7 M
Kind of participants	EP[2] with and without cognitive deficits	EP with and without cognitive deficits	EP with memory deficits	EP with memory deficits	EP with and without cognitive deficits
CSW length	1 hour	1 hour	1 hour and half	1 hour and half	2 hours and half

[1] Cognitive stimulation workshop [2] Elderly people

A qualitative analysis of the data was performed to synthesize needs and to extract recommendations for the design of STIMULEE tool.

2. Results

According to our observations, CSW are often recommended by neuropsychologists for people with MCI. They are usually proposed to a homogeneous group of about 12 participants, and focus on specific objectives, like memory retrieval. CSW generally include 10 weekly 90-minute sessions. The sessions are scheduled at the same time and same place to preserve the participants' habits. The process of the sessions is unchanging and includes welcoming the participants with a hot drink and some questions about the date, sharing good news, correcting homework if prescribed, training using different kinds of exercises (semantic or episodic memory, attention, planning, orientation or concentration), and ending the session by delivering homework.

As often as possible, the CSW sessions are delivered by the same facilitator throughout the sessions. Group leaders require skills to conduct the CSW, like flexibility and efficacy, and the capacity to adapt the content to the needs of the patient. Our study highlights this need according to three phases: before, during and after the CSW. Before the CSW the facilitator needs multimedia content (images, music, sounds, and videos) to prepare the exercises, to enrich the CSW and to have the possibility to adapt the sessions to the participants. During the CSW the facilitators have to quickly react to the participants' emotions and wishes, as well as to facilitate all exchanges. They also have to avoid letting the participants feel as though they have failed in certain situations. We identified that, after the CSW, the facilitators want to assess the participants and the sessions, to share information with their colleagues, and to reflect on important events that occurred during the session.

Presently, all these needs are not satisfied. In order to answer this issue we designed the STIMULEE service.

3. Co-design of Web 2.0 Based CSW

Due to this study and the collaboration of the partner Ergonomica, specialized in design and ergonomics, we were able to elaborate on recommendations for the design of the Web 2.0 based software STIMULEE service for the preparation, facilitation and assessment of CSW. In a co-design user-centered approach with selected caregivers, we identified the features and the scenario for use. The collected information was translated into wireframes used as interfaces to demonstrate the process and the specifications of STIMULEE during the co-design meetings.

STIMULEE is connected to a memory database in which multimedia content can be indexed, in particular, using facial recognition, and stored. STIMULEE contains three main modules: a manager, an editor and a viewer (Figure 2). The manager module allows the facilitator to organize the CSW: e.g., creation of participants groups, sessions, and compilation of participants' data. It may be used before and after the CSW. Moreover, the facilitators have the possibility to use this module to share data and to collaborate on the CSW. The editor module is used before the CSW to build the CSW sessions by combining different exercises, and to upload multimedia material from a local hard drive or from the Internet. It proposes a visualization of the various exercises using a sequence of slides. The viewer module is used during the CSW session to provide the content to the participants in an interactive way during the session. The viewer is also used to tag and comment during the session and concerning the participants' behavior. These collected data give the facilitator further assessment possibilities.

A study of feasibility and usability is currently being carried out. Some results will be available at the end of June 2011.

Figure 2. The STIMULEE web application integrates three different modules

4. Conclusion and Novelty

We reported preliminary steps towards the design of a tool dedicated to facilitating cognitive stimulation workshops. First, STIMULEE will allow end users easy insertion and indexing of new multimedia data in the memory database. Then, it can facilitate the generation of cognitive stimulation scenarios, which will contribute to proposing innovative workshops. The achievement of these developments will provide novel therapeutic practices to our clinical partners.

Acknowledgments

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Active Video Gaming to Improve Balance in the Elderly

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Abstract. The combination of active video gaming and exercise (exergaming) is suggested to improve elderly people's balance, thereby decreasing fall risk. Exergaming has been shown to increase motivation during exercise therapy, due to the enjoyable and challenging nature, which could support long-term adherence for exercising balance. However, scarce evidence is available of the direct effects of exergaming on postural control. Therefore, the aim of the study was to assess the effect of a six-week videogame-based exercise program aimed at improving balance in elderly people. Task performance and postural control were examined using an interrupted time series design. Results of multilevel analyses showed that performance on the dot task improved within the first two weeks of training. Postural control improved during the intervention. After the intervention period task performance and balance were better than before the intervention. Results of this study show that healthy elderly can benefit from a videogame-based exercise program to improve balance and that all subjects were highly motivated to exercise balance because they found gaming challenging and enjoyable.

Keywords. active video gaming, exergaming , balance training, elderly

Introduction

The expanding aging population has ignited a growing interest in the prevention of balance problems to reduce the risk of falling; falling can result in loss of independence, significant morbidity or death. Coaching of balance and muscle strength can contribute to the prevention of falls and maintaining physical activity. However, conventional exercise therapy is difficult to maintain. New technology-based techniques, such as interactive (video) games appear quite promising for (home-based) balance and strength training in the elderly. Exergaming (exercise plus gaming) devices have several advantages compared to conventional exercises. When practicing, people do not pay attention to the exercise and their own movements, but on the outcome of their movements in the projected environment. This is important because in more daily-life settings, balance control is not an aim by itself, but postural adjustments of the whole body are continuously needed for many goal-directed movements within a specific environment. Serious gaming systems motivate people to practice and are ideal for learning task-specific and target-specific activities and for provoking the proper motor response under different circumstances and cognitive conditions. Moreover, learning and training of specific motor skills is possible by using continuous visual feedback. This will stimulate the "Discovery Learning" principles, important for elderly, since implicit learning capacity appears to be less affected than explicit learning capacity in the elderly. Nowadays, video gaming devices are becoming more and more cost-effective, portable and user-friendly. With these devices people can also exercise at home. In addition, smart sensors could help give feedback to the user and the game, and be helpful in monitoring and controlling coaching from a distance.

Although several systems exist to practice physical activity, scarce evidence is available for the direct beneficial effect of playing an active video game with a balance board as a peripheral on postural control in the elderly [1-3]. Therefore, the objective of the study was to assess the effect of six-week videogame-based balance training program on balance performance in a group of elderly community dwelling persons. Balance control, as well as pleasure in activity and motivation for the game-based training, were assessed using the Self Regulation Questionnaire for exercising. (SRQ-E)[4] and Visual Analogue Scales.

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1. Methods

Nine healthy elderly subjects participated in this study (age >65 years). All participants signed an informed consent form and the study was approved by the ethics committee. A balance-training device was used which integrates video gaming with balance control on a moveable platform (SensBalance Fitness Board; Sensamove®, the Netherlands). Sensors measure the acceleration of the moveable platform, and this signal is used to interact with a video game. The system provides real-time visual feedback of postural sway on a screen by means of a dot. By subtly shifting weight on the balance board people can learn to move the ball through the maze to a target hole. When the platform is perfectly balanced the maze is horizontal and the ball lies still. The game has different levels of difficulty which can be adjusted to the performance level of the individual subject. In the easiest level the game only required movements on the board in one direction: forward, backward and lateral displacement. With increasing difficulties, the maze required postural movements in all directions, making the game more complex. A game was successfully completed when the ball fell in the hole. There was no time constraint; the subject could perform the task at their own speed.

An interrupted time series design was used with a three-week baseline period preceding the intervention, and a three-week baseline period (delayed phase) following the six-week intervention. Before, after and during the intervention, performance was tested three times a week by using a dot-task. During this task subjects had to stand still on the moveable platform keeping the dot in the center of a circle on the screen (zero-point). The intervention phase included a six-week exergaming training program on the SensBalance Fitness Board, consisting of three 20-minute training sessions a week. Elderly subjects were recruited from senior apartments and practiced in a senior center nearby.

Balance was assessed using general clinical balance assessment instruments (these results are reported elsewhere), during which trunk accelerations were registered with an ambulant accelerometer device (DynaPort®MiniMod, McRoberts BV, The Hague, the Netherlands). The acceleration module (64x64x13 mm) is fixed with an elastic belt near the center of mass at the level of lumbar segment L3 over the clothes. The tests included the figure-eight test (fig-of-8), quiet standing with feet parallel, and the tandem stance. The figure-eight consists of two sets of two circles, the inner with a diameter of 1.50m, the outer with a diameter of 1.65m. The participant was told to walk in the space between these circles without touching them. Data are sampled at 100 Hz. Participants were tested individually and all tests were administered according to a standardized protocol.

Intervention effects were examined using the multilevel modeling program MLwiN [5]. In the present study a two level hierarchically structure was made with the participants individual measurements defined as level 1 nested within the individual participants, who represent level 2. First, the effect of the grand mean underlying all observations of the tests was modeled: the so-called empty model. Subsequently, the parameter for the individual participant was set random. The new regression model enclosed the estimates of the differences between the means of the participants. The statistical significance of the model was judged by the change in the similarity to the model to the data, as measured by the change in the model's log likelihood ratio from the previously model, following a chi-squared distribution. Thereafter, measurements of the baseline phase were compared with those of the intervention phase and delayed phase. The intervention variable was added as an exploratory variable to the model; if the model improved significantly, the intervention influenced balance performance. By comparing the deviance of the final model and the empty model, the model fit was evaluated. P-levels were set a 0.05. Outcome measures were:

- Task-related measures, the mean and standard deviation, of the dot with respect to zero point on the screen.
- Medio-lateral and anterior-posterior trunk acceleration time-series. The variability, regularity, and smoothness of trunk acceleration patterns recorded during the balance assessment tests were quantified using the root mean square (RMS), the sample entropy (SE) and the mean power frequency (MPF), respectively [6, 7]. In addition for the figure-eight walking test, mean stride time and the coefficient of variation of the stride time was calculated.
- Motivation to participate in the intervention was examined using the QRS-E [4]. The score of this 16-item questionnaire combines scores of subscales of questions about external regulation, introjected regulation, identified regulation and intrinsic motivation (max score = 72). From these scores the Relative Autonomy Index Rate is calculated as: 2 x intrinsic motivation + identified regulation – introjected regulation – 2x external regulation. External and introjected regulation is considered a controlled form of extrinsic motivation, whereas intrinsic motivation and identified regulation are considered relatively autonomous (max score = 72). In addition,

after the three and six-week intervention, four visual analogue scales (VAS) were used to asses motivation and experience of practicing balance with the video game (see Table 1). On the left side of the VAS the negative effects were given and on the right end, the positive with a maximum score of 100 (cm; e.g. no effect- strongly improved).

2. Results

A significant effect of task was found on the mean and standard deviation of the dot with respect to the zero point on the screen (Figure 1). Performance on the dot task showed a quick improvement, that is, smaller mean deviation and standard deviation in the first two training weeks and remained unaltered thereafter ($p < 0.05$).

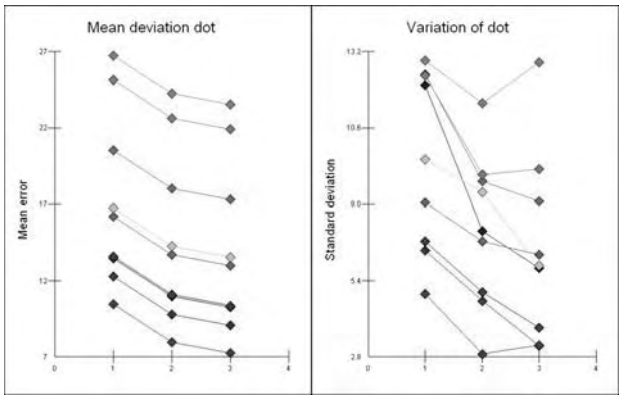

Figure 1. The mean and deviation of the dot with respect to zero point. The best fit model lines represent the fits for the individual subjects. On the x-axis the phases are given: 1 = baseline phase; 2 = intervention phase; 3 = delayed phase.

Postural control measured with accelerometry during quiet standing with feet parallel and in tandem stance improved significantly during the training ($p < 0.05$) and was significantly better after than before the training. Particularly, trunk acceleration patterns were more regular and smooth, as indicated by a lower SE and higher MPF values in both anterior-posterior and medio-lateral direction (Figure 2). The RMS was lower after the intervention for medio-lateral accelerations only. During the figure-eight test, MPF frequency increased, implying a smoother, more rhythmic gait pattern and stride variability decreased. However, for all trunk accelerations patterns, the time-scale of improvement was slower than that of the dot-test. Multilevel modeling revealed that participants with low scores at the start of the program improved more over time than the best-scoring participants.

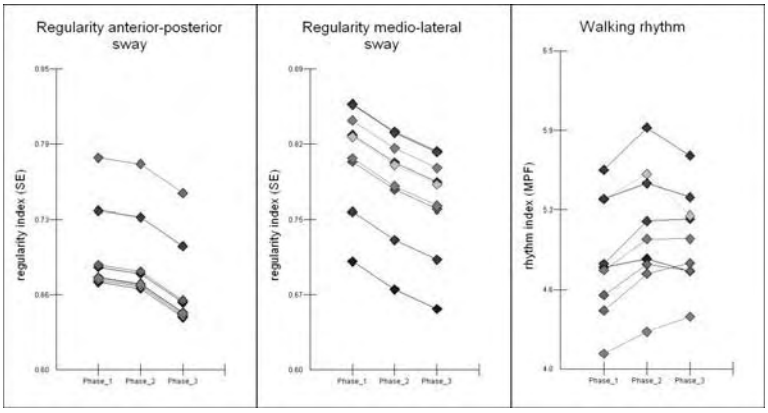

Figure 2. The best fit models for regularity of trunk sway as indexed by the sample entropy value (SE) in anterior-posterior (left) and medio-lateral (middle) direction during standing with feet parallel. Higher SE values indicate a more irregular sway pattern. Rhythm or smoothness of

walking of the figure-eight task, higher values indicate smoother, more rhythmic gait pattern. Lines represent the fits for the individual subjects. On the x-axis the phases are given: 1 = baseline phase; 2 = intervention phase; 3 = delayed phase.

All subjects reported being highly motivated to exercise, because they found the games challenging and enjoyable. No significant change in motivation was observed after three and six weeks of intervention (Table 1).

Table 1. Individual subject scores on the Self Regulation Questionnaire for exercising (QRS-E) and the visual analogue Scales after three (A) and six weeks (B) intervention.

	QRS-E	VAS 1		VAS 2		VAS3		VAS 4	
		A	B	A	B	A	B	A	B
S01	63	82	90	97	90	91	95	65	70
S02	37	80	49	80	50	73	65	75	67
S03	43	85	95	100	100	10	98	100	80
S04	56	96	90	98	90	98	85	95	75
S05	63	78	93	100	89	100	95	53	93
S06	50	70	100	95	100	98	100	98	100
S07	65	83	95	96	95	75	94	53	45
S08	62	-	-	-	-	-	-	-	-
S09	69	67	100	72	100	78	100	72	100
S10	48	80	85	75	79	91	95	91	89
mean	55.6	80.1	88.6	90.3	88.1	79.3	91.9	78	79.9

VAS 1 = Do you like practicing on the balance board? VAS 2 = Do you like playing the game when practicing balance? VAS 3 = Do you think the balance training with the computer game is useful? VAS 4 = What is the effect of the training on your balance according to your experience?

3. Discussion/Conclusion

Elderly people without a specific pathology can benefit from a videogame-based exercise program aimed at improving balance, where people had to move a platform in response to stimulation from a game that was challenging and fun to play. Balance measurements indicate that although performance on the game might improve quickly, it takes a longer amount of time training to improve postural control. The present study provides further evidence that video-based games or exergaming can be employed as attractive and motivational learning devices for the elderly. By using exergames, not only is the control of posture studied, but also the interplay between posture and movement. This interplay is an important characteristic of most of our daily activities as posture is never an aim by itself, but supplies the voluntary production of goal-directed movements within a specific environment. Future studies will be aimed at studying not only balance, but the ability to orient oneself in space using serious gaming with motion-tracking devices to capture whole body movements.

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Simulated Interviews 3.0: Virtual Humans to Train Abilities of Diagnosis – Usability Assessment

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Abstract. Diagnostic interviews in Psychology require the mastery of several skills and abilities that are required and need to be trained. The purpose of this study was to develop a virtual environment that simulates a situation where trainees can interact with virtual patients. The usability of the application was assessed. Results suggested that simulated interviews are a friendly and motivating tool to train diagnostic abilities in psychology students.

Keywords. virtual humans, diagnostic interview, training, psychology, usability

Introduction

Virtual Reality (VR) is widely used to train healthcare professionals [1]. This technology provides trainees with simulations of real life situations where they can learn by completing actions in a safe, educational context. Furthermore, VR allows a gradual increase in the difficulty of the problems that need to be solved in training tasks, thus, facilitating the process of learning by leading students progressively closer to their best performance.

The diagnostic interview in Psychology requires the mastery of several skills and abilities that need to be trained. However, interaction with real patients should be avoided during the initial stages of training. Instead, training should be provided under guidance from a professor in controlled settings that mimic real-life situations as closely as possible. The purpose of this study was to develop a virtual environment (VE) that simulates a situation where trainees interact with virtual patients. Simulated patients are realistic objects constructed using a series of parameters that define their verbal, emotional and motor responses. The *Simulated Interviews 3.0* system was developed in two phases. First, the diagnostic decision trees suggested in the DSM-IV-TR [2] were used as a main source of information in order to compile a linguistic corpus about the most relevant diagnostic groups included in axes I and II of the APA classification system: anxiety disorders, psychotic disorders, mood disorders and personality disorders. Later, the corpus was used to generate the agents that would simulate the answers of patients corresponding to different specific diagnostic categories from each of the main diagnostic groups. VEs simulating a psychologist's office were developed (Figure 1). Applications such as 3D Studio Max were used to construct the models. Graphic simulations of virtual patients were created with Poser and Ventriloquist for 3D Studio Max. Seven virtual simulations were developed including patients with the following conditions: obsessive compulsive disorder, generalized anxiety disorder, schizoaffective disorder, bipolar disorder, borderline personality disorder, schizophrenia and schizophreniform disorder. Psychopathological diagnostic skills were trained and examined through these virtual diagnostic interviews.

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Figure 1. Psychologist office

The objective of the clinical interview is to obtain relevant information from patients to formulate a diagnosis. To do so, the student is required to select the most suitable question at each stage of the interview; the system informs them about how accurate the choice is, and the virtual patient responds to the question. Each list of possible questions displays a button called "HYPOTHESIS," which, when pressed, leads to a list of possible diagnoses appearing on the next screen. The student decides at each stage of the interview whether to continue asking questions or to formulate a diagnostic hypothesis. If the student selects the correct diagnosis at any given time during the interview, the system will only accept it if the patient has been properly examined, which means that the student has already obtained the necessary information to determine the diagnosis (Figure 2). Once the correct diagnosis has been achieved at a suitable moment of the interview, a prognosis can be formulated.

Figure 2. Virtual interview: The patient appears on the left screen while the answer choices and the diagnosis hypothesis are displayed on the right screen

1. Method

1.1. Participants and Procedure

Sixty-seven undergraduate students participated in the study. Mean age was 24.70 (SD= 3.25) and most of them were female (77.6%). The study was previously approved by the ethics committee of the Department of Personality, Assessment and Psychological Treatments and participants signed an informed consent form.

1.2. Assessment

The usability of *Simulated Interviews 3.0* was assessed with the *Software Usability Measurement Inventory* (SUMI) [3]. The SUMI is a 50-item questionnaire that measures five aspects of user satisfaction: affect (whether users like the program), helpfulness, learnability, efficiency, and control.

1.3. Procedure

Simulated Interviews 3.0 was included as a task for undergraduate students to be performed during an academic year at the University of Barcelona (Barcelona, Spain) and the University Jaume I (Castellón, Spain). Once finished, participants assessed the usability of the application.

2. Results

Given the specific characteristics of the *Simulated Interviews 3.0* system, only SUMI's items that were applicable were considered for data analysis. We selected 15 items listed in Table 1. Participants showed a good level of general satisfaction with the application and found it easy to use and helpful. More specifically, most participants agreed that the way the information is presented is clear and understandable, and found that instructions and prompts are helpful. Moreover, most participants agreed that learning to use the software is easy and fast. Participants also agreed that *Simulated Interviews 3.0* system is an efficient application, while providing appropriate and quick solutions. Furthermore, most participants agreed that working with this software is satisfying and stimulating. They considered that the software has a very attractive presentation and enjoyed the sessions. Finally, most participants (80% of men and 90.4% of women) would recommend it to their colleagues.

We also explored whether there were differences in the answers of participants depending on gender. A chi-squared 2(male vs. female) x 2(agree vs. disagree) analysis was conducted. Given that the assumption concerning the "minimum expected cell frequency" was violated, we used Fisher's Exact Probability Tests. As Table 1 shows, both men and women gave similar responses to all the assessed items.

Table 1. Answer frequencies in men and women, and differences depending on genre.

	Frequency (%)							
	Agree		Undecided		Disagree			
	♂	♀	♂	♀	♂	♀	χ^2 (2,67)	*p*
2. I would recommend this software to my colleagues	80	90.4	20	7.7	0	1.9	2.54	1
3. The instructions and prompts are helpful	86.7	88.5	13.3	9.6	0	1.9	.28	1
5. Learning to operate this software initially is full of problems	6.7	5.8	6.7	15.4	86.7	78.8	.002	1
7. I enjoy my sessions with this software	93.3	82.7	6.7	17.3	0	0	_	NS
12. Working with this software is satisfying	93.3	82.7	6.7	17.3	0	0	_	NS
13. The way that system information is presented is clear and understandable	93.3	92.3	6.7	5.8	0	1.9	.29	1
17. Working with this software is mentally stimulating	86.3	92.3	13.3	7.7	0	0	_	NS
19. I feel in command of this software when I am using it	93.3	76.9	6.7	17.3	0	5.8	1.03	.57
26. Tasks can be performed in a straightforward manner using this software	93.3	84.6	6.7	13.5	0	1.9	.32	1
27. Using this software is frustrating	0	5.8	0	94.2	100	0	_	NS
29. The speed of this software is fast enough	80	73.1	20	19.2	0	7.7	1.23	.56
32. There have been times in using this software when I have felt quite tense	13.3	3.8	6.7	13.5	80	82.7	1.64	.24

42. The software has very attractive presentation	86.7	88.5	13.3	9.6	0	1.9	.28	1
44. It is relatively easy to move from one part of a task to another	80	86.5	20	9.6	0	3.8	.53	1
48. It is easy to see at a glance what the options are at each stage	93.3	71.2	6.7	26.9	0	1.9	.38	1

3. Conclusions

Simulated Interviews 3.0 system is a highly usable VR application for psychopathological diagnostic skills training. The software provides trainees with a motivating and friendly context that allows students to develop diagnostic interview skills according to their needs and at their own pace. Furthermore, the high level of interactivity achieved during the task increases the trainees' sensation of participating in the simulated situation and thus, improves the learning of required skills.

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A Lightweight Augmented Virtuality System for Providing a Faithful and Spatially Manipulable Visual Hand Representation

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Abstract. This paper introduces the technical foundations of a system designed to embed a lightweight, faithful and spatially manipulable representation of the user's hand into an otherwise virtual world – Augmented Virtuality (AV). A highly intuitive control during pointing-like near space interaction can be provided to the user, as well as a very flexible means to experimenters, in a variety of non-medical and medical contexts. Our approach essentially relies on stereoscopic video see-through Augmented Reality (AR) technology and a generic, extendible framework for managing 3-D visual hand displacements. Research from human-computer interaction, perception and motor control has contributed to the elaboration of our proposal which combines a) acting in co-location, b) avoiding occlusion violations by assuring a correct scene depth ordering and c) providing a convincing visual feedback of the user's hand. We further present two cases in which this system has already successfully been used and then outline some other applications that we think are promising, for instance, in the fields of neuromotor rehabilitation and experimental neuroscience.

Keywords. Augmented Virtuality, video see-through head-mounted display, co-location, visuo-proprioceptive sensory conflict, visual hand shift framework

Introduction

Experimental setups typically used to manipulate the perceived location of one's own hand are often very restrictive for subjects or patients who are forced to take specific artificial fixed postures and have only a little space to move the interacting limb around. Moreover, the visual hand feedback is often reduced to ordinary cursors or otherwise oversimplified, while it is known that the quality of hand representation can have a strong impact on the feeling of limb ownership, self-action recognition, and thus, on the reliability in the display and so, on the performed actions. Different types, amounts and variations of visuo-proprioceptive conflicts (VPC) can rarely be simulated by the same system.

Independent of the actual purpose or application context, be it the investigation of human multimodal perception, the study of certain symptoms of neuromotor disorders or the development of novel rehabilitation methods for motor skill recovery, it seems that the range of possibilities and the richness of the tools can, at a fairly low cost, still be increased. To approach such a multipurpose solution is what we aim to do in this paper. We also think that our system, which does not require complex 3-D hand reconstruction techniques, can be of great interest to human-computer interaction.

1. Related Work

The vision of one's own hand affects efficiency and comfort during direct manipulation, even of virtual objects. A virtual hand-substitute is perceived as faithful and better attributed to the own body [1], if it reflects biologically plausible motion [2, 3] and looks natural or familiar [4, 5]. High fidelity visual hand feedback has been further

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demonstrated to produce a strong visuo-proprioceptive integration [6], shorter reaction and movement times compared to a lower fidelity hand feedback [7], and less position estimation errors [8]. The rubber hand illusion [9] has recently been replicated in Virtual Reality (VR) and it seems that its effectiveness depends also on visual limb faithfulness [10].

Co-location refers to the visuo-proprioceptive alignment of an interacting limb. Qualitative and quantitative benefits could be shown [11, 12], as well as a stronger sense of presence [13]. These factors support the self attribution process [9], and thus, favors a continuous natural observation and correction loop that is responsible for the compensation of pointing errors or target modifications [14], also in VR settings [15].

Whenever VPC have been produced, for instance, by visually simulating haptic constraints [16, 17] or inducing force illusions [18], it might be useful to return to “normal” visuomotor conditions (i.e., no VPC). To limit both a potential performance decline and VPC aftereffects (e.g., perceptual recalibration [19]), there are approaches to reduce VPC [16, 20]. The latter aims at a fast, unconscious offset reduction.

2. Technical System Foundations

Our AV [21] systems represent a generalization of the system used in a previous study [18]. It merges the advantages of a) acting in co-location, b) avoiding occlusion violations (i.e., the hand can occlude and be occluded by virtual objects) and c) providing a convincing visual feedback of the user's hand. We further aim at spatial employment flexibility and ease of system integration.

The system is composed of four network-enabled building blocks: 1) The video see-through [22] head-mounted display (HMD) with two built-in (stereo) cameras, 2) the video acquisition and post-processing unit, also used for image correction and background segmentation, 3) the tracking system that tracks head and hand at six degrees of freedom and 4) the compositing unit performing real-time simulation, interaction and rendering.

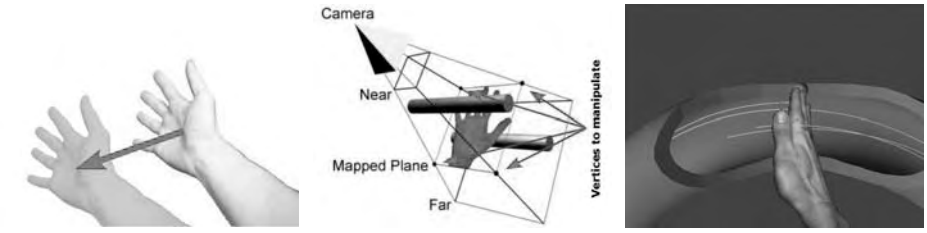

Figure 1. Here, we illustrate all key elements of our approach. Left: The overall concept of visually displacing the hand in 3-D space using live video data captured in stereo by the HMD's built-in cameras. Middle: The mixing approach generalizing a previous study [18]. We provide an extendible framework for creating and managing VPC that operates on the vertices of the carrier geometry mapped with the segmented live video hand. Virtual objects in front occlude the hand correctly as virtual objects behind the hand are correctly occluded. Right: A screenshot from a study on perceptual illusions [18] we conducted using an earlier version of the presented system. Subjects had to expose their hand (viewed through the video see-through HMD) to a virtual force field that attracted the “visual hand” and shifted it progressively away from its real counterpart. The triggered motor reaction in the pectoralis major produced the illusion of a flow that pushes the hand/arm to the side.

On top of this basic infrastructure is our VPC generation and management framework (henceforth: VPC framework) that offers a highly configurable interface to the top-level application layer. The VPC framework does all the work, including the dynamic control (i.e., increase or reduce) of visual hand shifts, performing feasibility tests and storing intermediate runtime data for post-hoc analyses. In Figure 1, the essential steps are summarized. As the hardware and software platforms are similar to our configuration presented in a previous study [18], we will, in the next section, primarily focus our attention on the novel platform-independent VPC framework.

3. VPC Generation and Management

The presented a lightweight solution for embedding the user's hand in a virtual scene that can easily be exploited for static and dynamic visual hand displacements. Since the hand texture carrier objects consist of simple OpenGL

quads redefined at runtime, their spatial attributes are available for additional computations. These quads are the result of a virtual camera frustum section performed in the viewing frame. This operation yields the final carrier objects' vertices that will later be transformed into the virtual world frame. A visual repositioning of the real hand can thus be achieved by shifting these objects or rather, their geometry within the different frames of reference.

To manage static offsets, as well as dynamic displacements in either the local viewing or the global world frame, we provide a data flow concept and a set of basic control functions. At the lowest level of the AR/AV mixing [23], the only thing we need is access to the carrier quads. Note that enabling this access represents the only change to be made to the kernel, whatever the actual AR/VR platform is.

A concrete application can trigger a fixed or a continuous shift of the visual hand feedback, while specifying the manipulation target frame. In the static case, an offset vector ^{o} or a direction vector ^{d} plus an offset distance ^{l} in cm have to be passed. Parameters are pushed to the hand shift matrix $^{m_{HS}}$. For dynamic displacements, a direction vector ^{d} and a displacement velocity $^{v_{displ}}$ in cm / s are required. The displacement control computes $^{m_{HS}}$ assuming a linear offset development. Using the hand feedback convergence (HFC) flag, applications can activate an automatic process as MACBETH [20] or any other (e.g., [16]) to reduce a given offset, while assuring the best possible motion coherence. Such a reduction helps return to “normal” visuomotor conditions and limit the risk of placing the visual hand outside the display space over time. ^{o} would be updated in this case before it is assigned to the hand texture carrier objects. Through a convergence amplifier, it is possible to control the impact of the HFC process. After the actual shift has been calculated, an optional target-frame-dependent feasibility test (FT) takes place in order to prevent inconvenient VPC (e.g., outside the video capturing or display range, risk of perceptual stress). The test is based on the estimated visual-to-real hand deviation angle and returns an error message if predefined constraints have been violated. Alternatively, the hand representation can fall back to any static 3-D hand model [1-2]. Offset thresholds are declared in a configuration file. It is further recommended to experimentally determine the true device properties for an optimized VPC bandwidth. $^{m_{HS}}$ will finally be applied to the viewing or world coordinates of the hand texture carrier objects.

At each tier before handing over the VPC data to the AR/VR platform, previous inputs, intermediate outputs and the current head and hand tracking information can be read by the concrete application or be stored by the VPC framework for analyses.

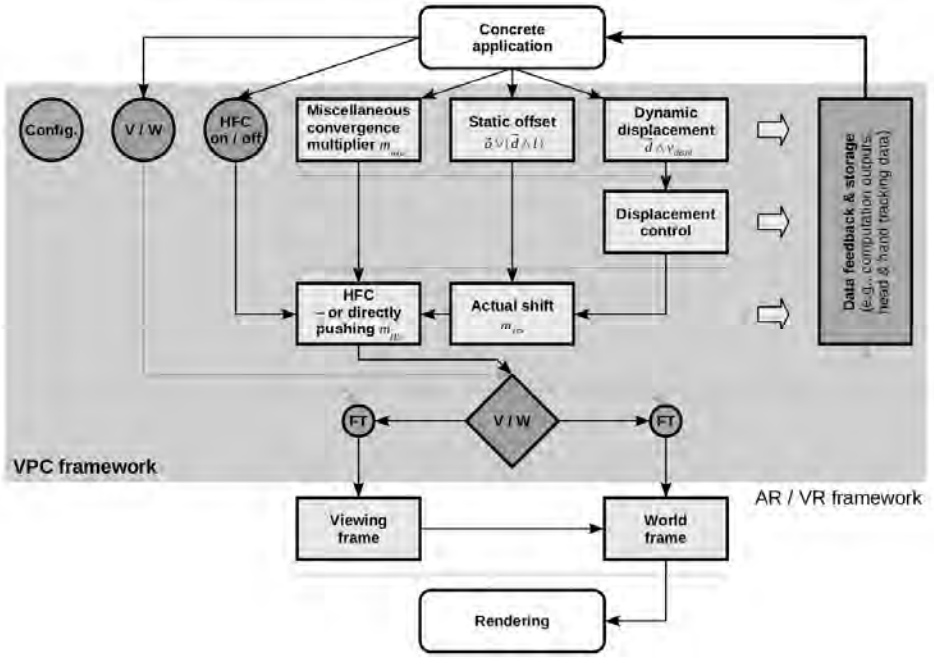

Figure 2. The internal architecture of the VPC framework (for details, please refer to the text)

Generality and extendibility are important characteristics of the VPC framework. Beside the open framework entries, also m_{HS} is generic in terms of its applicability.

Even virtual hand avatars can be managed using this matrix. Although the upper two layers can easily be extended, more specific modules should preferably be situated at the application side. From a development point of view, the VPC framework is designed as a Singleton and consists of a C++ application programming interface.

4. Conclusion and Future Work

We have designed and implemented a novel lightweight near space interaction system generalizing earlier work [18] that aims at a better stimulation of the processes involved in natural visuomotor coordination. The system includes a generic, extendible framework capable of inducing static and dynamic spatial VPC at hand level. We have recently used this setup to investigate effects of hand feedback fidelity on motor performance and user acceptance in a virtual object touching task [8]. Other promising fields of applications can be found where controlled VPC at hand level are to be combined with hand/finger visualization and naturalness of motion (e.g., studies of multimodal perception and online manipulation of visually guided actions, also for early diagnostics and rehabilitation of specific neuromotor disorders). We wish to perform conformity evaluations in order to compare our system to well-established, though mostly much less flexible, tools.

Further work is required to overcome technical limitations, such as incomplete stereo for very near objects due to insufficient viewing frustum overlaps in this region (possible solution: [24]), linear cutting edges on virtual object intersections due to using planar texture carrier objects (possible solution: simplified 3-D proxies for the computation of intersection effects; could additionally cast shadows) or the impression of having one's arm cut at the display boundary if the hand is shifted away in the opposite direction (possible solution: texture extension or repetition). Moreover, multimodal stimulation (e.g., acoustic and vibrotactile) does either partially exist or can easily be added.

Acknowledgments

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An Evidence-based Toolset to Capture, Measure, and Assess Emotional Health

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Abstract. We present: (1) an automated telephone check-in system to capture emotional health, based on automatic emotion classification, crowd-sourcing, and the experience sampling method; (2) a method that combines acoustic-based and perception-based emotion classifiers to maximize the likelihood of correctly identifying the emotion in a speech recording; (3) an evidence-based toolkit to measure and assess emotional health; and (4) the results of three experimental trials held in 2010 and 2011: (a) English speaking members of Alcoholics Anonymous, (b) English and French speaking general population, and (c) English speaking Opioid addicts undergoing Suboxone maintenance treatment. Emotional health can be defined as the ability to express emotions, identify one's own emotions, relate to other people's emotions, and to live life with predominantly positive emotions. Emotional health plays a major role in addiction treatment and Cognitive Behavioral Therapy (CBT).

Keywords. emotion detection, emotional health, crowd-sourcing, ecological momentary assessment method (EMA), experience sampling method (ESM), interactive voice response (IVR), Cognitive Behavioral Therapy (CBT)

Introduction

The goal of this research is to provide mental health and addiction treatment professionals with an evidence-based toolkit that will capture and measure momentary emotional states of patients in their natural environment and help professionals interpret and assess their emotional health. Emotiondetect.com can automatically capture and measure all four aspects of emotional health: ability to express emotions, identify one's own emotions, relate to other people's emotions, and to live life with predominantly positive emotions. The capture phase is performed either by an inbound or outbound call and takes less than 20 seconds (12 seconds on average), thereby avoiding procrastination typically associated with lengthy pen and paper journaling, form-based mobile device entry, and multiple question interactive voice response (IVR). Measurement is automatically performed by the toolset. Analysis and assessment is the domain of the professional.

Emotional health plays a major role in Cognitive Behavioral Therapy (CBT), as well as addiction, treatment, and recovery. Scott [1] refers to "emotional muscle" as a necessary skill to cope with life's problems. Addicts are very inexperienced in processing feelings. As they come to understand their emotions, they develop the ability to tolerate them more easily and change their responses. Each time an addict experiences a negative emotion without mood altering through drugs or alcohol he/she learns to take control a little more. The more addicts do this, the stronger they become, and the more emotional muscle they develop to cope with life's problems. Most chemically-dependent individuals cannot identify their feelings and do not know how to express some effectively.

Lyubomrsky [2] states that the notion that frequent positive affect is a hallmark of happiness has strong empirical support. People who report high levels of happiness have predominantly positive affect (stronger positive emotions than negative) 80% or more of the time. Lyubomrsky suggests that positive emotions might help people exert willpower and self-control over unhealthy urges and addictions.

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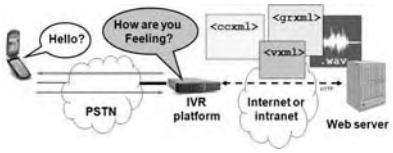

Figure 1. IVR network architecture

Interactive Voice Response (IVR) was selected as the best method to automate momentary emotional speech capture. Time-sampled and self-initiated ESM are performed by scheduled outbound dialing and inbound dialing, respectively, over the Public Switched Telephone Network (PSTN).

Tugade [3] states that substantial empirical evidence supports the anecdotal wisdom that positive emotions are good for health. Those who used a greater proportion of positive emotion words (versus negative emotion) showed greater positive morale and a less depressed mood.

The benefits of ecological momentary assessment method (EMA which includes ESM) are avoidance of recall and bias by collecting data on momentary states, realization of ecological validity by collecting data in the real-world, and achievement of temporal resolution enabling an analysis of dynamic processes over time [4]. A common ESM in CBT is for a patient to maintain a daily written journal of the day's events and associated feeling, emotions, and actions. This journal contributes to the therapist's assessment of the patient's cognitive and behavioral health. Research has recently commenced in evidence-based methods to capture and measure momentary emotional state using windows-form mobile devices [5] and Interactive Voice Response (IVR) systems [6]. These systems can capture self-assessment of emotional state, but do not provide empirical methods to measure a person's ability to express emotions, identify their own emotions, or relate to other people's emotions. In addition, these methods suffer from busy bias, resulting in participation apathy and neglect.

1. Emotional Health Capture and Measurement

Emotional speech can be elicited by asking the quintessential question, *"How do you feel?"* It is human nature to color our response to this question with emotion [1]. Many researchers have attempted to define the primary human emotions. Goleman [7] grouped emotions into eight primary emotions: anger, sadness, fear, enjoyment, love, surprise, disgust, and shame, but faith, encouragement, forgiveness, complacency, and boredom do not fit neatly into these primary categories. Ekman [8] proposed 15 primary emotions. Miller [9] proved that human short-term memory has a forward memory span of 7 ± 2. In addition, the state-of-the-art in automatic emotion detection in speech is currently five classes [11]. Hence, to elicit emotional classification over the phone from a data collection participant, we devised five categories: okay, happy, sad, angry, and anxious, which fit well into CBT emotion categories.

Emotions are momentary and may not coincide with the time sampled. If the time-based sampling is performed while the patient is in a particular mood, the emotional state can still be captured. Participants can also self-initiate emotional speech registration by calling in to the IVR system.

Results indicate that emotional health measurement reliability and assessment efficacy is dependent on the willingness and openness of the participant. Willingness and openness can be inferred from call completion rates and the expressiveness in the speech recordings. It is also evident that negative emotions are more difficult to collect than neutral or happy emotions. People may have a tendency to "put on their best face" and indicate they are "fine," regardless of the emotional turbulence they are experiencing; thereby, avoiding vulnerability or embarrassment.

2. Emotion Detection in Speech

What is the actual emotion in a speech recording? There is no "ground truth" in emotion detection. People will listen to a speech recording and classify the emotion differently. Even with professional emotion transcribers, Steidl et al. showed that normally only in a few cases do labelers agree on one common emotion label. In most cases, only three out of five labelers agreed on emotional content [12]. Contrast this to speech recognition where there is ground truth:

a speech recording is transcribed to text, and the speech recognizer's textual result can then be verified against the transcription for accuracy.

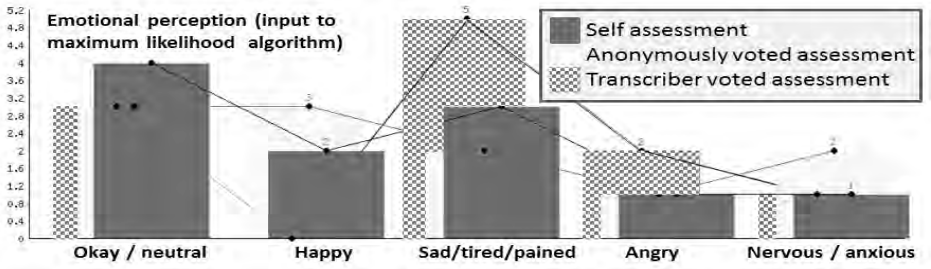

Figure 2. Perception of emotional recordings by different people

A method has been devised to combine emotion classifiers to maximize the likelihood of correctly identifying the emotion in a speech recording. This method is based on the maximum likelihood of the combined weighted scores from self-assessment, crowd-sourced anonymous assessments, trained professional transcriber assessments, and automatic acoustic classifiers [11].

3. Data Collection Trial Results

Table 1 provides data on three data collection trials[2] held between August 2010, and March 2011. The general population, comprised of friends, members of Le *Grand orchestre* de *Châteauguay*, and people recruited from newspaper advertisements, had the highest positive affect rate (78%); which approaches Lyubomrsky's 80% postulate [2]. Members of Alcoholics Anonymous had the highest call completion rate due to their focus on recovery and interest in self-help tools. Suboxone patients had the lowest happy rate and highest negative emotion rate. The Suboxone patients' openness (emotional variety and verbal descriptiveness) and willingness (call completion rates and hang ups) varied widely. It is hypothesized that recording prompts with the Doctor's voice will increase these rates.

Table 1. Emotional speech data collection trial results.

Data collection August 2010 - March 2011	AA members	General Population	SUBOXONE patients	Totals
total participants	40	49	39	128
total calls attempted	4755	4032	2025	10812
completed calls	2540	1729	703	4972
unanswered calls	2215	2303	1322	5840
call success rate	53.42%	42.88%	34.72%	45.99%
emotional speech collected	2596	1773	687	5056
Happy speech recordings	794	638	165	1597
Okay / Neutral speech	1078	751	291	2120
Sad / Tired / Pain speech	260	215	122	597
Angry speech	203	76	35	314
Anxious / Nervous speech	257	88	36	381
unintelligible recordings	4	1	8	13
recordings no speech / hang up	0	4	30	34
happy rate	30.59%	35.98%	24.02%	
okay rate	41.53%	42.36%	42.36%	
positive rate	72.12%	78.34%	66.38%	
negative rate (sad+ angry + anxious)	27.73%	21.60%	32.46%	

[2] The study was approved by the École de technologie supérieure ethics committee. All participants signed an informed consent form.

Figure 3 shows three analysis tools from the emotiondetect.com toolset that a professional can use to assess a patient's emotional health. "Patient X" is undergoing Suboxone treatment at Dr. Moehs' clinic. Patient X was called once a day by emotiondetect.com (patients were called up to three times a day, and dialed in as well). Peaks and valleys in the graph provide a quick overview of Patient X's emotional state over time. Overall, Patient X was depressed 34% of the time. A period of four days from Feb. 17-20 is consistently negative. These recordings can be played back for further insight.

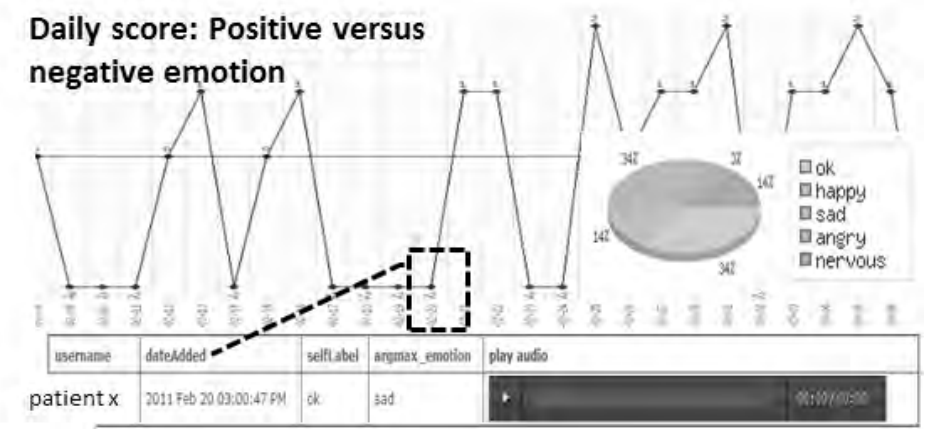

Figure 3. Daily graphed score of positive versus negative emotions

Figure 2 on page 3 depicts Patient X's ability to identify her own emotions versus the perception of her emotions by others. Fellow Suboxone patients generally agree with her self-assessment; professional transcribers' perception skews towards "sad."

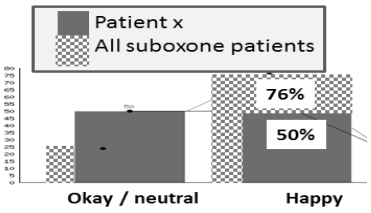

Figure 4. Ability to relate to "happy"

Figure 4 depicts Patient X is having difficulty recognizing the emotion "happy" in others. Speech recordings with known emotional content are played back during the telephone call. For recordings known to be happy, the average for all 39 suboxone patients was 76% correctly relating to happy. Patient X was only able to correctly identify this emotion in others 50% of the time. Her misidentified recordings were seen as "okay."

4. Conclusions

Emotiondetect.com can automatically capture and measure all four aspects of emotional health: ability to express emotions, identify one's own emotions, relate to other people's emotions, and to live life with predominantly positive emotions. It is hoped that Mental Health and addiction professionals will see the potential in this toolset and contact the authors at emotiondetect@gmail.com to participate in trials to further validate and improve the methodology, and collect speech for automatic emotion detection acoustic algorithm development.

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Accuracy of a Brain Computer Interface (P300 Spelling Device) used by People with Motor Impairments

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Abstract. A Brain-Computer Interface (BCI) provides a completely new output pathway and so, an additional possible way a person can express himself if he/she suffers from disorders like amyotrophic lateral sclerosis (ALS), brainstem stroke, brain or spinal cord injury, or other diseases which impair the function of the common output pathways which are responsible for the control of muscles or impair the muscles. Although most BCIs are thought to help people with disabilities, they are mainly tested on healthy, young subjects who may achieve better results than people with impairments. In this study we compare measurements, performed on 10 physically disabled people, to the results of a previous study, taken using 100 healthy participants. We prove that, under certain constraints, most patients are able to control a P300-based spelling device with almost the same accuracy as the healthy ones. Tuning parameters are discussed, as well as criteria for people who are not able to use this device.

Keywords. Brain-Computer Interface (BCI), P300, visual evoked potentials, locked-in syndrome

Introduction

In previous years Brain-Computer Interfaces (BCI) were used to control external devices such as virtual environments, orthotic, prosthetic, or spelling devices, among others. Therefore, different electroencephalography (EEG) signals can be used for BCI control, for example, slow cortical potentials [1], event related (de)synchronization [2], steady-state visual potentials [3], or the P300 event related potentials [3, 4]. For spelling devices a P300-based BCI is most common, due to a higher number of different characters, leading to a higher communication rate. The P300 is part of the visual evoked potential (VEP), and calculates when an unlikely event occurs randomly between events with a high possibility, and was described for the first time by Farwell and Donchin [5] in 1988. Since then, many studies have been performed to optimize the spelling parameters. For example, larger matrices evoke higher P300 amplitudes [6]. Also the stimulation frequency [3], the stimulation intensity [7], the classification algorithm [8] and electrode position [9] have been intensively analyzed.

Although most of the BCIs are thought to help people with impairments, many studies are only performed on healthy subjects, or people who have no benefit from using these devices. It is of special interest to test the performance of the BCI on people with motor impairments and compare these results to those taken from studies using healthy participants to prove if the current settings are working properly and under which constraints the device is working. For example, Brunner et al. [11] recently found that the commonly used electrode position is suboptimal when subjects do not gaze at the target, as it is the case for people suffering from conditions such as amyotropic lateral sclerosis (ALS) or massive subcortical stroke.

In a previous study [4] we examined the overall accuracy of our P300 speller for healthy subjects. After five minutes of training the subjects were asked to spell five characters. It was up to the subjects to choose between a row/column (RC) speller or a single character (SC) speller. Of the subjects, 72.8% (N=81) were able to spell with 100% accuracy in the RC paradigm and 55.3% (N=38) spelled with 100% accuracy in the SC paradigm. Less than 3% of the subjects did not spell any character correctly. Following this first study, we examined the same paradigm, with exactly the same settings, on people with motor impairments. Only the RC speller was used in this study, as it resulted in better accuracy in the former study.

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1. Method

A total of ten subjects (six male, four female, age: 35.6 ± 11.96) who were unfamiliar with using BCIs participated in this study. Inclusion criteria were: Cervical Spinal Cord Injury (between C2 and C6) and massive subcortical stroke patients with preserved cognitive function. The scale of the American Spinal Injury Association (ASIA) is evaluated for spinal cord injury patients to show the level of completeness of the injury. Two subjects suffered from a locked in syndrome (LIS). The recordings were done at the Neurorehabilitation Hospital Institute Guttmann (Badalona, Spain) following the clinical protocols and according to the local Ethics Committee. All patients gave informed consent to participate in the study. The subjects sat in front of a laptop computer and were instructed to relax and remain as still as possible. The EEG data were acquired using eight active electrodes at positions Fz, Cz, P3, Pz, P4, PO7, Pz and PO8. The "intendiX" Spelling System (g.tec medical engineering GmbH, Austria) was used for the study.

The speller showed a matrix (see Figure 1), consisting of 26 characters (A, B,…Z), 10 numerical characters (0…9), five punctuation marks (,.:!?) and nine extra token icons (e.g. for ringing an alarm) on the computer screen. The RC speller highlights a whole column (Figure 1, left) or row (Figure 1, right) for 100 ms (flashing time). The pause between the flashing is 75 ms each time (dark time). Each row and column is flashed several times in a random order before a classification via a linear discriminant analysis (LDA) is done. This number can be selected variably, to adapt the system to the specific user. Afterwards, the signal processing unit calculates the evoked potential for each character and performs the classification to determine which matrix item the subject was attending to. Then, the highlighting sequence starts again and the subject is prompted to attend to the next character. The subject's task is to attend to (or look at) the character she/he is prompted to spell and count how many times the character is highlighted. The BCI system must be trained first on individual EEG data and therefore, the subject was asked to "select" (or attend to) a specific word.

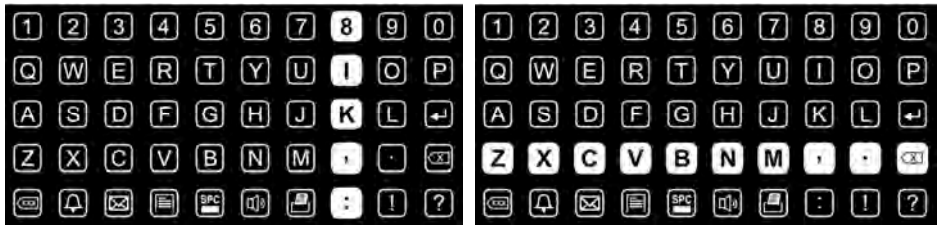

Figure 1. Matrix of the row-column speller (intendiX, g.tec medical engineering GmbH) used for the spelling experiments. Flashing column (left) and flashing row (right)

For comparability, the paradigm was performed in the same way as in the former study [4]. The number of flashes of each row and column for classification was 15, hence, each row and column flashed 15 times before a classification was done. The characters for the training procedure were WATER, therefore, it took about five minutes to set up the classifier. No habituation session was done before, meaning the participants started spelling immediately after the five minute training session. Next, the subject was asked to write the word LUKAS, one character at a time, also taking about five minutes. The spelling accuracy of each person was calculated by looking at the number of correctly spelled characters of the word LUKAS. For example, when one person misspelled one character (e.g. LUFAS instead of LUKAS) then there were four out of five characters correct, and the accuracy was 80%. In a second step the accuracy versus the number of used flashes was calculated. Figure 2 shows as an example of the accuracy for S8 when less than 15 flashes were used. One can see that using only 11 flashes would have been enough to obtain 100% accuracy. In the next paradigm, these plots were used for choosing the individual number of flashes.

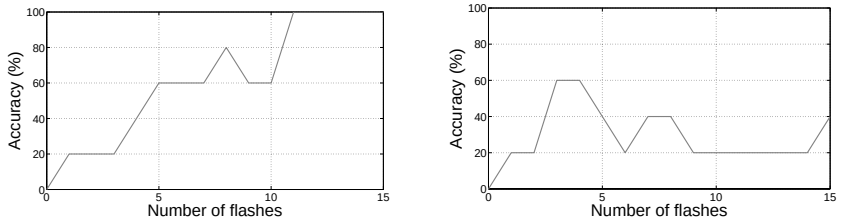

Figure 2. Accuracy versus number of flashes used for the classification. For example, subject S8 (left) obtained 100% accuracy when using 11 or more flashes. For subject S4 (right) the best classification was reached using three or four flashes (60%)

2. Results

Table 1. The accuracy results of all subjects.

Patient ID	*age (J)*	*Neurologic level*	*Cause*	*ASIA*	*Accuracy (%)*
S1	37	C3	Traumatic	A	80
S2	42	LIS	Brainstem		0 (40)
S3	24	C6	Traumatic	A	100
S4	21	C4	Traumatic	A	60
S5	24	C6	Traumatic	A	80
S6	60	C4	Medical	A	20
S7	31	C6	Medical	B	100
S8	40	C5	Traumatic	A	100
S9	46	C2	Medical	B	80
S10	31	LIS	Brainstem		0 (20)

2.1. Main Results

Table 1 shows the accuracy results of all subjects. Three of them (S3, S7, S8) achieved an accuracy of 100%. S4 had strong muscle activation in the neck due to a lack of control of main breathing muscles (e.g. diaphragm). This is a common mechanism in patients who need assistive breathing support during long periods of time. This influenced the EEG signal and led to a poor result (60% accuracy). S6 had to stay in bed during the measurement. However, the monitor was placed on the desk as we did for the other patients, so the configuration did not fit the special needs of this patient. Also because of this, his accuracy was poor (20%). The two patients suffering LIS (S2 and S10) did not obtain any control with the predefined settings. These results were included in the table for comparison of accuracy. Nevertheless, afterwards another measurement was performed, applying different settings (flashing time: 150 ms, dark time: 100 ms). As a result, the subjects reached an accuracy of 40% and 20%, respectively.

3. Discussion

In this study we collected data from 10 people with different motor disabilities. The aim of the study was to compare the results of these subjects to the accuracy of healthy people. S1, S3, S5, S7, S8, S9 reached accuracy levels between 80-100% with a mean of 90%. This proves that their control of the speller is comparable to the 81 healthy subjects (accuracy: 91%) in the previous study. The other subjects could possibly benefit from a longer period of time for adaptation of the settings, or maybe another BCI would be better suited to their needs. Of special interest is S9, who suffers a lesion at C2. Additionally, because of complications due to a tracheostomy, the subject is not able to communicate without any help. He achieved an accuracy of 100%, hence, the speller could be a very helpful device for him. S4 had strong artifacts caused by muscle activation in his EEG-signal, which negatively influenced the resulting accuracy.

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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 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

Interweaving Interactions in Virtual Worlds: a Case Study

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Abstract. The aim of this study was to examine the effect of playing the online game World of Warcraft (WoW), both on adolescent's (effective) social interaction and on the competence they developed on it. Social interactions within the game environment have been investigated by integrating qualitative and quantitative methods: conversation analysis and social network analysis (SNA). From a psychosocial point of view, the in-game interactions, and in particular conversational exchanges, turn out to be a collaborative path of the joint definition of identities and social ties, with reflection on in-game processes and out-game relationship.

Keywords. videogame, interaction, social network, identity

1. Introduction

World of Warcraft (WoW) is a Massively Multiplayer Online Role-Playing Game (MMORPG) produced by Blizzard Entertainment, which has achieved a global success since its launch in November 2004. As stated by Krzywinska and Lowood, "[It] is a complex world indeed, an extraordinary mixture of art and design, technologies, economics, the social and the cultural. It is a game, a virtual world, and an online community"[1]. We can therefore consider it as a laboratory where the social and behavioral sciences can observe and experiment socially realistic situations.

One of the factors characterizing this type of game is the "social factor:" the possibility to get in touch with other people, and the richness of collaborative and competitive activities within a community of gamers [2]. As real-world interactions are influenced by social norms and architecture of places, such as the presence and position of tables and chairs in a classroom, in a MMOG there are social architectures and game mechanics that have a major impact on social interactions experienced in these places. Game mechanics affect group development and numerosity and their cohesion, and more generally, the way players interact and why they behave in this way [3].

By recognizing the processes of co-construction of meanings and interactional strategies made available in such games, they can be defined as "inhabitated cyberplaces" in which the dialectic of Self, plural identity, subjectivity and inter-subjectivity unfolds in analogy to what happens in face-to-face social spaces [4].
Many studies [5-9] have shown that lucid videogame experiences can trigger significant changes, such as the ability to be part of a group, to take charge of leadership, to manage roles (attribution and empathy) and to interact towards a shared goal [10-12].

The aim of this study was to examine the consequences of playing the online game WoW both on adolescent's (effective) social interaction and on the competence they developed on it. In order to understand the interactive dynamics occurring in the virtual world, we analyzed the conversations taking place between the students, both in-game and out-game, integrating the results with a social network analysis (SNA).

Many social scientists are conducting studies on MMORPG, and many publications are already available. International conferences devoted to social studies on video games, or to the digital world in general, are focusing on this topic: for example, the Digital Games Research Association (DIGRA) has already organized three international conferences: the Computer Games and Digital Cultures Conference in Tampere in 2002, the Level Up conference in Utrecht in 2003 and the Changing Views: World in Play in Vancouver in 2005, hosting an increasing number of contributions devoted to the MMORPG. The Center for Computer Games Research at the IT University

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of Copenhagen hosted the multi-disciplinary conference Other Players in 2004, explicitly dedicated to studies of multiplayer games, and even here some contributions related to its qualified social research on the MMORPG.

Social research in the MMORPG may be somewhat divided between those that focus more on the player and the world outside the game, and those that instead focus on character and social interactions inside the game, although, of course, both types of study start from a (often implied) theoretical model of the phenomenon as a whole.

The first type of research that focuses more on the player takes into consideration issues such as the different approaches related to gender, nationality, age group of players [13], or the possible effects in the "real" world of phenomena related with MMORPG: negative, such as the phenomena of addiction and cyber-crime [14], or positive, such as the spread of new forms of political and social awareness and the development of learning strategies [15].

The second type of research is more focused on internal dynamics of the "virtual world," and covers topics such as the structuring of in-game social groups (such as clans or guilds) [16], foul play (so-called grief play)[17], and communication techniques [18], such as the patterns of cooperation and trust [19].

In this study, we focused on a meso-level, taking into consideration how the psycho-social dimension of the game can spread out of the virtual environment and into the real world classroom.

2. Method and Tools

The research involved seven classes, with a overall sample of 149 students (63 females and 86 males), from the first course at the Liceo Scientifico Statale Marconi (Milano, Italy). Game sessions and data gathering meetings lasted for two months (for a total of 10 game sessions). The classes were divided into three experimental groups defined as:

- Group 1 (Lab): composed of two classes whose students have played the game in the computer lab, accessing the game for two hours a week;
- Group 2 (House): composed of three classes that received a game license (with software and manual), whose students were allowed to play at home (2:30-4 p.m. on weekdays from 10 a.m.-12 p.m. and from 2:30-4 p.m. on Sundays);
- Group 3 (Control group): composed of two classes, whose students followed the normal timetable and activity plan of the school.

Conversational data have been gathered by means of a modified version of the internal chat logger, set up in order to automatically log every channel (public chat, group chat, guild chat) except for the private channel (also called “Whisper). The interactions in the laboratory room have been recorded with a camera, and the moderators have taken field notes of ethnographic elements during each sessions, while social network data are base on a questionnaire, administered during the first school week and after the last, tenth game session. Questions were formulated in order to gather data on ego-centric connections of each actor, with a binary measure.

3. Results

A first level of analysis of the chats shows that first sessions are characterized by very short conversations, or in some cases, no use of in-game chat. Ethnographic observation can help us understanding this configuration: during the first session kids resorted almost exclusively to the “out game” channel, often moving away from their desk and speaking to friends or neighbors around the room. In the subsequent sessions, although characterized by constant out game buzz, there was an increased use of in-game chat channels. The analysis revealed the emergence of a structure that gives form to the conversations.

In detail, we found three stable phases: alignment, coordination, and closure. Such a result is consistent with recent studies on conversational dynamics in virtual worlds [20], and it can be read as an evolving path towards the co-definitions of roles and meanings.

The alignment phase is characterized by efforts to confirm the mutual presence in the environment: the kids show off their presence by the mean of the avatars, asking for feedback from others, and in turn, confirm that they can see others’ avatar. These actions are commonly found in other interactive contexts, and are consistent with the literature – they can be interpreted as conversational tricks aimed at the creation of a shared conversation. During

this phase we observed lively verbal exchanges between the boys, with a constant movement in the room in order to show off and explicitly present their avatar to the other kids, and at the same time looking at the mates' character, taking note of their reciprocal position.

The alignment phase evolved from the first session to last, particularly, in regards to the reciprocity and the in-game/out-game alternation. In the first session it is possible to observe a prevalence of self-centered or own avatar-centered turns; while in advanced sessions there is a greater reciprocity, primarily aimed not at the affirmation of their own presence, but the confirmation of the presence of the other.

The coordination phase, usually following the alignment phase, is characterized by a focus on in-game content. In particular, the in-game themes mainly discussed were:

- actions necessary to complete the current mission,
- characteristics of the environment,
- game features and mechanics.

The coordination phase is based on the success of the previous alignment: in order to successfully ask, answer, and generally discuss tasks and actions, participants must share a clear understanding of their reciprocal position and role within a mutually shared representation of their environment.

Initial sessions are characterized by a prevalence of unmet questions and requests, with frequent direct appellation to the moderators. Conversely, in the last sessions it is possible to see an increase in role casting actions, such as operational guidance, orders and coordination.

From these elements we can see a leadership-centered evolution, with the first sessions characterized by a transfer of leadership and expertise on the outside, to the moderator, while the last sessions show the emergence of leadership within the groups of players.

The last phase consists of turns aimed at closing the conversation: for example greetings, declarations of intent (what will be done at the next interaction), and the description of the current relative positions.

A salient feature of the analyzed chat regards the register, and the very colloquial style of many turns.

The analysis showed that the first few sessions are characterized by the presence of vulgarity and by frequent exchanges of playful insults. The frequency and intensity of these exchanges, however, decreases within the following sessions, and they can be considered as conversational tools for the reciprocal definition and recognition of the other. Their role appears to be twofold: on the one hand, they are a way to test freedom within the game (students seem to use bad language as an affirmation of the possibility to speak freely, to be in a "different" context); on the other hand, the use of colloquial epithets allows players to establish a presence of themselves and of others as part of a in-group, defined by such practices.

Another element of analysis is the turn taking process: the first sessions are characterized by a considerable asynchrony, with the overlapping of different threads, particularly in the early stages of alignment. The frequency of overlaps decreases with the succession of sessions, with conversations becoming more functional and organized.

The evolution of the group dynamics emerged from the conversation analysis is confirmed by the analysis of the class social network.

The SNA shows a change in terms of structural indicators, as regards the classes in Group 1, with little or nothing to show for classes of Groups 2 and 3. In particular, a substantial increase can be observed for transitivity (Group 1 +5,34; Group 2 -5,54; Group 3 + 2,96), reciprocity (Group 1 +0,06; Group 2 -1,07; Group 3 -0.07) and density (Group 1 +0.07; Group 2 -0.017; Group 3 -0.059). The qualitative analysis of patterns shows fewer outsiders and isolated nodes in the classes of the Lab group, contrasting a tendency towards clustering of classes of the Control and Home groups.

4. Conclusions

The results showed that the group experience and the cooperation required by this video game allowed the classes to interact in a controlled environment where they experienced social ties, roles and responsibilities. As shown by conversations analysis, such dynamics don't have a priori features, but are defined within a series of incremental steps also influencing social relationships outside the game.

From a psychosocial point of view, the in-game interactions, in particular conversational exchanges, turn out to be a collaborative path of the joint definition of identities and social ties.

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Startle Reactivity in Acute Stress Disorder and Posttraumatic Stress Disorder

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Abstract. The aim of this study is to prospectively examine electromyographic (EMG) responses in patients diagnosed with acute stress disorder (ASD) after experiencing a traffic accident or violent attack, within one month after the traumatic event and six months later. Half of the participants met criteria for posttraumatic stress disorder (PTSD) after six months. Psychophysiological parameters can provide a better clarification between ASD and PTSD patients. Heightened startle magnitude in the immediate aftermath of trauma may be a good predictor of PTSD; moreover, a lack of startle habituation appears to be a more stable marker of PTSD, which persists for six months after trauma exposure.

Keywords: acute stress disorder, posttraumatic stress disorder, psychophysiology, startle response, EMG, EDA, ECG, HR

Introduction

Exaggerated startle responses are one of the diagnostic criteria shared by acute stress disorder (ASD) and posttraumatic stress disorder (PTSD). The acoustic startle reflex can be measured in the laboratory with sudden high-intensity tones used as startle stimuli delivered through headphones. The startle reflex is considered to be a sensitive measure of individual differences in emotional reactivity [1]. Startle reactivity can be measured using magnitude of the orbicular ocular electromyograph (EMG), heart rate (HR) and electrodermal activity (EDA) in response to the acoustic stimulus.

Startle reactivity in ASD patients has not been sufficiently investigated, while studies of startle reactivity in PTSD patients have frequently reported exaggerated startle reactions. For PTSD patients, findings of EMG startle responses were less consistent than those of HR and EDA measures [2]. One study found elevated eye blink EMG in PTSD but not in ASD [3]. Another study found that pre-trauma SC responses to startle stimuli supported the biological models of the acute arousal and its relation to development of PTSD [4]. Some of the studies have found larger eye blink EMG, EDA response magnitudes, and slower habituation rates to startle stimuli in PTSD patients [5, 6].

Some authors suggest that the results of startle reactivity shown by the studies of PTSD patients may serve as a vulnerability marker for the development of anxiety disorders [7].

Studies of ASD add to our knowledge of PTSD and its underlying neurobiology, as well as describe protective factors in the aftermath of trauma.

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1. Aim

The aim of this study is to prospectively examine electromyographic (EMG) responses in patients diagnosed with ASD after experiencing a traffic accident or violent attack, within one month after the traumatic event and six months later.

2. Methods and Participants

Data were gathered at the Department of Psychiatry at the University Hospital Dubrava, Zagreb, Croatia, as a part of a larger prospective study. The purpose of the study is to examine psychophysiological parameters of the acute and chronic phase of trauma. We have previously reported our findings of the acute phase of trauma [8]. The study has been approved by the Committee for Ethical Conduct of Research at the University Hospital Dubrava. All of the participants signed informed consent after given all the information on the protocol.

The same battery of scales and diagnostic procedures as we have previously reported were used [8]. All of the participants were examined by a psychiatrist and the Mini International Neuropsychiatric Interview, Croatian version (MINI) [9] was administrated to assess psychiatric disorders. Symptoms of ASD and PTSD were assessed by the Acute Stress Disorder Structured Interview (ASDI) [10] and the Clinician Administered PTSD Scale (CAPS) [11], respectively.

This study includes 16 individuals, 10 women and six men, who were evaluated within the first month following a traumatic event and were diagnosed with ASD. A second evaluation was done six months after the traumatic event. The mean age of participants was 46.1± 11.35 years old.

2.1. Psychophysiological Assessment

The psychophysiological assessment was done by using Biopac MP150 for Windows (Biopac Systems, Inc., Aero Camino, CA).

Although all of the following variables were recorded: electromyographic (EMG), electrodermal activity (EDA), electrocardiogram (ECG) activity, and respiration, we will present only the EMG data in this paper, as analyses of the other data are still ongoing. EMG was measured via magnitude of the contraction of the eyeblink muscle (m. orbicularis oculi) during the startle response. Data were sampled at 1000 Hz and amplified using the respective modules of the Biopac system. Data were exported for statistical analyses after being filtered, rectified, and smoothed in MindWare software (MindWare Technologies, Inc).

2.2. Startle Procedure

The acoustic startle response (eyeblink component) was measured via EMG of the right orbicularis oculi muscle. Two 5 mm Ag/AgCl electrodes filled with electrolyte gel were positioned approximately 1 cm under the pupil and 1 cm below the lateral canthus. The impedances for all subjects were less than 6 kilo-ohms. EMG activity was amplified and digitized using the EMG module of the Biopac psychophysiological monitoring system (Biopac Systems, Inc). The EMG signal was filtered with low- and high- frequency cutoffs at 28 and 500 Hz, respectively. Subjects were seated and asked to look at a blank computer monitor approximately 1 m in front of them. All acoustic stimuli were delivered binaurally through headphones (Maico, TDH-39-P).

Once the electrodes were attached, the participants were seated in a chair with a computer monitor in front of them. The participants were specifically told that no aversive or threatening stimuli would be given; they were asked only to relax and look at the monitor in front of them. The session began with a three-minute acclimation phase consisting of 70-dB A-weighted sound pressure level ([A] SPL) broadband noise, which continued as the background noise throughout the session. The acclimation phase consisted of five trials, with inter-trial intervals of 30 seconds. The startle probe (noise burst) was a 108-dB [A] SPL, 40-ms burst of broadband noise. The startle phase consisted of seven startle probe trials, with randomized inter-trial intervals of 9-22 seconds. This procedure, as well as the startle procedure was published in a 2009 article [12] that resulted from the collaboration with the team in Atlanta, Georiga, USA.

2.3. Exclusion Criteria

Individuals suffering from substance abuse, suicidal behavior, epilepsy, craniocerebral injuries, neurological disorders, history of a prior psychotic episode, schizophrenia, bipolar disorder, dementia, mental retardation, sight and/or hearing impairment, and any major acute or chronic medical illness were excluded.

2.4. Statistical Analyses

The dependant variable was startle magnitude measured from the EMG of the orbicularis oculi muscle; we used the peak amplitude recorded between 20 and 200 ms after the startle probe offset.

In order to examine the effects of the startle probe on the startle magnitude we used a 2 X 7 mixed analysis of variance (ANOVA) with GROUP (ASD vs. PTSD) as the between-groups factor, and TRIAL (7 STARTLE TRIALS) as the within subject factor. Interaction effects were followed-up by one-way ANOVAs. The Huynh-Feldt correction was used to control for sphericity violations. Alpha was set at 0.05. All analyses were conducted using SPSS for Windows.

3. Results

Preliminary data analyses from 16 individuals (10 women and six men) immediately after trauma and six months after trauma indicate that 50% meet criteria for PTSD after six months.

The eight participants who developed PTSD did not differ in age or gender from the eight that did not. However, when first tested for startle reactivity, those who later developed PTSD had significantly higher startle magnitude ($M=129.02$, $SE=27.00$ μV) compared to those who did not develop PTSD ($M=27.12$, $SE=8.24$ μV), $F(1, 14)=13.03$, $p=0.003$. Moreover, only those that improved showed significant startle habituation over the seven startle probes, linear trend $F(1, 7)=6.38$, $p=0.04$.

When re-tested after six months, average startle magnitude no longer differed between groups, $F(1, 14)=0.66$, $p>0.1$. However, only those who had improved after six months showed significant startle habituation at this time point as well, linear trend $F(1, 7)=9.80$, $p=0.02$.

4. Conclusion

Psychophysiological parameters can provide better clarification between ASD and PTSD patients. Heightened startle magnitude in the immediate aftermath of trauma may be a good predictor of PTSD; moreover, a lack of startle habituation appears to be a more stable marker of PTSD, which persists for six months after trauma exposure.

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Immersive Virtual Environments for Emotional Engineering: Description and Preliminary Results

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Abstract. This work aims to identify the arousal and presence level during an emotional engineering study. During the experimental sessions, a high-immersion Virtual Reality (VR) system, a CAVE-like configuration, will be used. Thirty-six volunteers will navigate through virtual houses that can be customized and that have been designed for emotional induction. Emotional induction will be obtained by stimulating the senses of sight, hearing and smell. For this purpose, the ambient lighting, music and smell will be controlled by the researcher, who will create a comfortable environment for the subject. Several physiological variables –Electrocardiogram (ECG), Respiratory signal and Galvanic Skin Response (GSR) – will be recorded during the sessions. The obtained results will help furniture companies identify the senses that have more influence on emotions and will be the basis for new studies about user needs in the sector of furniture and interior decoration.

Keywords. emotional induction, emotional engineering, Kansei, CAVE, HRV, respiration, GSR

1. Introduction

Emotional engineering is a field that studies the complex emotional relationships that connect objects, environment, etc. to individuals, with the aim of identifying user needs. The application of immersive virtual environments (VEs) for emotional engineering is a field that has not been widely studied, despite its potential for providing new useful information about human behavior. Nowadays, virtual technology used for emotional engineering studies has been limited to obtain custom prototypes of objects [1-3].

An immersive VE of a kitchen, for example, was used by Nagamachi, founder of Kansei Engineering, in a study on emotional engineering [4]. In this virtual kitchen, the participants could navigate in the VE and they decorated the kitchen. Information extracted from the customized virtual kitchen was used by kitchen designers with the purpose of creating an emotional kitchen. These studies were called Kansei Theory Type V or ViVA system by Nagamachi [4]. A head-mounted display and data gloves were used for this experiment. However, more immersive virtual technologies, such as CAVE-like systems or stereoscopic screens, can be used in any ViVA study.

These kinds of highly immersive systems have been widely used by Slater in studies about presence and arousal of subjects during navigation in virtual worlds [5-6]. Analysis of physiological signals has been used in these works with the objective of studying the relationship between these signals and arousal and presence levels.

In this study, we offer a new approach for the communication, marketing, design and manufacture processes applied to furniture and other habitat products, based on these previous works [4-6]. The goal is to use Virtual Reality (VR) to analyze the arousal and presence levels while participants navigate in virtual houses created for emotional engineering studies.

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2. Method

Kansei Theory Type V was applied in the study, combined with VR. Three VEs were developed with Vizard. Each of them contains a different lifestyle house (Figure 1). A virtual home applicable to a realistic lifestyle was designed for the young social sector (Figure 1a). A VE for a materialistic lifestyle was generated for another social group (Figure 1b), which grouped families with kids. Finally, the third environment was a work environment (Fig. 1c). All VEs were developed from real drafts of homes that were designed by a company dedicated to interior design. During the experimental sessions, a CAVE-like system with head-tracking and stereoscopic vision will be used to achieve a more immersive experience.

Figure 1. Three VEs of three lifestyle houses, a) Realistic lifestyle environment. b) User navigating in the CAVE-like system through the materialistic lifestyle environment. c) Work lifestyle environment.

In the global study that will be conducted, 36 volunteers will be exposed to this VE and will have to freely decorate the house. Sensory stimulation (hearing, sight and smell) will be applied to the subjects while they freely navigate through the custom VE in order to induce positive emotions. Ambient music will be used for hearing stimulation. Changes in illumination of the virtual house, which will depend on the time of the day that we want to simulate, will be used for sight stimulation. To stimulate the sense of smell, it will be necessary to use a scent delivery system (SDS100; Biopac System, Inc.), shown in Figure 2, that will provide different fragrances in the CAVE-like system. Specific software was implemented to allow a controlled stimulation by the researcher.

During the study, physiological signals will be recorded. ECG, respiratory signal and GSR [5-6] will be analyzed off-line (using Matlab) to obtain different parameters, in both time and frequency domain [7-9]. Custom software written in MATLAB will be used for this purpose.

Figure 2. Scent Delivery System. SDS100.

Furthermore, questionnaires concerning presence (SUS: Slater, Usoh & Steed questionnaire [9]) will be completed by the subjects at the end of the experiment.

Previously to this global study, a pilot study has been conducted with the objective of measuring the presence of a small population group when using the system. An additional pilot study will be used for usability testing.

In the following subsection, we are going to comment in more detail on the pilot study on presence.

2.1. Pilot Study

Ten volunteers (five men and five women) aged between 23-30 years old (mean age, 26.80; standard deviation, 1.751) participated in the pilot study. All the participants had normal or corrected-to-normal vision. All participants signed informed consent forms and the ethics committee approved this study.

In this pilot study, subjects had to navigate through the virtual house in two different experimental conditions. In one of them, they navigate through the VE that was presented in the CAVE-like system with stereoscopy for five minutes. In the other condition, they also had to navigate for five minutes through the same environment, but, in this case, it was presented without stereoscopy. The order of presentation of these two conditions was counterbalanced across the participants.

The realistic environment was used for this pilot study. Previously, all the volunteers learned to use the controls to navigate in a training environment. The SUS questionnaire [9] was completed by all participants at the end of each experimental condition.

3. Results

In this section, we present preliminary results about presence in our pilot study and future results which we hope to achieve with the global study.

SUS-mean (mean of all the individual responses to the presence questionnaire) and SUS-count (number of answers to the presence questionnaire with a value equal or greater than 6) factors were calculated for each subject. The mean value of each individual question, SUS-Mean and SUS-Count can be observed in Table 1.

A paired-samples T test was applied to compare between these factors in the two experimental conditions. Significant differences were obtained for SUS-mean, $t(9)=$ -2,885; $\rho=$ 0,018 and values close to significance for SUS-count, $t(9)=$-2,248; $\rho=$0,051.

Table 1. Mean of factors calculated with and without stereoscopy.

Variable	With Stereoscopy	Without Stereoscopy
SUS-Mean	5,23	4,65
SUS-Count	2,80	1,50
SUS-Q1	5,70	5,10
SUS-Q2	4,80	5,00
SUS-Q3	5,50	4,90
SUS-Q4	5,40	4,50
SUS-Q5	4,60	3,90
SUS-Q6	5,40	4,50

Other paired-sampled T tests were conducted to analyze differences between conditions in each of the questions. The statistical results are shown in Table 2. Significant differences have been found in all questions except questions two and three.

These results show a difference between the presence levels that subjects felt in the stereoscopic environment and the non-stereoscopic environment.

Table 2. Variable, t(degrees of freedom), and significance.

Variable	t(9)	Sig
SUS-mean (without – with)	-2,885	0,018
SUS-count (without – with)	-2,248	0,051
Q1_without-Q1_with	-3,674	0,005
Q2_without-Q2_with	0,480	0,642
Q3_without-Q3_with	-1,964	0,081
Q4_without-Q4_with	-3,250	0,010
Q5_without-Q5_with	-3,280	0,010
Q6_without-Q6_with	-2,862	0,019

In our complete study, arousal and presence level will be obtained using questionnaires and analyzing their correlation with physiological parameters. This way, we will study the influence on physiological signals of emotional induction during the navigation in the virtual house in the different experimental conditions based on light, ambient sound and scent customization. A file with all actions of the subject during the study will be generated by the system after each test.

4. Conclusions

The objective of the pilot study was to conduct a test where we could measure the presence level that the designed VE provided to the subjects using the stereoscopic environment and non-stereoscopic presentations. Previous section results show greater presence in the stereoscopic environment than in the non-stereoscopic environment. This indicates that users will feel more present in our VEs when they are presented with stereoscopy. Presence is an important measure relating to the subjective experience of participants in studies of VR. If a high sense of presence is provoked in participants by our VE, it will be a good indicator that our study can be a success.

On the other hand, the objective that our complete study pursues is to create a Kansei type V methodology and to use the results and conclusions obtained to help furniture companies identify different ways in which human senses influence emotional responses of subjects exposed to new furniture prototypes. This information will help them to design furniture that is better adapted to their consumers.

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