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Wounds of War II: Coping with Posttraumatic Stress Disorder in Returning Troops

EDITED BY:
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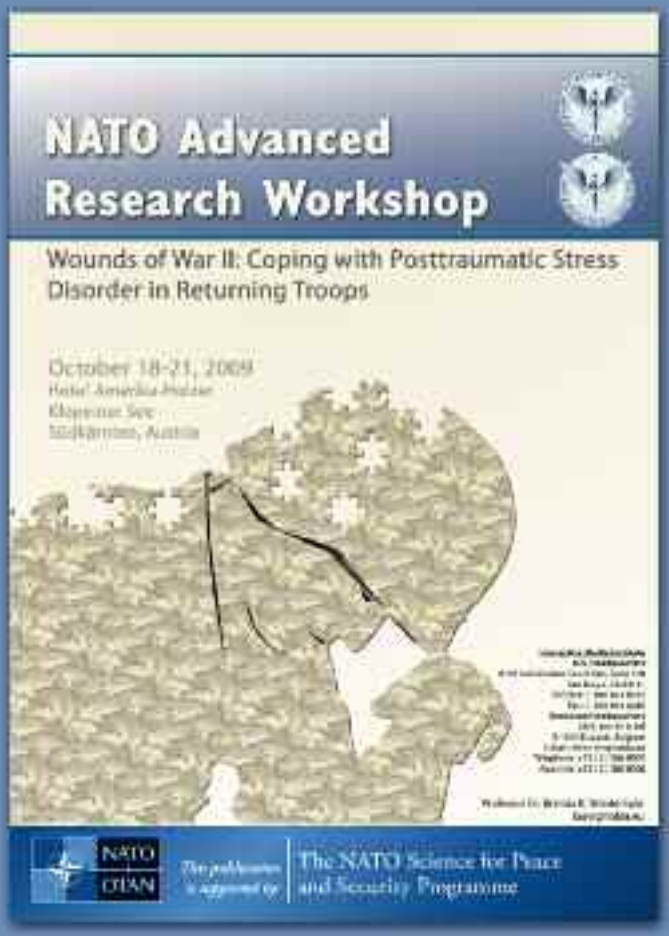
WOUNDS OF WAR II: COPING WITH POSTTRAUMATIC STRESS DISORDER IN RETURNING TROOPS

On October 18-21, 2009 the NATO Advanced Research Workshop 'Wounds of War II: Coping with Posttraumatic Stress Disorder in Returning Troops drew 30 eminent experts from 14 countries to discuss the impact of war-related stress on participants from current and past conflicts, particularly when it results in increased risk and incidence of PTSD. Held in Klopeiner See, Südkärnten, Austria at the Hotel Amerika-Holzer, discussion topics included increased PTSD as a result of missions, as well as how PTSD may be prevented. Often thought of as an "invisible wound of war," PTSD may manifest in very visible ways, affecting behavior, relationships and society. The ultimate aim of the workshop was critical assessment of existing knowledge and identification of directions for future actions. The co-organizers of this workshop alongside Professor Brenda K. Wiederhold included Professor Kresimir Cosic and Professor Dragica Kozaric-Kovacic of Zagreb, Croatia and Colonel Carl Castro from the United States.



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The post-conference book reflects the key topics discussed in the five sections at the workshop:

First Session – Vulnerability

Second Session – Diagnosis and Assessment

Third Session – Training and Treatment

Fourth Session – Technology-Based Training and Treatment

Fifth Session – PTSD and Comorbidity

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INTERSTRESS
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INTERSTRESS

Interreality in the Management
and Treatment of Stress-Related Disorders

The INTERSTRESS project aims to design, develop and test an advanced ICT-based solution for the assessment and treatment of psychological stress.

Objectives:

- Quantitative and objective assessment of symptoms using biosensors and behavioral analysis
- Decision support for treatment planning through data fusion and detection algorithms
- Provision of warnings and motivating feed-back to improve compliance and long-term outcome

To reach these goals, INTERSTRESS will use a new e-Health concept: Interreality. What is Interreality? It is the integration of assessment and treatment within a hybrid, closed-loop empowering experience, bridging physical and virtual worlds into one seamless reality.

- Behavior in the physical world will influence the virtual world experience
- Behavior in the virtual world will influence the real world experience

These goals will be achieved through:

- 3D Shared Virtual World role-playing experiences in which users interact with one another
  - Immersive in the healthcare centre
  - Non-immersive in the home setting
- Bio and Activity Sensors (from the Real to the Virtual World)
  - Tracking of emotional/health/activity status of the user and influencing the individual's experience in the virtual world (aspect, activity, and access)
- Mobile Internet Appliances (from the Virtual to the Real world)
  - Social and individual user activity in the virtual world has a direct link with the users' life through a mobile phone/PDA

Clinical use of Interreality is based on a closed-loop concept that involves the use of technology for assessing, adjusting and/or modulating the emotional regulation of the patient, his/her coping skills and appraisal of the environment based upon a comparison of the individual patient's behavioural and physiological responses with a training or performance criterion. The project will provide a proof of concept of the proposed system with clinical validation.

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EDITORIAL

Will flow in new...

Brenda K. Wiederhold, Ph.D., MBA, BCIA
Editor-in-Chief,
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Virtual Reality Medical Institute

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THE DEVELOPMENT OF VIRTUAL OPTOKINETIC STIMULATION AND ITS EFFECTIVENESS ON PSEUDONEGLECT

Ara Cho[1] and Jang-Han Lee[1]

"Pseudoneglect" is a small leftward bias, similar to hemispatial neglect, in healthy individuals. Optokinetic stimulation (OKS) is an effective technique based on coherently-moving stimuli used to treat neglect patients. However, OKS effects are temporary, and the task is uninteresting. In this study, we developed a virtual OKS (V-OKS) program that easily generalizes treatment effects to daily life, and is also interesting. Our aim was to examine the V-OKS program's effectiveness on pseudoneglect. 31 healthy individuals conducted a line-bisection test and a cancellation test at baseline, and were tested again after receiving six versions of V-OKS differing in speed and orientation. All speeds of rightward V-OKS made corrections of the leftward bias, the slow speed being most effective. Also, participants made initial cancellations from the left after leftward V-OKS in the cancellation test. Results revealed that V-OKS effectively regulates pseudoneglect and has potential to be clinically applicable to neglect patients.

Keywords: OKS, Pseudoneglect, Hemispatial Neglect, Virtual Reality, Leftward Bias

Introduction

Hemispatial neglect is characterized by the impaired or lost ability to react to or process sensory stimuli presented in the hemispace contralateral to the lesioned cerebral hemisphere, even in the absence of basic sensory or motor deficits. For example, when asked to place a mark at the center of a horizontal line, patients with neglect following right hemisphere damage show a rightward bias from the center (Bultitude & Davies, 2006). Interestingly, similar to the hemispatial neglect, healthy individuals also incorrectly bisect space in visual line-bisection or similar tasks, commonly erring to the left of the center of horizontal lines (Bowers & Heilman, 1980). Also, healthy individuals showed leftward bias during driving simulation (Jang et al., 2008). This phenomenon was first referred to as "pseudoneglect" by Bowers and Heilman (Bradshaw, Nathan, Nettleton, Wilson, & Pierson, 1987). The most supported theory of pseudoneglect is the activation-orientation hypothesis (Reuter-Lorenz, Kinsbourne, & Moscovitch, 1990), which proposes that the allocation of attention is biased in the opposite direction to the more activated hemisphere. According to the activation-orientation hypothesis, the left half of the horizontal line in a line-bisection test receives greater attention than the right because visuospatial tasks (e.g., line-bisection) cause the activation of the right hemisphere (Bultitude & Davies, 2006). It explains why healthy individuals tend to lean to the left side of the line during line-bisection tests.

There are some techniques used to treat neglect, such as a Caloric test, neck muscle vibration, transcutaneous electrical nerve stimulation (TENS), prism adaptation, visual scanning training (VST), and optokinetic stimulation (OKS). VST has been known to be the most effective technique for treating patients with neglect (Antonucci et al., 1995). However, VST has drawbacks including numerous laborious treatment sessions and being only effective for visual neglect. In addition, since VST is based on top-down mechanisms involving use of conscious strategies, VST is often challenging for patients with neglect who

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have the lack of awareness of neglect symptoms (Kerkhoff, Keller, Ritter, & Marquardt, 2006).

OKS is a technique that makes up for the weaknesses of VST. OKS basically shows many stimuli moving consistently to the neglected side (Kerkhoff et al., 2006). This technique has shown the beneficial effects on diverse neglect symptoms. For example, leftward OKS promoted attention in reading and writing in patients with acute hemispatial neglect (Schroder, Wist, & Homberg, 2008), temporarily reduced size distortion in patients with neglect (Kerkhoff, Schindler, Keller, & Marquardt, 1999), and reduced errors in the line-bisection test among patients with right brain damage (Pizzamiglio, Frasca, Guariglia, Incoccia, & Antonucci, 1990). Also, it was found to be helpful for treating neglect symptoms when stimuli were presented at slow rates compared to rapid rates because the stimuli presented at slow rates did not induce optokinetic nystagmus (OKN) (Kerkhoff et al., 1999).

Some studies found that OKS activates multiple brain regions, such as the temporoparietal cortex, basal ganglia, brain stem, and cerebellum (Kerkhoff et al., 2006). For this reason, not only is OKS effective for visual neglect, but also for other multiple aspects of neglect, such as tactile extinction (Nico, 1999), grip strength (Vallar, Guariglia, Nico, & Pizzamiglio, 1997) and position sense (Vallar, Antonucci, Guariglia, & Pizzamiglio, 1993; Vallar, Guariglia, & Magnotti, 1995). Furthermore, since OKS is based on bottom-up mechanisms that do not require awareness of the deficiency, this technique has been found to be more effective than VST in patients with neglect (Kerkhoff et al., 2006).

Also, there are a few cross-sectional pseudoneglect studies using OKS. For example, in Pizzamiglio et al.'s study (1990), as expected, leftward moving OKS caused greater leftward error whereas rightward moving OKS caused less leftward error in healthy subjects. Another study (Na et al., 2002) showed that when stimuli moved at rapid rates, bisection errors occurred, as expected, in the same direction to the stimuli moving, whereas when stimuli moved at slow rates, bisection errors surprisingly occurred in the opposite direction to the stimuli moving (Na et al., 2002). Given these inconsistent results, the effects of OKS on pseudoneglect need to be further explored.

Unfortunately, the OKS technique also has some limitations. First, the effects of OKS are temporary. There are several results demonstrating the transient effects of OKS (e.g., Pizzamiglio et al., 1990; Mattingley, Bradshaw, & Bradshaw, 1994; Nico, 1999; Kerkhoff et al., 1999) which suggest that the OKS treatment effects may not be generalized in daily life. To supplement such a drawback, Kerkhoff et al. (2006) provided the OKS treatment session repetitively and found its beneficial effects on the neglect symptoms at 14 days post-OKS treatment. Second, it is difficult to elicit individual's interest during OKS treatment. For example, observing routine stimuli for a long period of time may lead to difficulty in concentration and boredom during the OKS treatment. Third, some individuals, particularly the elderly, might not be familiar with using a computer.

To make up for these disadvantages, a virtual environment (VE) was suggested in that it allows individuals to control their visual field and increases immersiveness of the stimuli (Riva, Morganti, & Villamira, 2004). Also in the VE, individuals feel as if they are in the real environments, and thus VE can easily produce familiarity and interest. Given these, with the use of VE, it is relatively easy to obtain generalized treatment effects in daily life.

The aim of this study was to examine the effects of virtual OKS on pseudoneglect. To our knowledge, the effects of OKS using VE on pseudoneglect have not been empirically investigated. Thus, we developed the virtual OKS program as a treatment modality for pathological neglect. However, prior to its application to a clinical sample, in this current study we used the virtual OKS program to preliminarily examine its beneficial effects for pseudoneglect in healthy individuals. We hypothesized that a leftward bias (pseudoneglect) would be regulated to rightward after rightward OKS treatment sessions, whereas a leftward bias would be greater biased to the left after leftward OKS treatment sessions.

Method

Participants

Thirty-nine neurologically healthy university students were recruited from a university in Seoul, Korea, through an online bulletin board on the university website. The inclusion criterion for this current study was having a dominant right hand. Thus, the study sample was finally selected based upon the averaged score (i.e., greater than 3 out of 5) obtained from the Measurement of Handedness in Koreans Inventory (MHKI; Kang, 1994), a 20-item self-report measure. All of the participants met the inclusion criterion and thus were finally selected for the current study, and signed an informed consent that had been approved by the institutional review board (Chung-Ang Psy-

chology Research Ethics Committee). The sample consisted of 18 males and 21 females and their mean age was 22.90 years (SD=2.24).

Measures

Line-bisection test

The line-bisection test is one of the simplest measures to detect the presence of (pseudo)neglect. In this study, two different versions of the line-bisection tests (i.e., paper-based and computer-based) were used. For the paper-based test (consisting of a black horizontal line 288 mm in length on a white A4 sized paper), participants were instructed to "place a mark using a pen on the middle of the line as exactly as possible." Also for the computer-based test (consisting of a black horizontal line 370 mm in length on a white background on a 19 in monitor), they were instructed to "click the left mouse button on the middle of the presented horizontal line as exactly as possible." There was no time limit for the line-bisection test. Since each version of the line-bisection test was performed multiple times (i.e., three times) at baseline and each treatment session (though the paper-based line-bisection test was provided after the third and sixth OKS treatment sessions), it was scored by averaging all of the distances (n = 3) from the center of the line.

Virtual Cancellation test

The cancellation test is another screening tool to detect the presence of (pseudo)neglect. In this current study, the cancellation test was computer-based of which protocols were designed by our research team. In the cancellation test, a background of the screen consisted of buildings and stores on city streets. The screen was covered with red and white transparent rectangular boxes (see Figure 1-A). The ranges of boxes that participants were supposed to cancel were colored with red (7x5), and other boxes were marked with white. Participants were asked to clear only red boxes using an up, down, left, or right arrow on the keyboard, and the time to complete the task was measured.

Treatment session

Virtual Optokinetic Stimulation (OKS)

The virtual OKS program was developed by our research team and used as a treatment modality for pseudoneglect in the current study. The virtual OKS program was also computer-based and the background of the screen consisted of the same environment (i.e., buildings and stores on city streets) presented in the cancellation test (see Figure 1-B). The stimuli consisted of several transparent vertical columns continuously rotating across the screen, either towards the left or right, at three different speeds: slow (1.7 deg/sec), moderate (8.5 deg/sec), and fast (17 deg/sec). OKS treatment session consisted of six sessions. At the first three OKS treatment sessions, the transparent vertical columns moved in a direction (i.e., leftward or rightward). Then in the last three OKS treatment sessions (i.e., the fourth, fifth, and sixth sessions), the transparent vertical columns moved in the other direction. Direction was randomly assigned at the first session. Speed rates of the moving vertical columns were counterbalanced (i.e., slow-moderate-fast and fast-moderate-slow) in the first three and the last three sessions. The fixation mark was presented on the center, and participants were supposed to focus on it during the OKS treatment sessions.

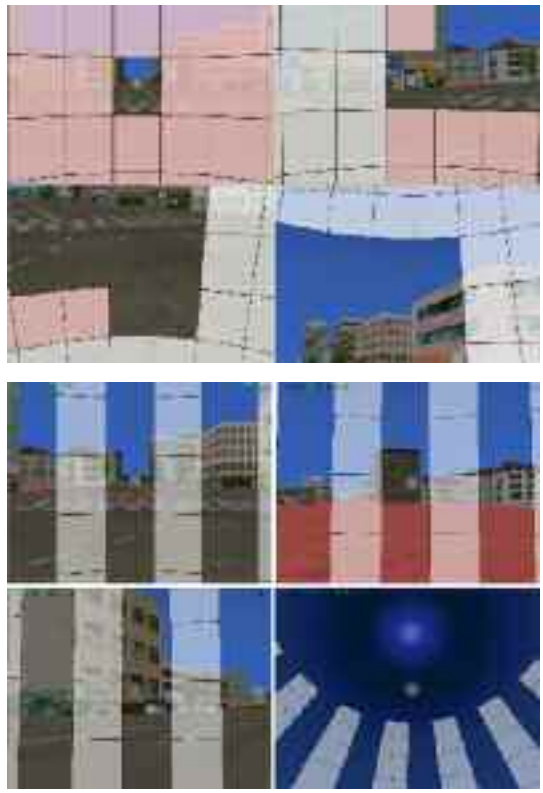

Figure 1. (A, top) Shows Virtual cancellation test, and (B, bottom) indicates Virtual optokinetic stimulation. Same background was used in both (A) and (B).

Apparatus

An IBM compatible personal computer with ATI Radeon HD 2600XT graphic card was used to present the virtual

program. The VE was presented through Deocom Vietor SX-I see-through head mounted device (HMD) with MicroInfinity A3330LS head motion tracker (HMT), throughout the computer-based tests (i.e., line-bisection test, cancellation test, and OKS treatment). A see-through HMD allowed participants to experience a mixture sense of reality between VE and real environment. However in this study, we did not use the see-through function to examine the effects of VE only.

Procedure

Initially, participants were asked to fill out the MHKI (Kang, 1994), to select the right-handed participants. Once the participants were identified as right-handed, a paper-based line-bisection test, a computer-based line-bisection test, and a virtual cancellation test were provided or pretests to measure baselines. Participants wore an HMD with HMT throughout the experiment, except while taking the paper-based tests. Light was turned off to restrict the see-through function of HMD while using it. Then, six treatment sessions of virtual OKS were conducted, and after each session the computer-based line-bisection test was conducted three times. Following the third and sixth virtual OKS treatment session, participants were given a paper-based line-bisection test and a cancellation test. In this part, these tests were conducted for the results of OKS effect on direction but not speed rate. Each of the OKS sessions was presented for one minute, and there was approximately a one minute interval between the OKS treatment sessions. Exceptionally after the third session, intervals were approximately five minutes. This was to prevent transferring the effect of previous treatment to the next results, as well as to take the computer-based line-bisection test, virtual cancellation test and paper-based test. The entire experiment was conducted once and took approximately 30 minutes. Upon completion of the experiment, the participants were debriefed and received compensation.

Experimental design and data analysis

Out of 39 study participants, three male and five female participants were excluded from the analyses due to a high percentage of outlying responses and errors. An independent t-test was conducted to test gender differences in the paper-based and computer-based line-bisection test and cancellation test scores at pre- and post-virtual OKS treatment session. Statistical procedures also included one-way ANOVAs for repeated measurement designs in order to compare the paper-based and computer-based line-bisection test and cancellation test scores between pre- and post-virtual OKS treatment session.

Result

Line-bisection

In the baseline of the paper-based line-bisection test, both male and female participants showed leftward bias of -1.69 and -1.40, respectively, but there was no significant gender differences [$t(29)=.27$, n.s.]. The computer-based test did not show a significant difference between male and female participants either [$t(29)=.46$, n.s.], but female participants tended to show more leftward bias [male participants: $M=.33$, female participants: $M=-1.26$]. There was no significant difference between genders in the results of the virtual OKS treatment.

Both versions of line-bisection tests (i.e., paper-based and computer-based) had results of leftward bias [paper: $M=-1.54$, computer: $M=-0.49$] in the baseline. In the computer-based line-bisection test, rightward virtual OKS treatment revealed a significant effect. All speed conditions, slow [$F(1,30)=7.51$, $p<.05$], moderate [$F(1,30)=6.42$, $p<.05$], and fast [$F(1,30)=4.43$, $p<.05$], of virtual OKS were significantly effective, with the slow speed being the most successful (see Figure 2). However, there was not a significant effect of leftward virtual OKS treatment in the slow [$F(1,30)=1.26$, n.s.] and fast [$F(1,30)=1.55$, n.s.] conditions. However, the moderate speed [$F(1,30)=11.43$, $p<.05$] significantly showed more rightward bias compared with the baseline. In the paper-based line-bisection test, virtual OKS treatments did not show any significant effect, either rightward [$M=-1.19$, $F(1,30)=.17$, n.s.] or leftward [$M=-1.75$, $F(1,30)=.51$, n.s.], as compared to the baseline [$M=-1.54$, $SD=2.94$].

Virtual Cancellation test

The mean time of the cancellation performance was 21.03 sec in the baseline, but after both leftward and rightward virtual OKS treatment it was decreased to 17.79 sec and 17.35 sec, respectively. In the cancellation test, responses were analyzed by assigning a value of "-1" when beginning from the left, "0" when beginning above or below, and "1" when beginning from the right. Participants generally started the cancellation process from the right [$M=.03$], but the participants showed significant change when starting from the left [$M=-.32$, $F(1,30)=4.67$, $p<.05$] after leftward virtual OKS. Rightward virtual OKS did not show a significant effect [$M=.00$, $F(1,30)=.00$, n.s.].

We also measured whether participants cancelled more squares relative to the left or right of the starting point. Participants cancelled more squares to the left than to the right in the baseline [$M=-.32$]. After the leftward and

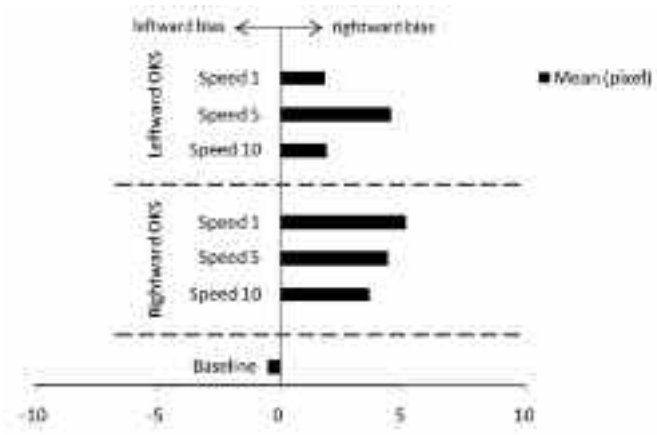

Figure 2. This is the mean of result of virtual OKS treatment in computer-based line bisection test. "-" values present leftward bias, and "+" values present rightward bias.

rightward virtual OKS treatment, participants still cancelled more squares relative to the left of the starting point [leftward virtual OKS: M=-.42, F(1,30)=.30, n.s., rightward virtual OKS: M=-.37, F(1,30)=.00, n.s.].

Discussion

In this study, we examined the effects of the developed virtual OKS program in regulating pseudoneglect. This virtual OKS program was expected to correct leftward bias in neurologically healthy individuals, and the hypothesis was partially supported. The main result of this study was that rightward virtual OKS treatment changed the leftward bias of participants to rightward, showing that this virtual OKS program had a positive effect on pseudoneglect. The program was the most effective in the slow condition of virtual OKS, and this result was consistent with the previous studies (Mattingley et al., 1994; Kerkhoff et al., 1999; Pizzamiglio et al., 2004). Although it was not statistically significant, the results of leftward virtual OKS showed a contradictory effect that drew the attention of participants more towards the right instead of the left. One possible explanation may be that a bias in the line-bisection test reflects a bias in motor response. Vicario, Caltagirone, & Oliveri (2007) mentioned that left-hand responses could be facilitated following leftward OKS and right-hand responses could be facilitated following rightward OKS. In our study, since all participants used only their right hand for all tasks, this rightward bias could be explained by Vicario et al.'s study.

In the cancellation test, participants began canceling on the right side, but leftward virtual OKS treatment resulted in a leftward shift in the starting position. This indicates that virtual OKS treatment could change the orientation of participants' attention.

However, in the paper-based line-bisection test, there was no significant effect of the virtual OKS treatment, which was contrary to the results of the computer-based test. Although it was not significant, participants tended to show more leftward bias after leftward OKS, and leftward bias was regulated to rightward in comparison to the baseline after rightward OKS. It could be interpreted that the effects of OKS were smaller in the paper-based test than the computer-based test. Taken together, positive effects of virtual OKS in the computer-based tests were seen, but may not be replicated in a real environment. The effects of the virtual program may not be completely transferred to real environment tests.

Additionally, a few limitations could be seen in our study. Firstly, participants were asked to focus on a central fixation point during the virtual OKS treatment sessions. However, according to the previous study, the effect of OKS is more obvious in the absence of OKN suppression, by increasing attention diversion (Vicario et al., 2007). It is speculated that better effects of OKS treatment can be obtained if the fixation mark was not used because it could have provided more optokinetics. Secondly, in the paper-based line-bisection test, leftward bias was not significantly regulated. Participants took the test right after taking off the HMD glasses and did not use HMD during the paper-based line-bisection test. This transition might induce motion sickness by providing visual confusion. Future studies may benefit from considering possible side effects, such as motion sickness and cybersickness. One more thing that could be viewed as a limitation is the short time between treatments. One minute might be short, and the previous treatment session(s) might have influenced the condition of the subsequent treatment.

In summary, this study used PC technology to provide VE which was familiar and interesting to individuals in virtual OKS for neglect symptom. Since we employed healthy participants who exhibited a small bias, a more clinical study may be necessary. Nevertheless, the effectiveness of this virtual OKS in regulating pseudoneglect was revealed, and it can be expected that this virtual OKS also has potential to be used for the treatment of hemispatial neglect.

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PHYSIOLOGICAL AND AFFECTIVE RESPONSES TO IMMERSION IN VIRTUAL REALITY: EFFECTS OF NATURE AND URBAN SETTINGS

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With the rapid advancements in technology, researchers are seeking new ways to incorporate modern high-tech solutions such as Virtual Reality (VR) into treatment paradigms for stress. The current experiment explores the beneficial effects of immersing an individual into VR after a stressful encounter. The potential restorative effects of three unique immersive VR environments were examined by inducing stress and negative affect in 69 participants, and then randomly assigning them to freely explore one of three environments (a virtual nature setting, a virtual urban cityscape, or a neutral environment composed of solid geometric shapes) for 10 min. Participants who explored the nature environment were found to have significantly improved affect (as measured by a standardized questionnaire), and significantly lower stress levels (as measured by self-report and skin conductance levels) compared to those who explored the urban and geometric environments. The results suggest that virtual nature has restorative properties similar to real nature, and that simply immersing participants into a virtual nature setting can reduce stress. These results also suggest that the content of the VR experience (i.e., whether it contains nature) is important in promoting restoration, and that in the absence of nature, stress levels remain unchanged.

Keywords: Biophilia, Restorative Effects, Stress Management, Virtual Reality, Nature

Introduction

Over the last 30 years, researchers have provided empirical evidence suggesting that surrounding oneself with nature can have restorative effects on emotional, physiological and cognitive states. The restorative effects of exposure to nature have been classified as a reduction in cognitive fatigue, decreases in both physiological and cognitive stress, a decrease in negative affect, and an increase in positive affect (Gullone, 2000; Hartig, Mang & Evans, 1991; Berman, Jonides & Kaplan, 2008). For example, recent research by Berman, Jonides and Kaplan (2008) comparing the effects of interacting with natural versus urban environments has found that individuals performed better on a working memory task after taking a walk in a local park versus taking a walk in a local downtown area. Furthermore, Berman et al. found that individuals' executive attention (as measured by the Attention Network Task) improved after viewing pictures of nature when compared to individuals who viewed pictures of urban areas (Berman et al., 2008) which suggests that simply viewing nature pictures can have restorative effects. Other studies by Ulrich et al. (Ulrich, 1981; Ulrich, Simons, & Losito, 1991) have also shown that viewing photographs and videos of nature scenes can promote significant reductions in physiological stress (shown by reductions in skin conductance level) and improvements in emotional states of individuals (shown through self-report on the Zuckerman Inventory of Personal Reactions).

Kaplan (1995, 2001) delineates how and why nature is restorative in his Attention Restoration Theory (ART), which states that when a person is immersed and interacting with a surrounding environment that contains fascinating stimuli, the stimuli modestly capture attention in an

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involuntary fashion. ART further states that while this form of involuntary attention is active, internal mechanisms responsible for directed attention are allowed to recover (Kaplan, 1995; Kaplan, 2001). ART attempts to explain the differences between exposure to nature versus environments by contrasting the types of stimuli present in both types of environments – nature environments contain many stimuli that modestly capture attention (such as grass and leaves swaying with the wind), which occupy attention but can also be disengaged from easily, allowing attention to drift from stimulus to stimulus. Conversely, urban environments contain bright lights, neon signs, loud vehicles and construction sounds that dramatically capture attention. Thus, directed attention mechanisms are taxed in order to disengage from the stimuli (e.g. ignoring neon advertisements), causing the environments to be less restorative. (Kaplan, 1995; Kaplan, 2001). Recent research by Berto Massacesi, and Pasini (2008) examining eye movements of participants that viewed urban and nature images provides some support for ART. Berto et al. (2008) found that when participants viewed images of nature scenes, they had fewer long fixations and visually explored more of the images compared to participants that viewed images of urban settings. This provides evidence that nature scenes prompt involuntary attentional drifts from stimulus to stimulus as suggested by ART.

A second theory that stands in contrast to Kaplan's ART was proposed by Ulrich et al. (1981; 1991). This theory states that an individual's initial response to immersion within an environment is affective instead of cognitive. Ulrich et al. proposed that the structural properties of an environment (such as complexity and focality) prompt an automatic affective response within the individual. Ulrich et al.'s theory proposes that stimuli seen outside of nature are more threatening and thus more physiologically arousing. In contrast to ART, where replenishment of directed attention mechanisms is believed to be the source of restoration, Ulrich et al.'s theory proposes that the initial automatic affective response to an environment shapes the cognitive events that follow (Valtchanov, Barton, & Ellard, 2010). If the affective response is positive (as when one is exposed to nature), the cognitive and physiological events that follow are also positive – negative emotions and thoughts are suppressed, resulting in higher levels of positive affect and ability to sustain attention, and reduced levels of negative affect and physiological stress (Valtchanov et al., 2010). Experiments by Ulrich et al. have focused on measuring the affective and physiological states of participants in an attempt to find support for this theory. These authors have shown that exposure to surrogate nature (such as videos and photos of real nature) promoted a decrease in heart rate and skin conductance (Ulrich et al., 1991), and even blood pressure (Ulrich, Simons & Miles, 2003) while also improving self-reported affect.

Much of the research on the restorative effects of nature has focused on identifying and understanding how the restorative properties of nature may be utilized to improve overall quality of life and well-being, rather than exploring the theories proposed by Kaplan (1995; 2001) and Ulrich et al. (1981; 1991). Some applications include making cityscapes more pleasant and appealing to individuals by adding trees (Sheets & Manzer, 1991) while others include improving workplace satisfaction by providing views of natural scenery within office spaces (be it through the use of windows or posters) (Leather, Pyrgas, Beale, & Lawrence, 1998; Kweon, Ulrich, Walker, & Tassinary, 2008). With the emergence of new technologies such as immersive Virtual Reality (VR) and 3-D video, researchers are investigating new ways to use these technologies to help improve the quality of life both within the home and clinical settings (Villani, & Riva, 2008; Valtchanov et al., 2010). Part of this line of research has focused on exploring the restorative effects of exposure to nature using immersive VR. Valtchanov, Barton and Ellard (2010) believe that the restorative properties of nature may be captured using computer-generated nature (i.e., the artistic interpretation of nature versus photographs or videos of real nature) which can then be used within VR to create restorative experiences. This notion is supported by research done by Villani and Riva (2008) which has found that immersive 3-D video (which coincidentally contained computer-generated nature) can aid recovery in a stress management protocol. Furthermore, research by Villani et al. (Villani, Riva, & Riva, 2007; Villani, Luchetta, Preziosa, & Riva 2009) and Freeman, Lessiter, Keogh, Bond & Chapman (2004) that suggest VR may be used to aid relaxation also used computer-generated nature environments. Lastly, Valtchanov et al. (2010) investigated whether computer-generated virtual nature had restorative effects, and found that exploring a virtual forest promoted reductions in physiological stress, and an improvement in emotional state when compared to viewing abstract paintings. While this research supports the idea that computer-generated nature may possess some of the properties of real nature to produce restoration, it does not definitively answer the question of whether it is the nature scenery or the immersive VR experience that is responsible for the observed restora-

tive effects. Such is the case partially due to the lack of controlled comparison groups. As acknowledged by Valtchanov et al. (2010) it is currently unclear whether the restoration produced by virtual nature shares a mechanism with restoration produced by real nature, or whether VR in general may provide an "escape" from one's current mindset and situation, resulting in psychological distance from stressors and thus restoration.

The goal of the present study was to build on the previous research by Valtchanov et al. (2010). Using improved methodology and measures, this study aspired to test the effects of a variety of virtual environments on physiological stress, ability to sustain attention, and affect. One environment was a virtual nature environment, another was a virtual urban environment modelled after the Shibuya area in Tokyo Japan, and the last was a geometric virtual environment featuring only regular geometric shapes (such as cubes, cylinders, spheres, etc.). Similar measures to Valtchanov et al. (2010) were used in order to examine whether the previously reported restorative effects of virtual nature settings could be reproduced using a more complicated and realistic nature environment conforming to the current computing power. This was also done to compare physiological and affective reactions of participants to three distinctly different virtual environments to clarify whether VR provides an "escape" which may cause restoration, or whether it is virtual nature that has been responsible for the restoration observed in previous literature (Freeman et al., 2004; Villani, Riva & Riva, 2007; Villani & Riva, 2008; Villani et al., 2009; Valtchanov et al., 2010).

Natural and urban environment types were used in order to mirror previous literature on restorative effects in real world studies (Ulrich, 1981; Ulrich et al., 1991; Sheets & Manzer, 1991; Berman et al., 2008) which have compared exposure to natural environments to urban ones. The geometric environment was developed as a third comparison in order to examine the question of whether nature environments are neutral and urban environments stressful, or if nature environments are restorative and urban environments neutral (Valtchanov et al, 2010). The current study aimed to address this question because much of the literature on restorative effects of nature has only compared natural versus urban environments, creating an ambiguity as to whether nature is restorative or neutral since urban settings could be either neutral or stressful.

Furthermore, the geometric environment was developed to help test both the Attention Restoration Theory (ART) as proposed by Kaplan (1995; 2001) and the "affective response" theory proposed by Ulrich et al., (1981; 1991) since both theories suggest contradictory outcomes when participants are exposed to such an "abstract" environment. Kaplan's ART would suggest that such an environment would be restorative since it lacks elements that demand attentional resources (such as advertisements, loud noises, etc), while still containing a new and fascinating experience (i.e., VR) to modestly capture attention, allowing directed attention to disengage and recover. Meanwhile, according to Ulrich et al.'s theory, since the environment is similar to an urban setting in its geometric focus, and contains visual patterns that are not found in nature, it should be viewed as threatening and promote stress and deterioration of affect. Lastly, the current study also aimed to examine whether virtual nature could promote an improvement in ability to focus, similar to that reported by Berman et al. (2008) when participants were immersed in real nature.

We predicted that there would be a similar pattern of results to that observed in research using real nature, such that the virtual nature environment would promote stronger improvements in physiological, affective, and cognitive states than the urban and geometric environments as shown by a decrease in skin conductance level, reduced heart rate, higher positive affect and lower negative affect scores on the Zuckerman Inventory of Personal Reactions (ZIPERS), and fewer errors on the Sustained Attention to Response Task (SART). We also predicted that the urban virtual environment would be more stressful than the geometric environment since the urban virtual environment contained features that may cause stress (such as advertisements, various colored lights, and high levels of various types of noise), potentially elevating physiological stress and having a negative impact on affect and sustained attention. Lastly, we predicted that immersion in the geometric environment would have no effect on all measures (relative to pre-immersion), since both major theories on restoration predicted results going in opposite direction (cancelling each other out) and the environment contained neither threatening stimuli, nor anything resembling nature (aside from colors). Thus it was used as the neutral control group.

Method

Participants

Prior to recruitment, participants were prescreened using a mass testing questionnaire. Participants were required to speak and read English fluently (in order to understand in-

structions), to not have experienced seizures, vertigo, or motion sickness prior to the study (to reduce risk of simulator sickness during the study), and to have reported that they have corrected-to-normal or normal vision. Participants were also prescreened using the Witmer and Singer (1998) Immersive Tendencies Questionnaire (ITQ). A random sample of 69 undergraduate students (32 male and 37 female), ages 18 to 26, who scored within one standard deviation of the mean on the ITQ were recruited to participate in the study in exchange for course credit. Participants were randomly assigned to one of the three conditions (nature, geometric or urban). There were 11 males and 13 females (24 total) in the nature condition, 10 males and 12 females (22 total) in the geometric condition, and 11 males and 12 females (23 total) in the urban condition.

Design

Measures of physiological, affective and cognitive states were taken at the start of the experiment (baseline), post stress induction, and post immersion in VR. Each participant served as his or her own control on the repeated measures. The VR experience required participants to explore one of the three virtual environments, either the nature setting, the environment full of geometric shapes, or the urban setting. Procedures and measures were identical between all three conditions. The only difference between conditions was the virtual environment participants explored.

Measures

Restorative effects were measured in three different ways (self-report questionnaire, physiological recordings, and behavioural task) in similar fashion to our previous work (Valtchanov et al., 2010). ZIPERS (Zuckerman, 1977) was used to measure positive and negative affect in accordance with previous research by Ulrich et al. (1981;1991) and Valtchanov et al. (2010). Measures of physiological stress consisting of skin conductance level and heart rate were used as they have been in previous research (de Kort et al., 2006; Villani et al., 2009; Valtchanov et al., 2010). To measure "cognitive fatigue" SART was employed, which has been shown to be a sensitive behavioural measure of sustained attention (Cheyne, Solman, Carrier, & Smilek, 2009) and has previously been used to test individuals suffering from stress (Van Der Linden, Keijers, Eling, & Van Schaijk, 2005). Individuals suffering from (chronic) stress have been shown to have trouble using executive attention to inhibit the automatized response in the SART (Van Der Linden, et al., (2005).

ZIPERS (Zuckerman, 1977) was adapted from previous experiments exploring restorative effects of nature both in the real world and within VR which have found it to be a reliable measure of restoration (Ulrich, 1981; Ulrich et al., 1991; Hartig et al., 1991; Valtchanov et al., 2010). ZIPERS includes 12 items that measure positive affect (happiness, friendliness, playfulness, and affection), negative affect (anger, sadness, and avoidance) and attentiveness on a 5-point Likert scale. Two more items were incorporated at the end of the questionnaire to measure self-reported stress. The two items were added at the end of the scale to prevent responses on them from influencing responses on any of the original scale items that preceded them.

Both skin conductance level (SCL) and heart rate (HR) were continuously recorded by a computer from the beginning to the end of the experiment and were used as a measure of physiological stress. Measurements were recorded using the ADInstruments PowerLab Data Acquisition System and accompanying LabChart software. Both SCL and HR were recorded using a sampling rate of 100 Hz. SCL was recorded using two fingertip electrodes attached to the index and middle fingers of the participant's non-dominant hand. SCL is viewed as a measure of sympathetic nervous system activity (Dawson, Schell & Filion, 2007; Valtchanov et al., 2010). Increases in sympathetic nervous system activity have been associated with increases in activation of epidermal tissue and sweat glands, which results in secretion of sweat and an increase in skin conductivity (Dawson, Schell & Filion, 2007; Valtchanov et al., 2010). The tonic skin conductance component (SCL) was used instead of the phasic component (skin conductance response: SCR) since SCL has been previously used in research on restorative effects of nature (de Kort et al., 2006; Valtchanov et al., 2010) and is associated with tonic states of sympathetic nervous system arousal (e.g., stress) Dawson et al., 2007; Valtchanov et al., 2010). HR was recorded using an infrared fingertip sensor placed on the ring finger of the participants' non-dominant hand, and served as a secondary measure of physiological stress. Both SCL and HR sensors and wires were secured to the participants' hand using Velcro straps to prevent sensors from moving during the experiment.

The third measure of restoration used was SART. SART is a powerful behavioral measure of sustained attention that gives insight into some of the states of sustained attention (Robertson et al., 1997; Manly et al., 1999, Cheyne et al., 2009). SART features a rapid display of randomized

numbers from 1 to 9. During SART, participants are instructed to press the "space" key on a keyboard every time they see a number that is not the target, and are told to withhold their response (i.e., refrain from pressing the "space" key) when the target (#3) appears onscreen. This produces an automatized behavior of pressing the "space" key since eight out of nine responses require the key to be pressed. Attention must be sustained in order to prevent pressing the "space" key when the target randomly appears. The main two measurements that emerge from the task are the number of inhibition errors, where participants have failures of sustained attention and fail to use executive control to inhibit the automatized behaviour of pressing the "space key," and response time. Both inhibition errors and response time have been associated with sustained attention (Robertson et al., 1997; Manly et al., 1999, Cheyne et al., 2009).

Lastly, simulator sickness was measured using the Simulator Sickness Questionnaire developed by Kennedy et al. (1993) which measures sickness induced by simulators (such as VR) using three subscales (nausea, oculomotor, disorientation). The questionnaire asks participants to rate the levels of various symptoms (nausea, blurred vision, eyestrain, etc) that they may be experiencing on a scale from "none" to "severe." Simulator sickness was measured in order to determine if measures of affect, sustained attention, and stress were being confounded by the simulator sickness that sometimes results from immersion in VR (Kennedy et al., 1993; Valtchanov et al., 2010).

Technical Information about Virtual Environments and Virtual Reality Setup

Both the virtual nature environment and virtual urban environment were constructed using a combination of the CryEngine 2 software developer's kit, the Crysis level creator, and Google Sketchup modelling software. The geometric virtual environment was constructed using a combination of Google Sketchup and the Worldviz VR software, Vizard. All three environments were built to be of similar size and to allow a similar amount of exploration on a grid of 3 km2. The overall layout of all three environments was kept as consistent as possible while retaining the uniqueness of each type of virtual environment. The nature island contained two waterfalls (with accompanying rivers flowing toward the ocean), various kinds of palm trees and types of broad-leaved trees, grass, rocks, varied flower bushes and plants, and a long stretch of beach by the ocean. Dirt path networks were clear and easy to follow throughout the island. Ambient nature sounds (such as the ocean, rivers flowing, etc.) were also present in the environment. The environment also featured simulated wind and realistic physics, creating a gentle sway of the tree branches and ripples/waves in the water. It should be noted that participants did not physically feel any wind or breeze inside the climate controlled lab room. The environment itself featured photorealistic graphics rendered in real-time using the CryEngine 2. This included (but was not limited to) things such as high dynamic range (HDR) lighting, high resolution textures, and highly detailed foliage (that included the rendering of individual leaves, blades of grass, and flowers).

The geometric setting was created using an assortment of 3-D geometric shapes including spheres, cylinders, cones, and rectangular and square boxes of various sizes. Shapes were colored using the color palette found within the nature environment (i.e., with a heavy focus on greens, blues, and browns) in order to help control the potential effects of color on affect. The geometric environment did not feature any sounds apart from the individuals' virtual footsteps since it was an empty environment (apart from the shapes themselves).

The urban environment was a model (to scale) of the area surrounding Shibuya station in Tokyo, Japan. A hypothetical urban environment was not created since the environment was intended to capture modern design and architecture accurately. Shibuya was chosen as the urban environment because it is a dense urban center that participants were unfamiliar with. It featured full-scale buildings, streets, sidewalks with photorealistic HDR ambient lighting, and advertisements. All buildings, signs and objects were made using realistic textures taken from photographs of the actual location in Japan. Ambient city sound was also present, giving the impression that people were present but very far away. However, no actual 3-D models of people were present and there were no moving vehicles on the streets. The three environments (nature, geometric, and urban) can be seen in Figure 1.

The three virtual environments were rendered using CryEngine 2, a platform available to individuals who have purchased the PC game Crysis. Environments were rendered using a consumer-grade gaming PC with a 2.4 GHz quad-core processor, 4 GB of ram and two AMD ATI 3870x2 video cards at 1280x1024 pixels per eye with photorealistic shadows and lighting. The rendered scene was then piped in stereo to an nVIS head-mounted display (HMD) that featured a 65-degree field of view. The HMD

also featured a thick light blocking cover which prevented participants from seeing the real world environment around them, allowing them to better focus on the virtual environment.

The viewpoint was controlled by an InterSense InertiaCube2 head-tracking device which was attached to the HMD, allowing the viewpoint to update in real-time with physical head movements (i.e., if a participant turned their head toward the right, the viewpoint in VR would update and look toward the right.) Self-locomotion through the virtual environments was achieved through the use of a wireless mouse calibrated to move participants' "virtual bodies" forward and backward with the left and right click respectively. The direction of movement corresponded to the orientation of their head in the physical world. Participants were instructed to orient their body to the direction of movement in order to reduce the mismatch between their physical and virtual bodies.

Procedure

Participants were randomly assigned to one of the three conditions (nature, geometric, or urban). An identical procedure was followed for all three conditions with the exception of the type of virtual environment (nature, geometric, or urban) participants were exposed to. Each participant was met in a central meeting area by appointment and was then escorted to a lab setting where he or she participated in the experiment. Participants were given a cover story stating that the purpose of the experiment was to examine the performance of stress and VR on their performance on SART.

At the start of the experiment, participants were seated at a desk in front of a computer monitor with a keyboard and mouse, and were hooked up to SCL and HR sensors on their non-dominant hand in order to measure physiological stress levels. Participants wore the SCL and HR sensors on their non-dominant hand throughout the entire experiment and were asked to keep the hand stationary on the desk while they filled out questionnaires (in order to prevent measurement noise and movement artifacts). In order to acclimatize participants to the equipment prior to obtaining measurements, participants wore the SCL and HR sensors for 5 min while sitting at the desk during which the experiment protocol was explained. They were then asked to fill out ZIPERS on the computer using the keyboard and their dominant hand in order to establish a baseline for self-reported affective state (on levels of positive affect, negative affect, ability to focus and stress) during which a SCL and HR baseline was established for 2 min. SART was then administered on the computer for 5 min in order to establish baseline performance and ability to sustain attention.

Participants were then given a 10 min stress induction task on the computer consisting of a modified version of the Markus & Peters Arithmetic Test (previously found to be effective at stress induction by de Kort et al. (2006)). During the task, participants were asked to use mental arithmetic to solve difficult multi-step multiplication questions (e.g., 56 x 37 + 17) within a time limit (a 60 sec timer was present for each question). While solving the questions, participants wore stereo headphones that played loud street traffic noises meant to distract them and make the task more difficult and frustrating. Participants were also given feedback after every incorrect response to induce further stress. A homogenized stress induction was used to induce stress in participants within the controlled lab setting in order bring participants to a similar level of stress and negative affect prior to immersion in VR. This was done so that the effectiveness of each virtual environment, in helping participants to recover from a similar level of stress, could be measured, and between-group comparisons could be made.

After the stress induction, SART was administered again for 5 min to measure if participants' ability to sustain attention had changed from baseline. After administration of SART, participants filled out ZIPERS for 2 min once again while SCL and HR data was collected. The SCL and HR data file was marked with the start and finish of the 2 min interval. ZIPERS scores and SCL and HR data was collected post stress and at the administration of SART in order to have an accurate measure of participants' physiological and affective states just prior to exploring VR.

After participants finished filling out ZIPERS, they were fitted with a HMD (with motion tracking) immersing them in one of the three virtual environments (nature, geometric, or urban) seen in Figure 1, based on random assignment. Participants were given 10 min to freely explore the virtual environment, with their only goal being to find objects or locations which they found pleasant or interesting.

After the 10 min VR session was finished, participants were once again given ZIPERS for 2 min to measure the effects of the virtual environments on their emotional state while SCL and HR were once again collected and recorded. Finally, SART was administered for 5 min for

Figure 1. Screen captures of the three virtual environments with the nature environment on the left, the geometric environment in the middle and the urban environment on the right. The nature environment featured a photorealistic nature island that was fully explorable and was surrounded by an ocean. The geometric setting featured solid colored geometric shapes comprised of boxes, cones and cylinders. Lastly, the urban environment featured a photorealistic recreation of the area around Shibuya Station in Japan. All three environments were rendered using the CryEngine 2 and featured photorealistic graphics and high dynamic range (HDR) lighting.

the final time to measure any changes in ability to sustain attention resulting from immersion in VR.

Results

Reliability Analysis of ZIPERS

To simplify data analysis, the questions measuring happiness, friendliness, affection, and playfulness were grouped under the broad category of "positive affect." These items were found to have an acceptable Cronbach's alpha of 0.88. Similarly, the questions measuring fear, anger, and sadness were grouped into the broad category of "negative affect." These items were also found to have an acceptable Cronbach's alpha of 0.81.

Stress Manipulation Check

To confirm that the stress induction was successful and that participants were stressed and experiencing a negative emotional state prior to their VR experience such that restoration could take place, baseline scores on ZIPERS, SCL, and HR levels obtained prior to stress induction and post stress induction were compared using a set of mixed-model repeated measures ANOVAs. As a result of the stress induction, participants reported feeling significantly lower positive affect ($M = 2.3$, $SD = 0.73$) than at baseline ($M = 2.8$, $SD = 0.70$), $F(1,68) = 32.90$, $p < 0.001$, $MSE = 0.234$, $\eta_p^2 = 0.326$. Participants also reported a significant increase in negative affect ($M = 1.65$, $SD = 0.73$) compared to baseline ($M = 1.29$, $SD = 0.42$), $F(1,68) = 18.90$, $p < 0.001$, $MSE = 0.228$, $\eta_p^2 = 0.217$, significantly higher feelings of stress ($M = 3.85$, $SD = 0.96$) compared to baseline ($M = 2.97$, $SD = 1.2$), $F(1,68) = 37.78$, $p < 0.001$, $MSE = 0.714$, $\eta_p^2 = 0.357$, and significantly lower attentiveness ($M = 2.7$, $SD = 1.11$) compared to baseline ($M = 3.28$, $SD = 0.89$), $F(1,68) = 12.39$, $p < 0.001$, $MSE = 0.889$, $\eta_p^2 = 0.154$. Physiological measures converged with the self-report of feeling stressed. As seen in Table 1, SCL increased significantly $F(1,68) > 100$, $p < 0.001$, $MSE = 0.621$, $\eta_p^2 = 0.796$, and HR trended increase, $F(1,68) = 2.771$, $p = 0.10$, $MSE = 39.577$, $\eta_p^2 = 0.039$. These results suggest that the stress induction was successful at inducing negative mood, and both self-reported and physiological stress.

A one-way ANOVA was used to compare group mean scores post stress induction to test if the stress induction prompted all three groups to experience a similar level of stress and affect. As expected, no significant differences in positive affect scores were found between the nature ($M = 2.208$, $SD = 0.714$), urban ($M = 2.400$, $SD = 0.826$) and geometric ($M = 2.391$, $SD = 0.670$) groups, $F(2,66) = 0.505$, $p = 0.61$, n.s., $MSE = 0.544$, $\eta^2 = 0.015$. No significant differences in negative affect scores were found between the nature ($M = 1.883$, $SD = 0.854$), urban ($M = 1.555$, $SD = 0.611$) and geometric ($M = 1.504$, $SD = 0.655$) groups, $F(2,66) = 1.932$, $p = 0.15$, n.s., $MSE = 0.516$, $\eta^2 = 0.055$. No significant differences in self-reported attentiveness scores were found between the nature ($M = 2.625$, $SD = 1.173$), urban ($M = 2.682$, $SD = 1.086$) and geometric ($M = 2.826$, $SD = 1.114$) groups, $F(2,66) = 0.197$. $p = 0.821$, n.s., $MSE = 1.268$, $\eta^2 = 0.006$. Also, there were no significant differences in self-reported stress between the nature ($M = 3.833$, $SD = 1.167$), urban ($M = 3.955$, $SD = 0.950$) and geometric ($M = 3.783$, $SD = 0.736$) groups, $F(2,66) = 0.186$, $p = 0.83$, n.s., $MSE = 0.942$, $\eta^2 = 0.006$. As seen in Table 1, there were also no significant differences between the nature, urban, and geometric groups post stress induction (prior to VR immersion) in SCL, $F(2,66) = 2.034$, $p = 0.14$, n.s., $MSE = 1.205$, $\eta^2 = 0.058$, or in HR, $F(2,66) = 1.552$, $p = 0.22$, n.s., $MSE = 139.859$, $\eta^2 = 0.045$. These results confirm that after the stress induction, all three groups were experiencing a similar level of stress and affect and that there were no significant differences in affect or stress between groups.
However, the stress induction failed to induce cognitive fatigue and lapses in sustained attention, since there was no significant change in SART inhibitory errors, $F(1,68) = 0.072$, $p = 0.789$, n.s., $MSE = 3.599$, $\eta_p^2 = 0.001$, or SART response time, $F(1,68) = 1.085$, $p = 0.301$, n.s., $MSE = 1281.444$, $\eta_p^2 = 0.016$. This suggests that participants' ability to sustain attention remained at baseline despite elevated levels of stress and negative affect.

Effects of VR on ZIPERS Scores

Scores on the Simulator Sickness Questionnaire (SSQ) were used to check if participants were experiencing any simulator sickness which may have influenced scores. Participants reported feeling "none" (1) to "slight" (2) simulator sickness on a scale from 1 to 4 (M=1.645, SD = 0.456), thus simulator sickness was not believed to be a confound. To examine the effects of immersion into VR on participants' self-reported affect, ZIPERS scores obtained just prior to immersion into VR (but post stress induction) were compared to scores obtained immediately after immersion into VR, using a set of mixed-model repeated measures ANOVAs with time (prior to VR, post VR) as the repeated measure and condition (nature, urban, geometric environments) as the between variable.

A significant time by condition interaction on the positive affect dependent variable was found, $F(2,66) = 9.676$, $p < 0.001$, $MSE = 0.328$, $\eta p2 = 0.227$, suggesting that the three virtual environments had different effects on positive affect. To test for simple effects, the data was split by condition, and repeated measures ANOVAs were done. The analysis revealed that the nature virtual environment caused positive affect to increase significantly from a mean of 2.21 (SD = 0.71) prior to VR to a mean of 3.03 (SD = 0.98) post VR, $F(1,23) = 14.304$, $p < 0.001$, $MSE = 0.571$, $\eta p2 = 0.383$. Meanwhile the geometric virtual environment had no effect (M = 2.39, SD = 0.67 prior to VR to M = 2.27, SD = 0.94 post VR), $F(1,22) = 0.776$, $p = 0.388$, n.s., $MSE = 0.220$ $\eta p2 = 0.034$, and the urban environment had no effect (M = 2.40, SD = 0.83 prior to VR to M = 2.38, SD = 0.74 post VR), $F(1,21) = 0.021$, $p = 0.887$, n.s., $MSE = 0.175$, $\eta p2 = 0.001$. The means and standard error bars for each of the conditions can be seen in Figure 2.

A significant time by condition interaction on the negative affect dependent variable was also found, $F(2,66) = 6.140$, $p < 0.005$,

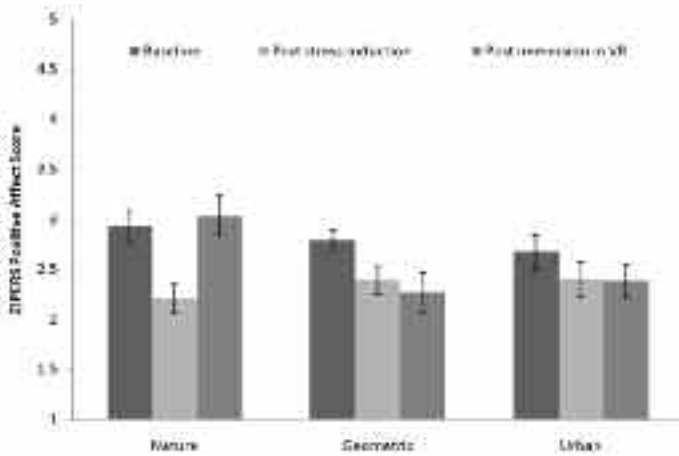

Figure 2. Mean positive affect scores (with standard error bars) on the Zuckerman Inventory of Personal Reactions Scale (ZIPERS) per condition at baseline, post stress induction, and then post immersion in VR. Here it can be seen that positive affect decreased in all three groups as a result of the stress induction (as seen by comparing the first and second bars in each set), and only improved when participants explored a virtual nature environment (seen by comparing the second and third bars in each set).

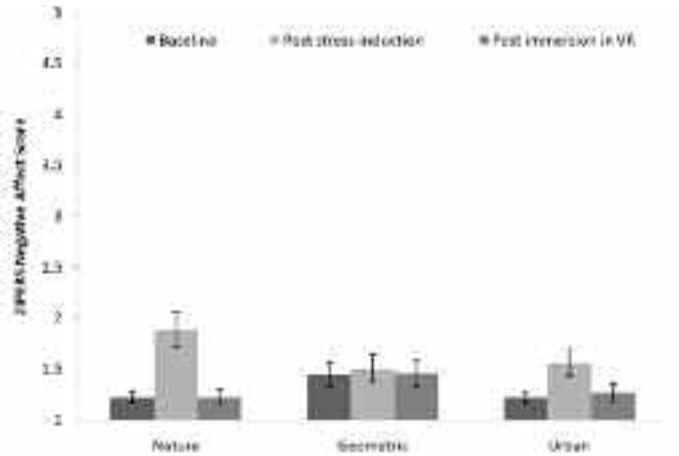

Figure 3. Mean negative affect scores (with standard error bars) on ZIPERS per condition at baseline, post stress induction, and then post immersion in VR. Here it can be seen that there was a potential floor effect since all scores were close to the bottom of the scale throughout the experiment.

MSE = 0.180, η_p^2 = 0.157, suggesting that the virtual environments had different effects on participants' level of negative affect. To test for simple effects, the data was split by condition and repeated measures ANOVAs were used. The analysis revealed that the nature virtual environment caused negative affect to decrease significantly from a mean of 1.88 (SD = 0.85) prior to VR, to a mean of 1.22 (SD = 0.35) post VR, $F(1,23) = 17.750$, $p < 0.001$, MSE = 0.293, η_p^2 = 0.436. The geometric environment had no effect (M = 1.50, SD = 0.65 prior to VR to M = 1.45, SD = 0.62 post VR), $F(1,22) = 0.268$, $p = 0.610$, n.s., MSE = 0.117, η_p^2 = 0.012, while the urban environment caused a significant decrease in negative affect from a mean of 1.55 (SD = 0.61) prior to VR, to a mean of 1.27 (SD = 0.41) post VR, $F(1,21) = 7.205$, $p = 0.014$, MSE = 0.121, η_p^2 = 0.255. The means and standard error bars for each of the conditions can be seen in Figure 3, where it also appears that there might be a floor effect since scores are near the lower end of the scale.

A significant time by condition interaction on self-reported stress was found, $F(2,66) = 12.763$, $p < 0.001$, MSE = 0.918, η_p^2 = 0.113, converging with previous measures and suggesting that the three virtual environments had different effects on perceived stress levels. Simple effects analysis using repeated measures ANOVAs revealed that self-reported stress decreased significantly from a mean of 3.83 (SD = 1.17) to a mean of 2.63 (SD = 1.35) as a result of being immersed in the nature environment, $F(1,23) = 12.219$, $p < 0.005$, MSE = 1.434, η_p^2 = 0.347, but did not change significantly as a result of being immersed in the geometric environment (M = 3.78, SD = 0.74 prior to VR to M = 3.70, SD = 1.11 post VR), $F(1,22) = 0.193$, $p = 0.665$, n.s., MSE = 0.451, η_p^2 = 0.009, or the urban environment (M = 3.95, SD = 0.95 prior to VR to 3.50, SD = 0.96 post VR), $F(1,21) = 2.692$, $p = 0.116$, n.s., MSE = 0.844, η_p^2 = 0.114. The

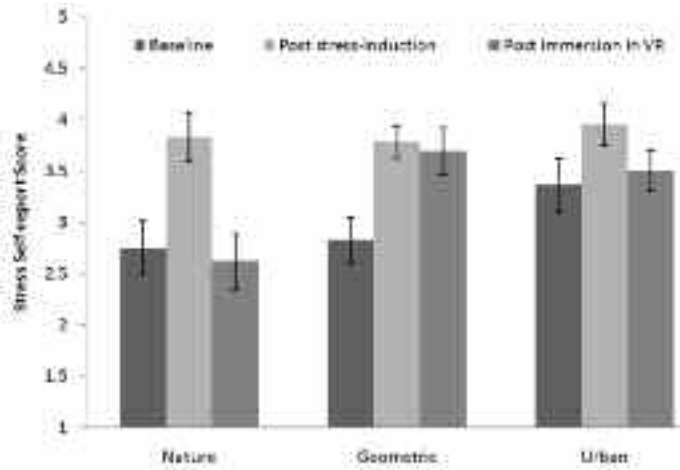

Figure 4. Mean stress self-report scores on a 1 to 5 scale with standard error bars. Here it can be seen that the stress induction was successful in bringing participants in all three conditions to the same level of stress prior to immersion in VR (middle bar), confirming that participants were similarly stressed between conditions before exploring VR. Here it can also be seen that participants who explored the nature virtual environment had the greatest decrease in stress (seen by comparing the second and third bars in each set).

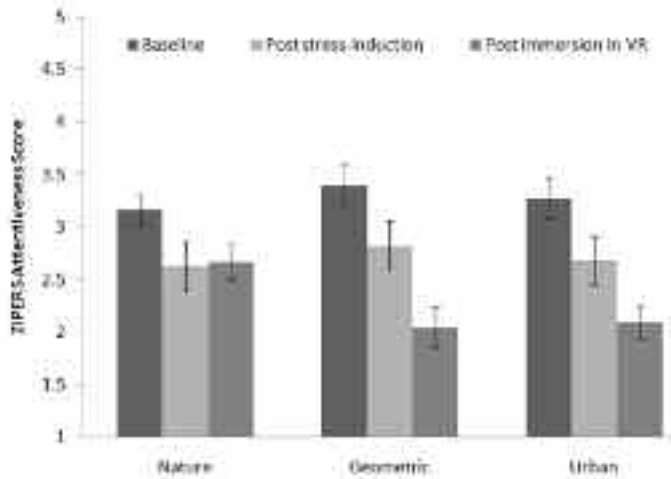

Figure 5. Mean attentiveness score (with error bars) on ZIPERS per condition at baseline, post stress induction, and then post immersion in VR. Here it can be seen (by comparing the first and second bars in each set) that self-reported attentiveness decreased in all three conditions as a result of the stress induction. It can also be seen (by comparing the second and third bars in each set) that attentiveness stopped declining after participants explored the nature environment, but not when they explored either the geometric or urban environments.

Table 1
Means and Standard Deviations of Physiological Measures

Physiological measure	Condition	Baseline	Post-stress induction	Post VR immersion
Heart rate	Nature	M=82.91 SD=12.92	M=86.16 SD=11.46	M=78.22 SD=13.42
	Geometric	M=81.77 SD=14.57	M=82.40 SD=11.33	M=76.97 SD=10.12
	Urban	M=78.67 SD=12.66	M=80.08 SD=12.70	M=76.78 SD=12.39
Skin conductance level change from baseline (z-score)	Nature	-	M=2.50 SD=0.98	M=1.76 SD=1.14
	Geometric	-	M=1.86 SD=0.95	M=2.02 SD=1.40
	Urban	-	M=2.15 SD=1.33	M=2.26 SD=1.37

means and standard error bars for each of the conditions can be seen in Figure 4.

Lastly, a significant time by condition interaction on the self-reported attentiveness dependent variable was also found, $F(2,66) = 3.436$, $p < 0.05$, $MSE = 0.638$, $\eta p2 = 0.094$. Simple effects were once again tested using repeated measures ANOVAs. The analysis revealed that self-reported attentiveness (i.e., ability to focus) did not change as a result of immersion in the virtual nature environment ($M = 2.63$, $SD = 1.17$ prior to VR to $M = 2.67$, $SD = 0.87$ post VR), $F(1,23) = 0.038$, $p = 0.846$, $MSE = 0.543$, $\eta p2 = 0.002$, but decreased significantly from a mean of 2.83 ($SD = 1.11$) to a mean of 2.04 ($SD = 0.93$) as a result of being in the geometric virtual environment, $F(1,22) = 11.960$, $p < 0.005$, $MSE = 0.589$, $\eta p2 = 0.352$. Self-reported attentiveness also decreases significantly from a mean of 2.68 ($SD = 1.09$) to a mean of (2.09, $SD = 0.75$) as a result of being in the urban virtual environment, $F(1,21) = 4.842$, $MSE = 0.793$, $\eta p2 = 0.187$. This data can be seen in Figure 5.

Statistical Analysis of the SCL and HR Measures

Both SCL and HR were recorded continuously throughout the experiment. The data file was marked with the start and finish of each ZIPERS questionnaire that was administered (i.e., at baseline, post stress induction, and post VR immersion). SCL and HR were averaged over the 2 min intervals during which ZIPERS was administered so that the congruent physiological (stress) state could be captured and potential movement artifacts could be diminished. This ensured that physiological measures were temporally linked with self-report measures, measuring the physiological state of participants as they were reflecting and filling out the self-report.

For the purpose of analysis, skin conductance measurements were converted into z-scores to standardize SCL responses between participants, so that between-subject comparisons could be made. This was required in order to prevent bias in the dataset due to "high-responding" individuals whose changes in SCL magnitudes were up to 10 times the average. Skin conductance was measured relative to a baseline established at the start of the experiment. The equipment was zeroed at this baseline. Similarly to the analysis of the self-report data above, measurements prior to immersion in VR were compared to measurements post VR immersion using a mixed-model repeated measures ANOVA. A significant time by condition interaction was found on the dependent variable of SCL, $F(2,66) = 7.166$, $p < 0.005$, $MSE = 0.424$, $\eta p2 = 0.178$, suggesting that the three virtual environments had different effects on participants' stress levels. Simple effects analyses were done by splitting the data by condition and performing repeated measures ANOVAs. The analyses revealed that (as seen in Table 1) SCL decreased significantly as a result of immersion in the nature environment, $F(1,23) = 11.625$, $p < 0.005$, $MSE = 0.577$, $\eta p2 = 0.336$, but did not change as a result of immersion in the geometric environment, $F(1,22) = 0.617$, $p = 0.441$, n.s., $MSE = 0.426$, $\eta p2 = 0.027$, or in the urban environment, $F(1,21) = 0.557$, $p = 0.464$, n.s., $MSE = 0.254$, $\eta p2 = 0.026$, converging with

the self-report stress measure. Means and standard deviations can be seen in Table 1.

HR was also analyzed using a mixed-model repeated measures ANOVA. The analysis revealed a trending time by condition interaction on the dependent variable of HR, $F(2,66) = 2.997$, $p = 0.057$, $MSE = 20.704$, $\eta p2 = 0.083$. Simple effects analyses revealed that HR decreased significantly as a result of immersion in the nature environment, $F(1,23) = 25.842$, $p < 0.001$, $MSE = 29.242$, $\eta p2 = 0.529$, the geometric environment, $F(1,22) = 34.714$, $MSE = 9.754$, $p < 0.001$, $\eta p2 = 0.612$, and the urban environment, $F(1,21) = 5.242$, $p < 0.05$, $MSE = 22.824$, $\eta p2 = 0.200$, suggesting that HR decreased significantly regardless of the virtual environment as seen in Table 1.
Statistical analysis of the SART measure

A set of mixed-model repeated measures ANOVAs were used to analyze the rate of inhibition errors and response time on SART prior to immersion in VR (post stress induction) and post immersion in VR. The analyses revealed no significant or trending interactions of time by condition on the dependent variable of inhibitory error rate, $F(2,66) = 1.607$, $p = 0.176$, n.s., $MSE = 3.470$, $\eta p2 = 0.024$, or the dependent variable of reaction time, $F(2,66) = 0.203$, $p = 0.817$, n.s., $MSE = 1182.581$, $\eta p2 = 0.006$. This supports the notion that participants were performing at baseline since the stress induction failed to induce cognitive fatigue, thus no restoration could occur.

Discussion

In the current study, a variety of measures of restorative effects were used, including a standardized self-report questionnaire measuring affect, perceived attentiveness and stress, physiological measures of SCL (stress) and HR, and a behavioral measure of sustained attention (SART) in order to thoroughly document the effects of three unique VR environments on affect, stress, and attention. In doing so, the current study was able to produce similar restorative effects to those reported by Valtchanov et al. (2010) when immersing participants in virtual nature, while also addressing several other important questions: Is it possible to determine whether it was the nature within VR, or VR itself that was responsible for reductions in stress and improvement in affect? The study also allowed determining whether the commonly used urban comparison group (Ulrich, 1981; Ulrich et al., 1991; Sheets & Manzer, 1991; Berman et al., 2008) was neutral or stressful in terms of eliciting an affective and physiological response.

Firstly, the current study found converging evidence from several measures that supported our hypothesis that computer-generated nature stimuli produce restoration when participants are immersed in VR. Immersion in the virtual nature setting prompted an increase in positive affect (happiness, friendliness, affection, and playfulness), and a decrease in negative affect (fear, anger, sadness) as seen in Figures 2 and 3. Furthermore, a significant self-reported decrease in levels of perceived stress (seen in Figure 5) converged with the significant decrease in levels of physiological stress (as measured by SCL). These results are consistent with findings by Valtchanov et al. (2010) who have previously reported that virtual nature can have restorative properties on affect and physiological stress, as well as research by de Kort et al. (2006) and van den Berg et al. (2003) which suggests that surrogate nature (such as photographs and videos) can have similar restorative effects.

Secondly, it becomes much more apparent that it is virtual nature that is responsible for the observed restoration and not VR itself when the group that was immersed in the virtual nature setting is compared to the group immersed in the geometric setting, and the group immersed in the urban setting. All participants underwent an identical protocol with the exception of the virtual environment they explored. All three virtual environments were equally large and afforded similar exploration paths, while providing appropriate cues (e.g. being able to hear the water near the ocean, or being able to hear the subway near the subway station). All three environments also had a similar level of interactivity (i.e., participants could explore freely and look at whatever they wanted). Despite the similarity of the VR experiences and identical protocol, only those who were immersed in virtual nature experienced a significant and consistent improvement of affect and reductions in stress across all measures, while those immersed in the geometric and urban environments displayed either no improvement or ambiguous improvement (as shown by reductions in HR in the absence of decreases in SCL and self-reported stress). These findings support our predictions and suggest that the content of the VR experience, specifically the presence of nature, and not the VR experience itself is likely responsible for the observed restoration. This notion is supported by the previously documented restorative properties of exposure to nature (Berman et al., 2008; Kweon et al., 2008, Valtchanov et al., 2010).

When exploring whether urban settings were stressful (as predicted) or neutral, we were able to come to a context-

specific conclusion. The results of the current study suggest that in the absence of threatening stimuli (such as moving cars, cyclists, and other pedestrians) that are normally present in an urban setting, (requiring individuals to be vigilant to avoid collisions or other threats,) virtual urban settings may reduce negative affect (anger, sadness, and fear), but do not improve positive affect or reduce stress. We believe this to be a characteristic of benign urban virtual settings since a similar effect was not present in the group that explored the geometric virtual environment. The geometric virtual environment proved consistently to have no effect on stress and affect (as predicted) and was thus used as the neutral comparison. The promotion of decreases in negative affect by urban settings in the absence of other changes may have been the result of the environment distracting individuals from their awareness of their negative emotions. In doing so, it could have influenced perceived affect (measured by the self-report) without influencing physiological state. This was not seen in the geometric environment since the urban environment may have been more "attention grabbing" (given that it contained many different advertisements while the geometric environment only contained solid colored shapes). However, this cannot be said for certain as it was not directly measured. It should be noted that the effects observed in this study were all in the context of virtual environments that lacked threatening stimuli. It is likely that the restorative effects of nature would disappear if the nature environment was filled with threatening stimuli (such as dangerous animals). Another important note is that the previous study by Valtchanov et al. (2010) and the current study both used nature settings with lush vegetation (trees, flowers, bushes). It is possible that the restorative effects of virtual nature may be restricted to natural settings containing dense vegetation. Further research is needed to clarify if other types of nature environments (e.g., rocky terrain, mountains, snow-covered landscapes, grassy fields) can also promote restoration. For example, Heerwagen and Orians (1992) suggest that our ancestors evolved to prefer habitats that offered access to food, water, and shelter from predators and the elements, which increased their chances of survival. Heerwagen and Orians further suggest that properties of good habitats became associated with positive emotional states during the evolutionary process. Thus, it is possible that various types of natural environments that have the characteristics of a "good habitat" may promote positive emotional states, and even restoration.

The unpredicted decrease in negative affect due to exposure to the urban setting, and the predicted and observed neutrality of geometric environment, present a conundrum that neither Kaplan's ART (Kaplan, 1995; Kaplan, 2001), nor Ulrich et al.'s (1981;1991) theories can fully explain. In the case of the decrease of negative affect after exposure to the urban virtual setting, ART cannot provide consistent explanation – since the environment did not contain threatening stimuli that demanded attention (such as moving vehicles), it could be argued that directed attention mechanisms were situated in a setting where disengagement was relatively easy. Once participants learned that there were no threats within the environment, recovery from a negative emotional state ensued. However, all participants were explicitly told that there were no threats within the virtual environment and that harm within the virtual world was impossible, so such an explanation seems inaccurate. Similarly, it could also be argued that participants habituated to the (potentially) "attention demanding" advertisements partway through their exploration, which then allowed directed attention mechanisms to disengage and recover. This explanation also seems inaccurate since the geometric environment, which was similar in structural features to the urban environment but did not contain any of the advertisements, did not show the effect. Ulrich et al.'s theory also fails to explain the observed pattern of results for the urban and geometric environments. In the current study, participants had an affective response to the stimulus (the urban environment) but did not exhibit a congruent physiological response as Ulrich et al.'s theory predicts. Furthermore, the observed affective and physiological responses are the reverse of the theoretical projections. Since both environments did not contain any nature stimuli, Ulrich et al.'s theory predicts that they would be perceived as threatening and would increase stress and cause a deterioration of affect. However, neither of the environments elicited a change in self-reported or measured physiological stress, and negative affect decreased due to exposure to the urban environment.

Given the presented data, several criticisms can be made about both ART as proposed by Kaplan (1995;2001) and Ulrich et al.'s (1981;1991) "affective response" theory. First and foremost, ART is ambiguous about what it means for a stimulus to modestly capture or demand attention, which makes it difficult to test empirically. However, despite this ambiguity, the theory still fails to encompass the results of the current study, predicting contradictory results to those observed. Similarly, Ulrich et al.'s (1981;1991) evolutionarily based "affective response" theory also fails

to predict the results observed in the current study. The presented data not only (partially) discredits both theories, but also demonstrates that a new theory is required to explain the effects on affect and stress that the three virtual environments promoted. From a technical perspective, all three VR experiences were identical with the exception of the visual and auditory information presented, yet participants had significantly different responses to the three virtual environments. While the visual and aural information can be identified as the cause of the differences in affect and stress elicited between the nature and urban environments, it cannot fully explain why there were only minor or insignificant differences between participants exposed to the urban and geometric environments. The urban environment contained visual and auditory stimuli (advertisements, sounds of crowds and vehicles in the distance, etc.) which restoration theories predict to be stressful, yet this environment was no more stressful than the geometric environment. The similarity between the effects of the geometric and urban environments on stress and affect suggests that the stimuli responsible for nature's restorative properties may be nested in the structural properties of the visual as opposed to auditory information. In support, it can be argued that the visual properties of the urban and geometric environments were similar, but quite distinct from the nature environment. For example, a cityscape is merely a composite of regular geometric shapes (cubes, spheres, cones, cylinders, etc.) once color and texture are removed from the visual information. Coincidentally, the geometric environment used in this experiment matches such a description (but includes colors seen within nature, which eliminates color as a potential stimulus for restoration). Meanwhile, once texture and color are removed from the nature environment, discrete geometric shapes are absent.

Thus, it is plausible that the structural information of the visual stimuli (such as the pattern of shapes, which can be further decomposed into spatial frequencies) may hold the key to discovering what makes natural patterns restorative. Such a notion is supported by examining the early work of Ulrich (1981), and later work by Kweon et al. (2008) which demonstrated that viewing photographs of nature promotes improved psychophysical states when compared to viewing photographs of urban settings or abstract posters. In these scenarios, only the visual information differed, yet nature images consistently promoted more restoration despite being photographs of different nature settings, such as water, grass, trees, and mountains (thus containing different visual information). Given this pattern, or lack thereof, one can begin to see that the major difference between nature and urban stimuli is the difference in their structural and geometric properties. Urban settings can be consistently described in terms of regular geometric shapes, while nature scenes contain significantly more complex structural properties that lack a discrete geometric definition. Given this, it is certainly feasible that on a lower perceptual level, different neural networks are activated by nature versus urban stimuli, resulting in an automatic psychophysiological response.

Unfortunately, the current study did not offer converging evidence for the effects of VR on the ability to sustain attention, since the stress induction manipulation in the current study failed to exhaust the cognitive resources of participants such that performance on SART would deteriorate. Participants were performing at baseline levels on SART before, and after stress induction, and after immersion in VR. However, it is interesting to note that while there were no changes in SART performance, participants who explored the nature environment reported no perceived deterioration of attentiveness, whereas those who explored the geometric and urban environments subjectively reported a significant decrease in perceived attentiveness. While interesting, this finding is not supported by the behavioral data from SART (i.e., if participants were truly less attentive, they should have made more errors on SART). It is possible that SART was not sensitive enough to measure the deterioration, but it is also possible that participants subjectively perceived deterioration of attention. A correction for further research would be to extend the stress induction to 20 or 30 min to properly induce cognitive fatigue.

Implications for Future Research and Conclusion

The current study provides evidence that computer-generated nature can be used to reduce both perceived and physiological levels of stress, as well as improving positive affect (happiness, friendliness, playfulness) and reducing negative affect (fear, anger, and sadness). In demonstrating that virtual nature has the power to promote restoration (compared to other virtual urban scenes) we propose that some of the benefits of exposure to nature (specifically reductions in stress and improvement of affect), can be harnessed using technology and brought into the global urban culture that has pushed many individuals into densely populated urban centers, away from nature. Future research aimed at stress management and clinical uses of VR to improve quality of life should focus on exploring ways to use nature stimuli to augment treatments.

Since the current study was able to generate an effective restorative environment using a consumer-grade computer and toolkits available to the general public, we believe that researchers should begin to directly target therapeutic solutions that can be brought to the general consumer market. Raw computing power and software have become relatively inexpensive in the last decade, and with the rapid advances in technology in the field of 3-D televisions, computer monitors, projectors and screens, and consumer-grade head-mounted displays, the general consumer market is at the brink of bringing VR into their living room. Thus, we encourage further research into how these technologies can be used to bring better mental health into the homes of the general public. Lastly, research aimed at exploring "why" nature stimuli promote restorative effects in individuals should focus on examining the structural properties of nature versus urban and abstract stimuli, as these may hold the key to discerning the qualities of nature stimuli that make them restorative.

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THE EFFECTIVENESS OF 3-D VIDEO VIRTUAL REALITY FOR THE TREATMENT OF FEAR OF PUBLIC SPEAKING

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Virtual reality (VR) has been utilized in conjunction with cognitive behavioural therapy (CBT) to decrease symptoms for people with specific phobias or anxiety disorders. Many studies investigating VR have employed complicated head-mounted displays with intricate software. This study investigates the effectiveness of presenting a 3-D video of a virtual audience to participants who experience the fear of public speaking. The VR environment was presented with a cost effective, standard CRT television using polarized shutter glasses. Results indicate that skin conductance and heart rate measures increased, which suggests that the VR 3-D video is effective in eliciting a fear response. Also, a decrease in anxiety and a decrease in negative self beliefs about public speaking ability suggest that VR 3-D video can provide an effective treatment. Future studies may combine this user-friendly technology with a therapeutic element, such as CBT, to treat anxiety disorders successfully and more cost effectively.

Keywords: Virtual Reality, CBT, Anxiety, Social Phobia, Fear of Public Speaking

Introduction

Social phobia is the third most common anxiety disorder (Hofmann et al., 2006) in which "exposure to social or performance situations almost invariably provokes an immediate anxiety response" (American Psychiatric Association, 2000). Social phobia can present itself in general situations in which a person fears all social situations, or in particular areas, in which a person fears specific situations such as performing in front of an audience, eating in public, or writing in front of others. The onset of social phobia generally ranges from the ages of 15 to 20, with the difference between genders being approximately equal (males – 11%; females – 15%) (Kessler, Stein, & Berglund, 1998).

People with social phobia experience physiological sensations and cognitive distortions. These may include difficulty breathing, pounding and racing heartbeat, shaking hands, mild to intense sweating, and blushing (Kessler, Stein, & Berglund, 1998). Cognitive distortions are evident in socially anxious people as social situations are unrealistically perceived as dangerous. The individual misjudges the reactions of others which contribute to underestimating their own ability to function, and overestimating the threatening nature of the situation (Clark & McManus, 2002). To avoid the bodily sensations and negative self-perception accompanied by faulty cognitions, people with social phobia will evade most or all social situations. This consistent avoidant behavior may lead to complications such as alcoholism, depression, and suicide (Davidson, et al., 2004; Kessler, Stein, & Berglund, 1998), and if not treated can be unremitting (Pollack, 1999).

People with social phobia reportedly have difficulty making social networks, and indicated the disorder interfered with their ability to generate close relationships. Some individuals noted an interference with their school performance (Tillfors & Furmark, 2007; Stein & Keen, 2000; Stein, Walker, & Forde, 1996) which may inevitably lead to early dropout due to the demands of academic presentations. Although treatable, few individuals seek out ther-

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apy because of their inability to confront their high levels of anxiety (Schneier, Johnson, Honig, Liebowitz & Weissman, 1992) as well as empirically validated treatment programs being time-consuming and economically costly (Barlow, Levitt, & Bufka, 1999).

A common treatment for social phobia is cognitive behaviour therapy (CBT). This treatment can consist of exposure therapy in which the individual is exposed to anxiety-provoking social situations (Spiegler & Guevremont, 2003). Exposure therapy can be conducted in two ways: 1) brief/graduated exposure therapy; or 2) prolonged/intense exposure therapy. Brief/graduated exposure therapy consists of exposing the client to the anxiety-provoking stimulus or situation, incrementally, for a few seconds to a few minutes. The exposure commences with one aspect of the situation or stimulus that produces a low level of anxiety, and then progresses to higher level anxiety-provoking situations. Subjective Units of Distress (SUDS) are measured by a 1 to 10 scale (or 1 to 100) and are utilized to describe the level of anxiety experienced by the participant, 1 being no anxiety, and 10 suggesting the highest level of anxiety. Participants rate their anxiety in the presence of the anxiety-provoking situation, and when the SUDS level is reduced to a manageable level, such as 3 or 4, the next higher anxiety level situation is introduced. This cycle is repeated until the participant is able to experience a low SUDS level at the highest anxiety-provoking situation.

Prolonged/intense exposure therapy consists of exposing the participant to the anxiety-evoking situation/stimulus for a longer period of time, such as 10 to 15 min, or more than an hour if necessary. In intense exposure, the participant is immediately exposed to the highest anxiety-provoking situation. Both treatments can be accomplished through either in vivo (real life) or imagining social situations as directed by a therapist or the treatment may be self managed. As stated earlier, conducting in vivo sessions can be time-consuming for the therapist and also induces higher dropout rates due to the inability of clients to manage the high anxiety-provoking situations (Butler, 1985). Imagining is also time costly and may require many sessions to be effective (Riva, Vincelli, & Molinari, 2002). By placing the two modalities on a continuum, in vivo on one end and imagining on the other, the utilization of Virtual Reality (VR) for exposure therapy would be closer to the in vivo end of the spectrum. VR has been determined to be an effective modality to produce anxiety-provoking situations in a "safe" environment (Spiegler & Guvremont, 2003).

VR is currently being utilized as an effective treatment for many phobias such as arachnophobia – the fear of spiders (Gacia-Palacios, Hoffman, & Carlin 2002), aviophobia – the fear of flying (North, North, & Coble, 1997; Botella, Villa, Garcia-Palacios, Quero, & Banos, 2004), and acrophobia – the fear of heights (Emmelkamp, Krijn, & Hulsbosch, 2002). VR has also been developed to stimulate combat scenarios to aid soldiers with PTSD (Reger & Gahm, 2008). VR has the capacity to recreate an anxiety-provoking situation and yet maintains a level of "safety" that is not always attainable through in vivo situations, thereby keeping the dropout rate lower. Fear of Public Speaking (FOP) is a prevalent form of social phobia that has also been determined to be treated effectively by VR (Wallach, Safir, & Bar-Zvi, 2009).

Anderson, Ziman, Hodges, and Rothbaum (2005) investigated the utilization of VR in conjunction with CBT for the reduction of anxiety associated with FOP. Participants received eight treatments, with the first four comprising of the anxiety management training. This included cognitive restructuring and breathing exercises. The last four sessions consisted of the participants being exposed to a virtual audience through a head-mounted display. The participants were presented a virtual podium and a virtual closed curtain. The curtain opened exposing either five people at a table or 22 in an auditorium. The audience was manipulated by the therapist by changing their reactions to the speaker, such as expressing boredom, showing interest, or applauding. The participants were then instructed to give a provided speech to the virtual audience with the therapist/researcher encouraging the participant through the exposure via a microphone. Each participant was administered three self-reported measures: 1) Personal Report of Confidence as a Speaker (Paul, 1966); 2) Personal Report of Communication Apprehension (McCroskey, 1978); and 3) Self-Statements During Public Speaking (Hofmann & DiBartolo, 2000). The results indicated a reduction in self-reported anxiety posttreatment which was maintained in a three month follow-up.

Harris, Kemmerling, and North (2002) also studied the effects of VR on FOP utilizing a head-mounted display with a head tracker for four sessions. The participants from an introductory public speaking class were recruited based on their PRCS scores (greater than 16). Each session consisted of 12-15 min of exposure to a virtual auditorium, with the first session consisting of exposure to an empty room. In sessions 2-4, the therapist controlled the virtual environment by adding people to the auditorium while

monitoring heart rates and SUDS ratings. The participants were also instructed to give a 2 min speech during these sessions. In the third session, the therapist manipulated the reactions of the audience by having them ask the participant to speak louder or by having them laughing among themselves. The results also indicated a reduction in anxiety as indicated by physiological measures and self-reported questionnaires.

In prior studies, the VR equipment utilized was bulky, expensive, and required a clinician to be available to fit the head-mounted display and/or deliver CBT. This technique proved to be expensive and time-consuming. The current study investigated the effectiveness of VR on public speaking anxiety utilizing less expensive equipment. Participants viewed a 3-D movie of "real," not animated, people sitting in a classroom setting. This study utilized a CRT television and polarized glasses to produce the 3-D effect, which proved to be less bulky and more cost effective than previous studies using the larger head-mounted display with a head tracker. Also, this method of presentation did not require a specialized technician or clinician to be present.

Participants were randomly recruited from the Psyc1000 pool, and unlike the Harris, Kemmerling, and North (2002) study, were not recruited from a public speaking class. The virtual audience was consistent throughout all four sessions to which the participants gave a "prepared speech" without the aid of a therapist. The sessions were 8.5 min long and participants stood behind a podium while addressing the virtual audience during which time skin conductance and heart rate measures were taken. Questionnaires were also administered before the first session and after the fourth session. It was predicted that the VR 3-D video would elicit a fear response which would be indicated by an increase in skin conductance and heart rate. Also, measures of state, anxiety and fear of public speaking would decrease.

Method

In this experiment, 150 participants were recruited from the Psyc 1000 pool from the University of New Brunswick. The participants completed a Personal Report of Confidence as a Speaker (PRCS) (Paul,1966) which consists of 30 statements that are rated as true or false about their experience with public speaking. Participants with a score greater than 21 out of 30 were invited to continue with the experimental portion of the research. Of this group, 20 participants (16 females and four males) volunteered for the experiment and were randomly assigned to either a Wait List (WL) group or a Virtual Reality (VR) group. Of the 10 participants for the WL group, six completed the experiment and four dropped out. Of the 10 participants for the VR group, one did not complete the last testing session.

The WL group participated in two sessions. During each session, the participants completed the following self-reports: 1) State-Trait Anxiety Inventory (STAI); 2) Social Phobia and Anxiety Inventory (SPAI); and 3) Self Statements During Public Speaking (SSPS). Each session was approximately four weeks apart.

The participants in the VR group participated in four sessions:

Session 1 and 4

A) Participants completed the following self-reports: 1) State-Trait Anxiety Inventory (STAI); 2) Social Phobia and Anxiety Inventory (SPAI); and 3) Self Statements During Public Speaking (SSPS).

B) Participants were exposed to a virtual audience through the use of shutter glasses and a 32 in CRT television. Participants stood behind a podium in front of the television wearing the shutter glasses for 8.5 min. For the first 2 min, the virtual audience talked among themselves, disregarding the speaker (participant). After 2 min, the virtual audience began paying attention to the speaker and the participants were instructed to read from the children's book Green Eggs and Ham for a 2 min period. Skin conductance and heart rate were recorded before exposure to the virtual audience, and at the end of the session. Skin conductance was monitored using a UFI model 2701 Bioderm Skin Conductance meter with which electrodes were attached to the skin on the hand and connected to a small portable data management box. These sessions took approximately 1 hr.

Session 2 and 3

- For sessions 2 and 3, only part B was conducted.

Scenario

The scenario consisted of a small group of people sitting in a classroom setting. Initially, the group talked among each other and after approximately 2 min turned towards the camera (the front of the room) as if waiting for the lecture to start. During the reading of the text, members of the group coughed, rustled paper, and eventually a new member joined the group. This new member also left the

group by standing up and waking off camera. In remaining minutes, the group watched the speaker as if a lecture was actually occurring.

Measures

Personal Report of Confidence as a Speaker (PRCS)

Developed by Paul (1966) as a shortened version of Gilkinson's (1942) original assessment of fear of public speaking. Its ability to assess cognitive features of public speaking anxiety is limited by its true/false design.

State-Trait Anxiety Inventory (STAI)

A self-report questionnaire developed by Spielberger, Gorusch, & Lushene27 that assess general trait and current state anxiety.

Social Phobia and Anxiety Inventory (SPAI)

A self-report instrument that assesses specific cognitions, somatic symptoms, and behaviors across a range of potentially fear-producing situations to measure social anxiety and fear. It is useful when distinguishing between agoraphobia, panic disorder, and social phobia.

Self Statements During Public Speaking (SSPS)

Developed by Hofmann & DiBartolo (2000), consists of five positive and five negative statements involving speech-related thoughts. It is limited in number of items to assess a full range of cognitions associated with public speaking anxiety.

Results

Skin conductance measurements, pretreatment and posttreatment, are presented in Table 1. The results indicate that there was a main effect for skin conductance measurements pretreatment versus posttreatment ($F(1,40) = 5.23$, $p < .05$). Skin conductance increased after performing the VR public speaking task. There was no main effect of session on skin conductance measurements. Heart rate measurements pretreatment and posttreatment are presented in Table 2. The results show that there was a main effect for heart rate pretreatment versus posttreatment ($F(1, 40) = 8.20$, $p < .05$). Heart rate increased after exposure to the virtual audience. There was no main effect for session on heart rate measurements. These consistent physiological findings indicate that the 3-D video environment was effective in eliciting a fear response.

A dependent t-test was used to compare the pretreatment and posttreatment scores for the SPAI, STAI, and SSPS inventories as indicated in Table 3. STAI state anxiety significantly decreased from pretreatment to posttreatment ($t(10) = 3.18$, $p < .05$) as the participants became more

Table 1
Mean measurements at pre and posttreatment for skin conductance.

Session	Pre	Post
Session #1	7.6+3.52	9.8+5.50
Session #2	6.6+3.21	7.01+4.13
Session #3	7.86+2.77	9.09+6.36
Session #4	8.05+3.66	10.26+8.03

Table 2
Mean measurements at pre and posttreatment for heart rate.

Session	Pre	Post
Session #1	87.91+14.40	93.00+12.30
Session #2	91.36+17.80	98.18+14.83
Session #3	96.09+15.46	96.73+11.90
Session #4	86.45+10.60	91.18+9.28

Table 3
Mean scores at pre and posttreatment for self-reported anxiety inventories.

Inventory	Pre	Post
SPAI	106.09+22.72	95.82+23.14
STAI - state	39.36+8.76	33.73+10.73*
STAI - trait	40.10+8.35	41.20+9.81
STAI - pos	10.45+3.86	11.55+3.42
STAI - neg	14.55+4.18	12.27+6.25*

*$p < 0.05$

comfortable with the public speaking task. Also, SSPS Negative decreased pretreatment to posttreatment ($t(10) = 2.313$, $p < .05$) indicating a change in the participants' own perception about public speaking. The results did not indicate any change in SPAI, STAI trait anxiety or SSPS Positive.

There were no significant differences in the control group with the exception of the SPSS test. The mean scores were significantly higher for the positive statements towards public speaking for the second session ($t(11) = -2.75$, $p < 0.05$).

Discussion

The intent of this study was to determine if a more cost efficient method of delivering VR would be effective for the treatment of fear of public speaking. During the investigation, a key finding emerged. The results indicated that the presentation of a VR audience using 3-D video and polarized shutter glasses does produce a physiological fear response in participants. Both the heart rate and skin conductance measures increased significantly during the course of the presentation of the virtual audience within each session. The increase in physiological measures suggests that the exposure to a virtual audience, utilizing a less sophisticated system, can produce the sensation of "being" in front of an audience. Therefore, the low cost, user-friendly equipment may be employed in conjunction with CBT to decrease anxiety for people with the fear of public speaking.

The results also suggest a fear response was elicited when introducing the same scenario for each session. Unlike other studies in which different environments were introduced to maintain a novelty effect, or that allowed participants to move within the environment (Klinger et al 2005; Harris, Kemmerling, & North, 2002; Wallach, Safir, & Bar-Zvi, 2009), this study elicited a response by presenting the same scenario for each session. The environment also consisted of real life actors as opposed to avatars or animated situations with real people inserted (Klinger et al., 2005). This also lowers the cost of production, as a scenario is filmed as opposed to being constructed by a computer technician with special training in 3-D animation.

The participants' self-reports support the notion that this form of VR is effective for treating public speaking anxiety. The STAI state measurements indicate that the participants' level of anxiety decreased after four VR sessions. Also, a decrease in the SSPS Negative indicates that the participants' negative beliefs about their ability to speak in public decreased.

The next step in this research is to combine technology with a therapeutic component such as CBT. Klinger et al. (2005) determined VR to be an effective treatment when combined with CBT during specific sections of the exposure. Giving the participants instructions on how to reduce their anxiety before exposure, along with performing relaxation exercises prior to each session, may increase the effectiveness of the VR treatment. The fact that the study presented here did not utilize a CBT component could be seen as a limitation.

Future studies will also include a more in depth examination of the heart rate responses throughout the session itself. The available technology allows the heart rate information to be extracted from the monitoring system and be assessed to a larger degree (Cornwell, Johnson, Berardi, & Grillon, 2006). This will allow for a greater understanding of the exact nature and timing of the anxiety as experienced by the participant, thereby anticipating the best time for an intervention to be introduced.

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ONLINE COUNSELING FOR EATING DISORDERS - AN ESTABLISHED SERVICE COMPLEMENTING TRADITIONAL SETTINGS

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Online counseling has gained more recognition in many areas of general and specialized health care. The German ab-server was established in 1998 and offers a highly professional anonymous online counseling service for people suffering from, or wanting to learn about, eating disorders (ED). The aim of the following analysis was to represent an actual user characteristic.

Methods: 1,055 inquiries sent to online counsellors of the ab-server by individuals affected by ED and their relatives were evaluated. The inquiries were received between December 2007 and December 2008 and all inquiries were analysed both qualitatively and quantitatively.

Results: The symptom descriptions given by persons suffering from an ED mostly referred to bulimia nervosa (BN) (44%); inquiries sent in by relatives of affected persons also mostly referred to BN (42%). Conclusions: The easy access to a professional counseling service online has made it accepted by individuals suffering from ED and their relatives.

Keywords: Online Counseling, Eating Disorder, Relatives, Internet, Text Analysis

Introduction

With the Internet having brought about the most sustainable change in information-related behavior since the invention of the letter press, it also made extensive information on almost all medical disorders and mental illnesses available. Internet-based information on aspects such as health advice and medical information is consistently sought by up to 40% of Internet users (Khorrami, 2002). Besides the availability of descriptive, statistical, objective, and also subjective information, the Internet also offers other forms of Internet-based interventions with Internet counseling being one of the crucial aspects (Grunwald & Busse, 2003; Grunwald & Wesemann, 2006a; Grunwald & Wesemann, 2006b; Grunwald & Wesemann, 2007; Wesemann & Grunwald 2008; Wesemann, Grunwald & Grunwald, 2009; Young, 2005). Other forms of intervention are made up of virtual realities (Perpiná, Botella, Banos, Marco, Alcaniz & Quero, 1999; Choi, Jang, Ku, Shin, Kim, 2001), self-help-groups (Cavaglion, 2008) and online therapy (Griffiths, 2005). In Germany, online counseling services focusing on a plethora of psychosocial challenges are available to Internet users. These services were mainly established as primary and secondary prevention measures (Domsch & Lohaus, 2009; Gerö & Zehetner, 2009). There are various specialized programs of online counseling regarding a certain disease or problem area (Nock 2006; Kostenwein & Weidinger, 2006; Brunner, 2005), aftercare (Kordy, Golkaramnay, Wolf, Haug & Bauer, 2006) or for relatives of affected patients (Musiat, Grover & Schmidt, 2008).

As the Internet allows (1) anonymity in communication, (2) rapid information exchange, (3) independence of time and place for the communicating individuals, and (4) low

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costs for keeping up with communication (Döring, 2003), online counseling is attractive for (1) people who prefer to give written reports of their problems instead of verbally confiding in a professional, (2) people unable to afford counseling or therapy, (3) people experiencing difficulties in accessing counseling or therapy due to living in remote areas, (4) people preferring to keep a certain distance in a counseling relationship, (5) people with physical disabilities encountering difficulties when travelling, and (6) people who prefer initial contact with a therapist to be non-binding (Eichenberg, 2003; Grunwald & Busse, 2003; Grunwald & Wesemann, 2006a, Wesemann & Grunwald, 2008).

The eating disorders anorexia nervosa and bulimia nervosa are severe mental illnesses with serious consequences. They remain chronic illnesses with high mortality rates. For most people suffering from an ED, the course of their illness will actually become chronic with, especially for AN, the highest mortality rate amongst the psychiatric disorders (Jacobi, Paul & Thiel, 2004). Whereas patients affected by AN tend to view their eating behavior as an accomplishment, patients suffering from BN are rather ashamed of their illness. As a consequence of these attitudes, both groups show limited motivation to change or seek professional help (Jacobi, Paul & Thiel, 2004; Zwaan de & Müller, 2005). Therefore, these types of ED are particularly well-addressed and accessible with online counseling (Zabinski, Pung, Widfley, Eppstein, Winzelberg, Celio, Taylor, 2001) as the target group is widely and regularly using the Internet (Yager, 2003; Zabinski, Celio, Jacobs, Manwaring & Wilfley, 2003). The acceptance for online counseling is high amongst sufferers of ED who use online means of communication as they feel they are far less exposed to comments on their appearance (Walstrom, 2000).

The "Information and Online Counseling Service for AN and BN" (www.ab-server.de) was the first specialized online program for ED in Germany. The ab-server was founded in cooperation with the Deutsche Forschungsinitiative Essstörungen e.V. (DFE) [German Research Initiative for Eating Disorders], the Clinic of Psychiatry, University of Leipzig and the Rechenzentrum [Computer Centre], University of Leipzig. The DFE is a non-profit association supporting research and the spread of knowledge in the field of ED. In addition to providing general information on ED, contact details for self-help groups, counseling centers, clinics and therapists in Germany, visitors to www.ab-server.de can find ED research results as well as links to national and international Web sites on ED. Furthermore, Web site visitors can anonymously use the online counseling service of the ab-server at no charge. This counseling service is found to be used by those affected by ED, their relatives, friends and colleagues, as well as teachers and health professionals (Grunwald & Busse, 2003; Grunwald & Wesemann, 2006b; Grunwald & Wesemann, 2007). The written inquiries are sent to the ab-server via SSL code. The counselors working for the ab-server are exclusively psychologists with master degrees and psychotherapeutic qualifications, as well as longstanding experiences with the care and management of ED.

The main goal of online counseling is to provide the person seeking advice with an awareness of problems related to eating disorders. Counselors provide information on subjects such as symptoms, manifestations, and therapy for the disease in response to the corresponding inquiries. Responses from the counselors do not contain a diagnosis and online counseling is not to be conceptualized as a long-term process. The online counselors respond to the different inquiries within two or three days at most. Responses are reviewed by another psychologist before they are sent back to the inquiring individual. In addition to this internal quality control, the ab-server receives scientific advice and is evaluated by Prognos AG (Basel/Switzerland). Furthermore, wide concomitant research has been pursued for a length of time, e.g. analysis of answers from online counselors (Fritsch, 2009), prior analysis of user characteristics and content of inquiries and continuous participant satisfaction survey. The last analysis (Grunwald & Wesemann, 2007) of user characteristics and content of incoming inquiries was conducted on 2,176 inquiries. More than half of the inquirers were females with a self-proclaimed ED (55.3%). The majority of inquiries were related to bulimic symptoms (63.1%), whereas 12.9% of the inquiries were related to anorexic symptoms. More than 30% of the inquiring persons asked the online counseling team for behavioral advice in connection with their own illness or the affected person (Grunwald & Wesemann, 2007). Results showed that the majority of the users (affected and relatives/friends) evaluated the service of the ab-server positively. Moreover, they reported that the counseling enhanced their understanding of ED and motivated the clients to seek further professional help (Grunwald & Wesemann, 2006a; Wesemann & Grunwald, 2008; Wesemann, Grunwald & Grunwald, 2009).

The goal of the following analysis was firstly, to describe different user groups. It also aimed to determine the specific questions and concerns of the inquirers, and gain insight into the clients' level of professional and therapeutic exposure prior to contacting the ab-server. Furthermore, we focused on the relatives' hardship related to caring for an individual affected by an ED.

Method

We evaluated 1,055 inquiries that were sent to the ab-server's counselors by 803 individuals affected by ED or socially related to an ED sufferer; repeated contact with the ab-server by the same individual was possible. The inquiries were written between December of 2007 and December of 2008. Individuals seeking information and help from the ab-server do not have to follow a standardized format when composing their inquiry. Therefore, individuals decide on the amount of personal details to disclose in their inquiries. Due to this fact and the self-descriptive aspects of most inquiries, their validity is limited.

The 1,055 inquiries were evaluated in two sequential work stages by the author (C.K.). Phase I consisted of a qualitative content analysis (Mayring, 2000) in order to identify and categorize users' specifics. The results of the qualitative analysis enabled the determination of a system of categories that encompasses all user-relevant aspects. The system's criteria exclusively stem from outcome of the inquiries' analysis. Data processing was carried out using the computer program MAXQDA (2007). This program was developed specifically for qualitative data analysis. Based on this analysis, the following categories were created:

A) *Group of individuals requesting support* (e.g. affected vs. relatives)

B) *Type of disease* (e.g. AN, BN, Obesity, Binge Eating Disorder - BED)

C) *Personal data of the affected* (e.g. age, gender, BMI, or migration background)

D) *Psychosocial situation of the affected person* (e.g. comorbidity, duration of the disease, medical complications related to ED, unspecific risk factors)

E) *Prior exposure to professional help/intervention* (e.g. no exposure, inpatient or outpatient treatment, semi-in-patient treatment)

F) Hardship experienced by people related to affected

G) *Content of inquiries* (e.g. wish for diagnosis, wish for information on treatment options, wish for facts on eating disorders, wish for contact details of clinics and therapists)

The qualitative content analysis of 45 randomly selected inquiries was carried out by a second rater, a certified psychologist. Inter-rater reliability of this sample resulted in a Cohen's Kappa of 0.83, on average. The qualitative analysis resulted in nominal data.

Phase II of the procedure consisted of quantitatively computing categories that were found. The combination of qualitative and quantitative analyses made it possible to compare the different user groups. The statistical data analysis was conducted using SPSS 14.0 for Windows. To determine whether there were any relationships between two categories the chi-square test was used. An alpha level of 0.05 was used for all statistical tests.

In this paper, we will focus on the results of the following main categories: *Group of individuals, Type of illness, Exposure to professional help, Hardship and Content of inquiries.* In this paper, we focus on the main results that the author described in her master thesis (Kündiger, 2009).

Results of the Study

Age

Almost 45% of the affected individuals revealed their current age in the inquiry, resulting in an average age of 25 years with a range of 13 to 58 years.

Duration of illness

In 347 of the analyzed cases, the inquiring individual revealed the duration since the onset of the illness, resulting in a mean duration of 76 months with a range of 1-456 months.

Group of Individuals Requiring Support

It was possible to classify three main groups. The first one consists of *people affected* by an eating disorder. From 803 inquirers, 565 (70%) disclosed their status as suffering from an ED, with the majority (n=432) being female. That means that 53.8% of the total inquiries came from affected adolescent girls and women. 4.1% of the suffering individuals were male (n= 23), and 15.5% of the inquiries (n=110) were written in a way that a gender determination was impossible.

The second main group consists of *individuals who are relatives or friends/partners of affected*. Twenty-seven and a half percent of the inquiries came from people belonging to the social network of affected individuals with the largest subgroup consisting of parents (n=77), followed by the subgroup of friends (n=50) and partners (n=51).

The third group was composed of *persons seeking general information for study-related purposes on ED* (n=6), professionals (n=5) and persons who disclosed too little information to place them in one of the existing categories (n=11). The descriptive results are shown in Table 1.

Type of ED

As the data is being collected in the form of self-description, the data's validity is limited. The type of ED to be leniently categorized with the given data as an exact categorization based on clinical standards was not possible.

Table 1
Group of individuals (whole sample, Anorexia nervosa, Bulimia nervosa)

Who asked?	Whole sample N	Whole sample %	Anorexia nervosa N	Anorexia nervosa %	Bulimia nervosa N	Bulimia nervosa %
Affected person	**565**	**70**	**127**	**59.4**	**235**	**71.2**
Female	432	53.8	102	47.7	191	57.9
Male	23	2.9	7	3.3	9	2.7
Unknown gender	110	13.7	18	8.4	35	10.6
Socially related	**216**	**26.9**	**83**	**38.8**	**92**	**27.8**
Mother	42	5.2	20	9.3	13	3.9
Father	13	1.6	6	2.8	4	1.2
Parents, unspecific	22	2.7	6	2.8	5	1.5
Sister	10	1.2	5	2.3	4	1.2
Brother	1	0.1	-	-	1	0.3
Sibling, unspecific	3	0.4	1	0.5	2	0.6
Cohabitants/marriage partners	**51**	**6.4**	**14**	**6.5**	**32**	**9.7**
Female	4	0.5	-	-	3	0.9
Male	40	5.0	12	5.6	25	7.6
Unknown gender	7	0.9	2	0.9	4	1.2
Daughter	4	0.5	-	-	2	0.6
Children, unknown gender	2	0.2	1	0.5	-	-
Friend	**50**	**6.2**	**18**	**8.4**	**25**	**7.6**
Female	35	4.4	13	6.1	17	5.2
Male	8	1.0	2	0.9	5	1.5
Unknown gender	7	0.9	3	1.4	3	0.9
Colleague from work/ Employer	8	1.0	5	2.3	2	0.6
Other	10	1.2	7	3.3	2	0.6
Socially not related	**22**	**2.7**	**4**	**1.9**	**3**	**0.9**
Interested person	6	0.7	-	-	2	0.6
Professional person	5	0.6	2	0.9	-	-
No information	11	1.4	2	0.9	1	0.3
Total	803	100	214	100	330	100

The majority of the incoming inquiries indeed matched criteria of certain forms of ED. More than a quarter of the inquiries (26.7%) could be placed in the category AN. The greatest percentage of the 803 inquirers fell into the category BN (41.1%). Some inquiries revealed too little information on the type of ED present (6.0%), other could be categorized as *binge eating disorder* BED (9.8%) or *obesity* (2.1%), respectively. In 82 inquiries (10.2%), a diagnostic *history of more than one form of ED* was mentioned. Some of the remaining inquiries were categorized as *children and ED (0.7%), other illnesses which could not be classified as any kind of eating disorder (1.4%)*, and in 2% of the inquiries no symptoms were described.

Exposure to professional help

On the basis of the exact indications given in the inquiries, it was possible to classify four subcategories in *exposure to professional help category – outpatient treatment, inpatient treatment, semi-inpatient care and no exposure*. Exposure to *outpatient treatment* includes the following aspects: *psychotherapy, nutrition and dietary counseling, medical care, information/counseling centers and self-help groups. Inpatient treatment care encompasses stays in psychiatric/psychosomatic hospitals/mother-child clinics, or rehabilitation centers, respectively. The semi-inpatient care consists of therapeutic stays in day clinics and therapist-led living programs.*

Examples: *Exposure to professional help*

- “I am scared to start therapy. I feel too powerless and even attending the day clinic is too exhausting.”

- “Sandra suffers from Bulimia, she has been seeing a dietician.”

- “I finally got a slot with a therapist two months ago. But I do not get on well with the therapist.”

In more than 60% of the 803 depicted cases, the affected persons had not turned to professional help before contacting the ab-server. In 28.0% of the inquiries, it was mentioned that the affected person had been exposed to at least one form of the classified help systems; 7.4% had turned to two forms of it. Only a few (0.5%) had established contact with all of the classified help systems. The majority of the affected persons who already had received professional help have turned to some kind of outpatient treatment (22.0%). The exact results are represented in tables 2 and 3.

Table 2
Exposure to professional help

Exposure to professional help	**Whole sample N**	**Whole sample %**	**Anorexia nervosa N**	**Anorexia nervosa %**	**Bulimia nervosa N**	**Bulimia nervosa %**
No experiences	515	64.13	128	59.8	216	65.5
Experiences with one help system	225	28.02	62	29.0	95	28.8
Experiences with two help systems	59	7.35	21	9.8	18	5.5
Experiences with all of the three help systems	4	0.5	3	1.4	1	0.3
Total	803	100	214	100	330	100

Content of inquiries

Nine categories were determined for the content analysis of inquiries.

A large number of inquirers (n= 197; 24.5%) asked for "*addresses of mental health professionals or institutions*." Of the 565 affected persons requesting help, 31.7% asked for "behavioral advice" on how to cope with their illness. 67.2% of the relatives/friends/partners of the affected solicited the need for behavioral advice on how to cope with the suffering person. Furthermore, the category *general information on ED* could be established. Questions about *epidemiology, aetiology, prognosis, complications, relapse risk and prevention*, as well as *interventions* fell into this category. More than 40% of the inquiring persons asked the online counselors for *general information on ED*. Table 4 show the content of inquiries with related frequencies in detail.

Table 3
Exposure to professional help

Help system*	**Whole sample N**	**Whole sample %**
In-patient treatment*	109	13.6
psychiatric/psychosomatic hospitals	101	12.6
mother-child clinic	1	0.1
rehabilitation centers	7	0.9
Out-patient treatment *	238	29.6
psychotherapy	165	20.5
nutrition counseling	14	1.7
medical care	67	8.3
information centers	11	1.4
self-help groups	6	0.7
other	8	1.0
Semi-inpatient*	8	1.0
day clinic	6	0.7
therapist-led living programs	2	0.2

* Multiple indications possible

Example: *Questions related to legal matters*

- "Can I be held in a clinic against my will?"

Examples: *Search for contact details*

- "Could you please recommend me a clinic in our federal state?
- "Could you please recommend a specialized clinic to me? Please help me!"

Examples: *Behavioral advice requested by affected*

- "Could you please tell me how to deal better with this?"
- "I am hoping that you will be able to help me with my problem."

Examples: *Behavioral advice requested by relatives*

- "How shall we react and what should we really not do or say?"
- "My question is the following: How can I help her?"

Examples: *Disease management*

- "I would like to go on the pill. Will it be effective if I take it between 7-8 p.m. and refrain from throwing up until 2pm the following day?"
- "Is it recommended to clean my teeth directly after having thrown up, or shall I wait for at least half an hour if not longer?"

Additionally, an analysis of differences in content regarding exposure to professional help was carried out. As the requirements for using the chi-square test were not fulfilled for every category of *content of inquiries*, the following categories were entered: *request for professional contact details, interventions, complications, prognosis, aetiology, behavioral advice as requested by an affected person, wish for a diagnostic evaluation and wish for communication with a professional*. People who wrote to the ab-server being in this last category wished to communicate with a mental health professional and felt a strong need to "share" their predicament. Often they commented on having an immediate benefit from expressing their emotions and thoughts.

Examples: *Questions about general information about ED, therapeutic interventions*

- "Hey folks, I am interested if and how hypnosis works for ED and what is the difference between Psychoanalysis

Table 4
Content of inquiries

Inquiry concerns…?*	Whole sample N	Whole sample %	No Experience N	No Experience %	With Experiences N	With Experiences %
Questions related to legal matters	72	9.0	37	7.2	35	12.2
Search for contact details (Addresses)	197	24.5	116	22.	81	28.1
Behavioral advice	339	42.2	219	42.5	120	41.7
requested by affected	179	22.3	112	21.7	67	23.3
requested by relatives	160	19.9	107	29.8	53	18.4
General information on ED *	333	41.5	200	24.9	133	16.6
e.g. epidemiology	2	0.2	0	-	2	0.7
aetiology	28	3.5	15	2.9	13	4.5
prognosis	55	6.8	33	6.4	22	7.6
complication	70	8.7	50	9.7	20	6.9
relapses	4	0.5	1	0.2	3	1.0
interventions	206	25.7	114	22.1	92	32.0
research findings/ literature	22	2.7	12	2.3	10	3.5
Eating behavior	91	11.3	66	12.8	25	8.7
Disease management	5	0.6	5	1.0	0	-
Wish for a diagnostic evaluation	110	13.7	80	15.5	3	10.4
Wish to communicate with a professional - "sharing"	46	5.7	22	4.3	24	8.3
Interpersonal problems	9	1.1	5	1.0	4	1.4
Specific questions	14	1.7	8	1.5	6	2.1

* Multiple indications possible

and training analysis. Does the therapist work differently? Is the experience different for the client? "
- "Can you please help me and provide me with information on different forms of therapy?"

Examples: *Question about general information about ED, aetiology*

- "It is possible that an eating disorder (refusing to eat) is caused by a virus even if there is no medical history?"
- "..and damn, WHY is it the way it is? I mean what causes it?"

Examples: *Question about general information about ED, prognosis*

- "I of course would like to get treated but how successful is a treatment going to be after such a long time?"
- "Will I ever live a normal life free of eating issues?"

Examples: *Wish to communicate with a professional - "sharing"*

- "…but you have already helped me by reading this. It feels good to get this all out."
- "I actually do not need any advice because I know that it is wrong…thanks for listening : ´- ("

Affected individuals who already had exposure to professional help asked significantly more often for information related to therapeutic interventions ($\chi 2$=3.872;

Table 5
Hardship (N=216)

Type of Hardship	N	%
Emotional hardship	61	28.2
Social hardship	11	5.1
Hardship due to unwanted behavioural change of the affected	2	0.9
Emotional and social hardships	23	10.6
Emotional hardship and hardship due to unwanted behavioral Change of the affected	5	2.3
Social hardship and hardship due to unwanted behavioural change of the affected	0	-
Emotional and social hardships as well as hardship due to unwanted behavioural change of the affected	2	0.9
Total	104	48.1

p=.049), and also wrote more often to the counseling team just to "share" their challenges with someone. This disparity was statistical not significant ($\chi 2$=3.391 p=.066).

Hardship

Almost half of the relatives (48.1%) who contacted the ab-server's counselors described their hardship having to care for an affected person. It was possible to differentiate between *social* and *emotional hardships* as well as *hardship based on the unwanted behavioral change of the affected*. The most frequent comments were on emotional hardship with 42.1% of the relatives describing their emotional hardship caused by a sick relative. A considerably smaller percentage could be assigned to social hardship (16.6%) and to *hardship due to unwanted behavioral change of the affected* (4.2%). Additional separate analysis was conducted on the different groups of relatives. Mainly male partners, both married and unmarried, highlighted *emotional* (42.5%), *social hardships* (30.0%) and those based on *unwanted behavioral change of the affected* (5.0%) that are brought about by their mostly female partners. In contrast to this, women did not state experiencing hardship caused by a partner or spouse with an eating disorder. The exact results are represented in table 5.

Examples: *Emotional hardship*

- "Visiting our child is more and more straining for both us and our child because of the extremely low moods."
- "Beside me being so frustrated and feeling desperate, I am also worried sick about my 3 year old granddaughter."
- "I worry about me not challenging her, I just watch and let it happen and she continues with the same old sick behavior. I think I reinforce her sick behavior by just watching and not helping her."

Examples: *Social hardship*

- "Of course, I already had fights about it with my wife. It is not good for our relationship and, therefore, I am now keeping quiet much more often. "
- "Everything could be great if we did not clash daily because of the eating."
- "When I try to talk to her about her eating behavior, she withdraws and sometimes does not speak to me for days. How can I reach out to her?"

Examples: *Hardship due to unwanted behavioural change of the affected*

"She has totally changed, this hurts me so much. Maybe that is my fault because I have regularly scolded her and shouted at her because I just could not cope with the situation."

Discussion

Prior to this analysis, it was found that the majority of the users of the ab-server were persons suffering from an ED. As expected, we could replicate this outcome. Of the 803 inquirers, 565 can be classified as having a self-declared ED.

According to the typical distribution of ED among the sexes (Hudson, Hiripi, Pope & Kessler, 2007), the largest group amongst the affected people was female. This ratio can also be found in other analyses of user characteristics

for online counseling (Kostenwein & Weidinger, 2006; Brummel, 2008). Additionally, Fittkau & Maaß (2005) have shown that in the domain of German-speaking Internet users, women are dominating. These findings and the gender differences in eating disorders explain the higher percentage of inquiries sent in by women. The proportion of males affected increased from 1.9% to 2.9% since the last analysis (Grunwald & Wesemann, 2007).

Other studies have also shown that the percentage of men who are frequenting online counseling offers is increasing (Gehrmann & Klenke, 2008). The determination of the nature of this increase is difficult. A contributing factor might be a higher awareness to the fact that there are males suffering from ED (Greenberg & Schoen, 2008). Another factor might be the fact that online counseling is becoming more widely accepted (Khorrami, 2002). The average age of the inquiring individuals suffering from an ED was 25 years and thus higher than in the previous analysis.

About 40% of all inquiries could be placed in the category of bulimic symptoms. In comparison to the results of the last study (63.1%) (Grunwald & Wesemann, 2007), the percentage of inquiries related to bulimic symptoms has now clearly decreased. An opposite trend was shown for AN and anorexic symptoms in general. In the analysis of Grunwald & Wesemann (2007), only 12.9% of the inquiries were found to be related to anorexic symptoms. Apparently, the ab-server is now more established as part of primary healthcare for German-speaking individuals who suffer from anorexic symptoms. A corresponding difference between these clinical pictures is found in prevalence studies (Hudson, et al., 2007). It was found that the online counseling service is mainly used by bulimic patients. This can be explained with their higher level of psychological strain (Krauß & Zwaan de, 2007) which is different from anorexic patients who would rather conceal their illness and often avoid professional help (Gerlinghoff & Backmund, 2006). The results do highlight that there is a need for online counseling for both bulimic and anorexic patients.

It also became evident that more than one in four people writing to the ab-server belonged to the group of relatives/friends of sufferers. It is known that the hardship relatives and friends of mentally ill patients are exposed to is manifold (Schmid, Spießl, Vukovich & Cording, 2003). However, this aspect had been excluded from previous examinations. The described hardship was categorized as emotional, social and unwanted behavioral change of the affected. As a large number of persons expressed their difficulties in coping with their eating disordered child, spouse, sibling, parent, or friend, we were able to conclude that there is a strong need for professional support for this particular group of people. The ab-server prides itself in offering a widely acceptable and satisfactory counseling option for the group of relatives/friends/partners of affected.

In the majority of the described cases, the written communication with the ab-server's counselors was the first contact with a mental health professional. Compared with the 206 analysis (Grunwald & Wesemann), the number of incoming inquiries written by individuals not having had any prior contact to mental health professionals has increased. It is thus extremely important that the online counselor's response is phrased in a very sensitive way in order to further encourage the inquiring person to seek professional help. Due to the above mentioned characteristics of online communication (Döring, 2003; Eichenberg, 2003), the ab-server is an ideal starting point for initial contact with mental health professionals.

It could be noted that in recent years, the content of received inquiries has become more specific and detailed. It is assumed that enhanced exposure to the topic of ED in the media has led to an even greater public awareness, and the ab-server is an ideal option to help answer specific questions and worries concerning ED.

A consecutive separate analysis was conducted on the categories of *no exposure to mental health professionals* and *past individual exposure to professional help*. Those affected who had been exposed to prior professional help requested information about therapeutic interventions more often. It can be assumed that this group of people has gained a fair amount of knowledge on different forms of treatment and, thus, are more apt to ask specific questions.

As this was often their first contact with an ED expert, they expressed their wish to be diagnosed. This was expected as it was found that persons with prior exposure to a mental health expert will likely have been told what disorder they suffer from.

Interestingly enough, a higher number of affected persons with prior exposure wrote to the ab-server with the intention of sharing their thoughts and feelings. This particular group of individuals might have been treated for a different psychological disorder at the time of writing their in-

quiry or the therapeutic interventions had already been terminated and they were left with no current psychotherapeutic support.

Online counseling is accepted by a wide range of Internet users. It is frequented by the affected, their family members and friends. In recent years, online counseling has been established as an independent form of therapeutic intervention which can complement and enrich traditional face-to-face settings.

Lastly, it is important to mention again that all of the above discussed categories have a restricted validity due to the fact that the data was gathered in the form of self-description. Most of the defined variables are dichotomous. If there was no precise information on having experienced therapeutic interventions given in the inquiry, it was classified as belonging to the category of not having had any exposure to mental health professionals. Therefore, it is assumed that the percentage of non-exposure might be non-representatively inflated.

There is a need for further research in order to combine inquiries with the answers from the consultants and to also determine the user-satisfaction with the counseling process. Furthermore, scientific research is needed for an adequate and correct handling of changing trends in online behavior.

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A PSYCHODYNAMIC VIEW OF VIRTUAL REALITY EXPOSURE THERAPY

Brenda K. Wiederhold[1], Lauren Gavshon[1] and Mark D. Wiederhold[1]

Fear of flying impacts an estimated 10-20% of the U.S. population. Those suffering from this fear either avoid flying or endure flights with intense anxiety and distress, often relying on alcohol or medication to transcend the experience. Virtual Reality Exposure Therapy (VRET) has been successfully used to treat fear of flying for the past four years. Clinical case reports and controlled studies have shown VR to be highly effective in treating this phobia, as patients can actively practice new coping skills while engaging in a controlled exposure experience. The stimulus of the virtual environment has been found to trigger a dissociative state in patients prone to react this way when confronted with an anxiety-provoking situation. A case report examining the impact of dissociation on VRET for fear of flying will be presented. This case will incorporate physiological data as well as patient information obtained through self-report measures, and will be discussed through modern psychoanalytic theory. Virtual Reality has typically been thought of as a useful adjunct to traditional cognitive behavioral therapies, however, it is also proving beneficial as an additive to psychodynamic therapy. Viewing a patient through the lens of psychodynamic theory can be particularly helpful in understanding the effectiveness of VRET.

Keywords: needed...

Introduction

Virtual Reality (VR)-based therapy has been used in the mental health field for the past seven years, and is now becoming recognized as a valuable form of treatment and adjunct to traditional psychotherapy. The use of virtual environments (VE's) has shown to be particularly effective in treating anxiety-related disorders, such as specific phobias and panic disorder (Hodges, Rothbaum, Watson, Kessler, Opdyke, 1996; North, North, Coble, 1996; Wiederhold & Wiederhold, 1999).

One phobia in particular, fear of flying, impacts an estimated 10-20% of the U.S. population (Agras, Sylvester & Oliveau, 1969; Boyd, et al., 1990; Howard, Murphy & Clarke, 1983). Those suffering from this fear either avoid flying or endure flights with intense anxiety and distress, often relying on alcohol or medication to help them through the experience. Virtual Reality Exposure Therapy (VRET) has been used successfully to treat fear of flying for the past four years. Clinical case reports and controlled studies have shown the use of VR to be highly effective in treating this phobia (e.g., Hodges, et al., 1996; North, North & Coble, 1996; Wiederhold, Wiederhold & Gevirtz, 1998).

Theoretical understanding of why VR is effective has primarily been discussed through the viewpoint of Cognitive Behavioral Theory (CBT), focusing on solidly established concepts such as systematic desensitization and cognitive retraining. As most researchers in the field have focused on CBT, little has been written about VR through the perspective of psychodynamic theories.

The existing literature comprising modern psychoanalytic thinking provides a vast pool of information that can be used to explore and understand new treatment methods. The intention of this paper is to present an analytic view of why VR is an effective tool for treating

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anxiety disorders. In addition, clinical observations made while treating a patient with this medium will be used to illustrate the role of the VE for the patient.

Psychoanalytic View of Anxiety

Optimal development occurs in the context of what psychoanalytic pediatrician Donald Winnicott (1951) termed "good-enough mothering." The good-enough mother is "one who makes active adaptation to the infant's needs, an active adaptation that gradually lessens, according to the infant's growing ability to account for failure of adaptation and to tolerate the results of frustration" (p.10). An individual's cognitive capacities will develop independently of or despite conflict when the mother is "good enough." Development of these capacities, however, can be altered in various ways by early conflict, just as they can be disrupted at any age by overwhelming emotions such as anxiety or fear (Tyson & Tyson, 1990). An individual's response and adaptation to frightening experiences is dependent on the functioning of the ego as a whole (Spitz, 1959). So, if the ego's ability to modulate affect is disrupted, leading to the inability to use affect (particularly anxiety) as a signal, anxiety will flood the ego and the result will be the development of an anxiety disorder.

Psychoanalytic theory defines anxiety as a "signal" that warns an individual of impending danger (Moore & Fine, 1990). Upon receiving the signal, some attempt is made to either avoid or adapt to the anxiety-provoking situation. In general, when a person is confronted with an anxiety-provoking situation, they will respond with the deep-rooted instinct to either stay and fight or to flee the situation. Individuals tend to oscillate between which responses they will choose, depending both on environmental and on personal characteristics. Many individuals, however, react to stressors instinctively in a way that is maladaptive. On one end of this continuum may be a panic or anxiety attack. For these individuals, the adrenaline-triggered physiological symptoms feel overwhelming, and an often crippling panic attack results. They may react by freezing, hyperventilating, losing bowel or bladder control, fainting, or a host of other reactions which do not contribute to assuring their safety. A response on the other end of this continuum, but triggered by the same physiological cues, may be dissociation. Individuals who react in this way also feel overwhelmed and overstimulated by the situation, but respond by shutting down some part of their consciousness. As the situation entails anxiety and fear, and often feelings of helplessness, the part of consciousness that is shut down is the affect-experiencing part (Kluft, 1992). In this way, the individual is fully aware of the stressor, while unconsciously isolating the affect associated with it. In retrospect, the individual may claim to have felt emotions during the stressor, and may even be able to identify these emotions (although they are usually the typical emotions one would expect to feel in such a situation). Measures of physiology taken during the stressful event, however, would show little to no arousal or may show initial high arousal that quickly drops to below baseline measures. To illustrate this phenomenon, a case report of a patient who displayed a dissociative reaction during her VR sessions to treat fear of flying will be presented and discussed using psychoanalytic theory.

The Containing Role of the Virtual Environment

In the virtual world, the patient is placed in a safe environment in which he can develop more effective coping skills and strengthen psychological functions that have become weakened or derailed by overwhelming anxiety. The VE can be viewed as analogous to the "holding environment" described by Winnicott (1958), or Bion's concept of "the container" (1962), both of which refer to an external (outside of the person) agent that serves as a regulator for anxiety or overwhelming emotion. Initially, this regulating agent is the mother and, through the course of normal development, as an individual's capacity to tolerate his or her anxiety matures, this task is internalized such that the individual is able to contain his anxiety without requiring assistance from an external agent. Individuals usually seek treatment when such a process fails and he or she is unable to hold or contain their own anxiety—an indication that the ego's capacity to use anxiety as a signal has failed.

Although the VR world is designed to stimulate a patient's anxiety, this is done in a strictly controlled environment in which a patient is presented with anxiety-provoking stimuli in gradually increasing increments. The type and intensity of stimuli are modified according to that which the individual patient can tolerate, measured by the patient's subjective ratings (SUDs), as well as objective data obtained through physiological monitoring (Wiederhold & Wiederhold, 2000).

Patients who are highly anxious are often difficult to treat. Kissen (1986) holds that the therapist's task in working with such patients is to "contain the patient's

projected self-representational states and does not involve, to any great extent, interpretive procedures. Essentially, the therapist must provide a containing experience of a preinterpretive and largely nonverbal nature for these patients" (p. 7). Likewise, the VE serves as a container for anxiety while the patient learns new coping techniques through cognitive therapy and systematic desensitization. In other words, the patient is able to progressively explore feeling anxious without becoming overwhelmed by their anxiety, because the environment feels both safe and controlled. In gradually increasing the patient's ability to tolerate anxiety, the patient is also learning to contain his own anxiety.

The Virtual Environment as a Transformational Object

Before the mother is experienced as a whole person, and separate from the self, she functioned as a "region or source of transformation, and since the infant's own nascent subjectivity is almost completely the experience of the ego's integrations (cognitive, libidinal, affective), the first object is identified with the alterations of the ego's state" (Bollas, 1987, p. 28). That is, the mother is seen as an object whose purpose is to alter the infant's self and to promote ego development. She accomplishes this through manipulation and handling of the infant's environment (diapering, feeding, soothing, holding, etc). As the infant's ego functions develop, he begins to gradually take over the task of meeting his own needs and requirements (Mahler, Pine & Bergman, 1975). However, the ego experience of being transformed by an external force remains in unconscious memory and certain objects are sought out throughout life as the deliverer of an experience of such transformations. An example of this may be VR treatment.

The VE can serve as a transformational object allowing for safely monitored experiences that result in ego change and mastery over anxiety. Change in the external environment can lead to changes in internal structure and in a patient's overall self-efficacy. VR therapy can be a powerful medium of change because the patient identifies the VE as an object with the ability to transform them, just as the early mother served as such an object. This identification is unconscious and occurs at a deep psychosomatic, pre-verbal level (Bollas, 1987). While immersed in the virtual world, the patient re-experiences, through transference with the environment, a sense that the environment has the ability to transform their overwhelming anxiety and panic into mastery and adaptive coping. That is, a belief that the VE can transform them and allow them to learn coping skills just as the original mother did. So, the function of identification and transference with the virtual world is to mimic the transforming, skill-building relationship experienced early in life.

Patients seek treatment because they wish to transform themselves both internally (repair of ego deficits), and externally (decrease anxiety and increase self-efficacy). It is not the case that the patient consciously desires the VE to be a transformational object, but rather that the patient identifies or perceives the VE as a transformational object. The search for such an object "arises from the person's certainty that the object will deliver transformation; this certainty is based on the object's nominated capacity to resuscitate the memory of early ego transformation" (Bollas, 1987, p. 27).

Case Example

Amy is a 42-year-old female who sought treatment for her fear of flying. Although she had traveled oversees by airplane many times during her teen and early adulthood years, Amy's most recent travel experiences were marked by increasing amounts of anxiety both in anticipation of an upcoming trip and while on the plane. She had experienced her last two flights as "extremely turbulent" and had "felt sure that the plane would crash." Amy had also become hypervigilent around any media coverage of airplane crashes, using this information as "proof" that airplane travel was unsafe. At the time she began treatment, Amy had not flown for over five years due to overwhelming anxiety and feelings of terror induced by airplanes. Her motivation for seeking treatment at this time was provoked by a desire to visit her relatives who lived overseas.

Amy recalled being anxious and fearful as a child. She described a childhood marked by vague memories of witnessing a physically and verbally abusive relationship between her parents. In particular, she recalled a screen memory in which her father had physically assaulted her mother and threatened to kill her. Amy described these memories in a monotone voice with little emotion and flat affect. So, it was not surprising when Amy answered positively to a questionnaire regarding dissociation and met criteria for both depersonalization and derealization experiences (APA, 1994). This became particularly noteworthy once she was exposed to the virtual airplane environment, as dissociative states

became a regular occurrence during her VR exposure sessions.

Dissociation During VR Exposure

Spiegel and Cardena (1991) characterize dissociation as "a structured separation of mental processes (e.g., thoughts, emotions, conation, memory, and identity) that are ordinarily integrated" (p. 367). Dissociation exists on a continuum – at one end are mild dissociative experiences common to most people (such as daydreaming or highway hypnosis) and at the other extreme is severe chronic dissociation, such as Multiple Personality Disorder (MPD) and other dissociative disorders (APA, 1994). Dissociation appears to be a normal process used to handle trauma that over time becomes reinforced and develops into maladaptive coping (DePrince & Freyd, 1999).

It is not uncommon for traumatized individuals to use dissociation. They typically have learned to separate themselves from their emotions because the traumatic experience was unbearable or emotionally overwhelming. Young (1988) explains dissociation as "an active inhibitory process that normally screens internal and external stimuli from the field of consciousness," viewing it as a "shut-off mechanism to prevent overstimulation or flooding of consciousness by excessive incoming stimuli" (p. 35). He notes that dissociation can serve the normal role of enhancing "the integrating functions of the ego by screening out excessive or irrelevant stimuli" but that under pathological conditions, dissociation is employed defensively, resulting in "an interruption of integrating functions" (p. 36). Dissociation is not always linked to trauma, however, and this form of self-protection is also not available to all persons. In fact, Allen (1995) describes dissociation as a "skill" that likely develops in dire circumstances and then becomes maladaptive or defensive over time.

The initial trigger of dissociation is usually a situation in which fear and anxiety are primary emotions and there is an imminent threat to the self. Kluft (1992) describes dissociation in such a situation as "a defense in which an overwhelmed individual cannot escape [what] assails him or her by taking meaningful action or successful flight, and escapes instead by altering his or her internal organization; i.e., by inward flight" (p. 143). Individuals who are prone to use dissociation defensively may dissociate in circumstances that induce any amount of fear or panic.

Amy's Treatment

A brief overview of four consecutive VR sessions will be presented and discussed in light of Amy's tendency to use dissociation as a defense against overwhelming anxiety. The airplane environment used during her sessions provided Amy with a virtual experience of being on an actual airplane, during which she could actively practice new coping skills. In addition, physiological monitoring was used as an objective measure of her anxiety (focusing on Skin Conductance), and Amy provided subject measures by rating her anxiety on a scale of 1-100 (SUDs) during various parts of the virtual flight.

Session 1

Amy displayed a noticeable increase in anxiety upon seeing the airplane seats and became immediately hyperverbal and fidgety. Following exposure, she described the virtual airplane experience as "really intense and real" and stated that she "felt afraid" and "emotionally overwhelmed." Although Amy reported high SUDs levels, her skin conductance (SC) showed little variability, indicating little to no physiological arousal (Wiederhold, et al., 2000). Amy also stated that she had felt markedly "sleepy" and "detached" during the virtual flight, and was noticed yawning and stretching upon emerging from the VR environment.

Amy's observed behavior and self-report, coupled with a lack of the expected increase in SC, can be understood as pointing to a dissociative experience. Anxiety and fear — triggered initially by the airplane seats and then by the VE itself — overwhelmed Amy's ego and led her to use her habitual anxiety-triggered defense of dissociation. When her ego becomes overwhelmed in this way, Amy is unable to use anxiety as a signal to trigger some form of adaptive coping mechanism. Even mild anxiety floods her ego and causes her to feel "emotionally overwhelmed" and unable to contain her own anxiety. At these times, Amy resorts to what she describes as "checking out" as a way to escape her fear.

Session 2

Amy began the session by stating that she had gone to the airport the day before to pick up a friend and had felt "anxious" and "detached." Before beginning the VE exposure, this incident and her emotional reaction to it were processed fully with the therapist. As a result of her increased anxiety related to the discussion, Amy's baseline SC was higher than usual. Her SC decreased below baseline during initial exposure to the VE, but then significantly

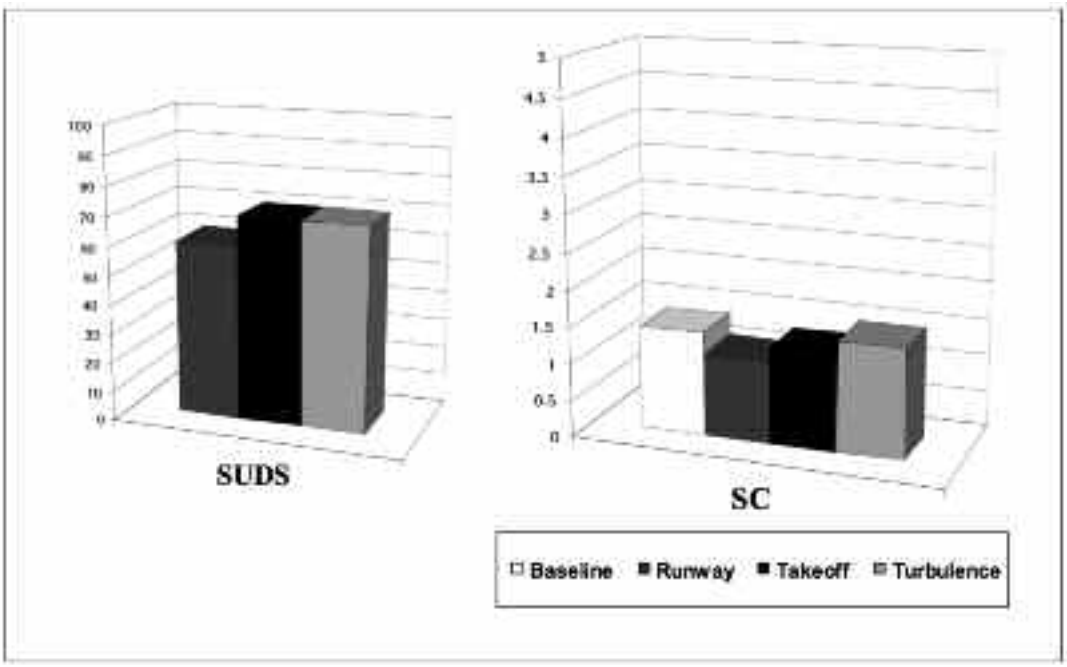

Figure 1. Subjective and Objective data from Session 1:
Subjective Units of Distress (SUDs) and Skin Conductance (SC) Levels.

increased following takeoff. Amy reported that while in the virtual airplane, she was "thinking continuously about our conversation" regarding the airport and that this had kept her from thinking about being in an airplane.

Amy's focusing on the conversation reflects a defensive use of denial and intellectualization, used to distract her from immersion in the VE. Since she cannot self-soothe or contain her own anxiety, she distracts herself with rumination and attempts to deny her presence in the airplane. This defense proved effective as a distraction only for a brief period of time (the initial decrease in SC), however, after which she returned to being immersed in the VE and experienced an expected amount of anxiety provoked by the airplane environment (increase in SC).

Session 3

Amy initiated the session by stating that she had been practicing the relaxation techniques (taught during previous sessions) that morning and felt "very relaxed" with little subjective anxiety. For this session, Amy was directed to focus her attention on any physiological changes experienced while in the VE, and to notice at which times during the virtual flight her body felt more or less tense. During exposure Amy's SC steadily increased, peaking at takeoff. She reported mild SUDs during the flight, commenting that she felt the treatment was working. Amy also noted that the airplane noise during this particular session "felt too loud." This is noteworthy, as the volume level had not changed since her last exposure session.

Amy did not manifest dissociative symptoms during this flight. It may be that a shift in her attention took place because she was instructed to focus on bodily sensation, rather than emotion or anxiety, which kept her present in the environment and did not allow for escape into dissociation. This could also be understood as Amy being fully immersed and present in the VE and, for the first time, noticing the high volume of the sound that she had previously been able to block from awareness through dissociation. In addition, as Amy reported little subjective anxiety, this session represents an initiation of her ability to begin to use the VE as a container for her anxiety.

Session 4

During this session, Amy displayed an increase in head

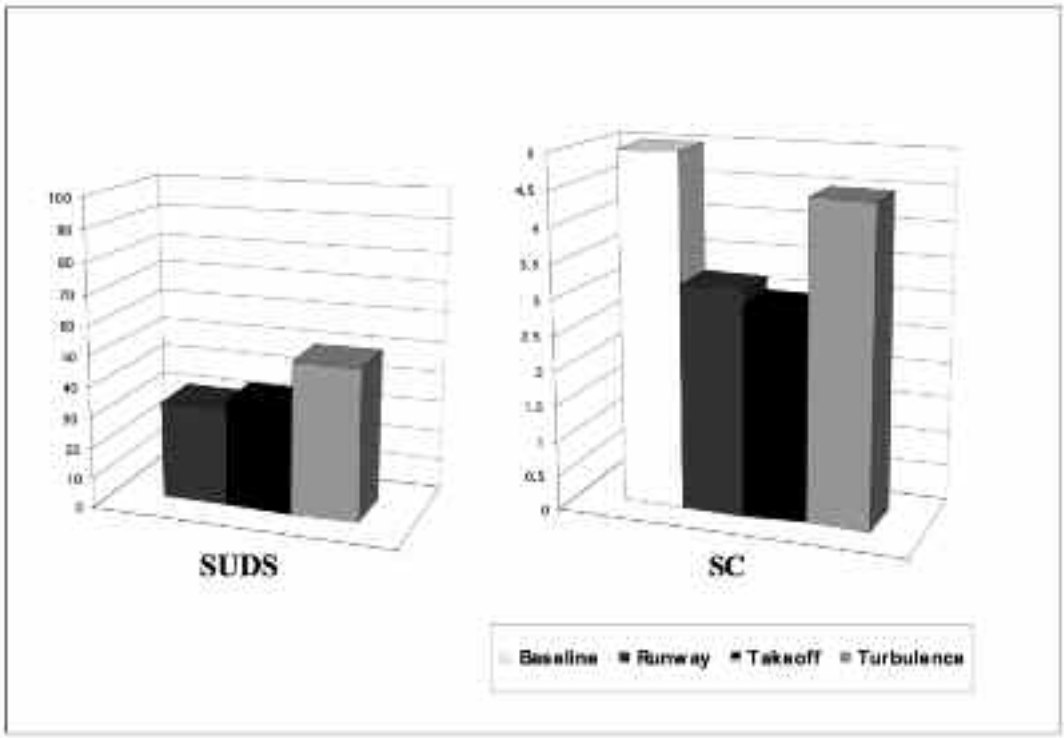

Figure 2. Subjective and Objective data from Session 2:
Subjective Units of Distress (SUDs) and Skin Conductance (SC) Levels.

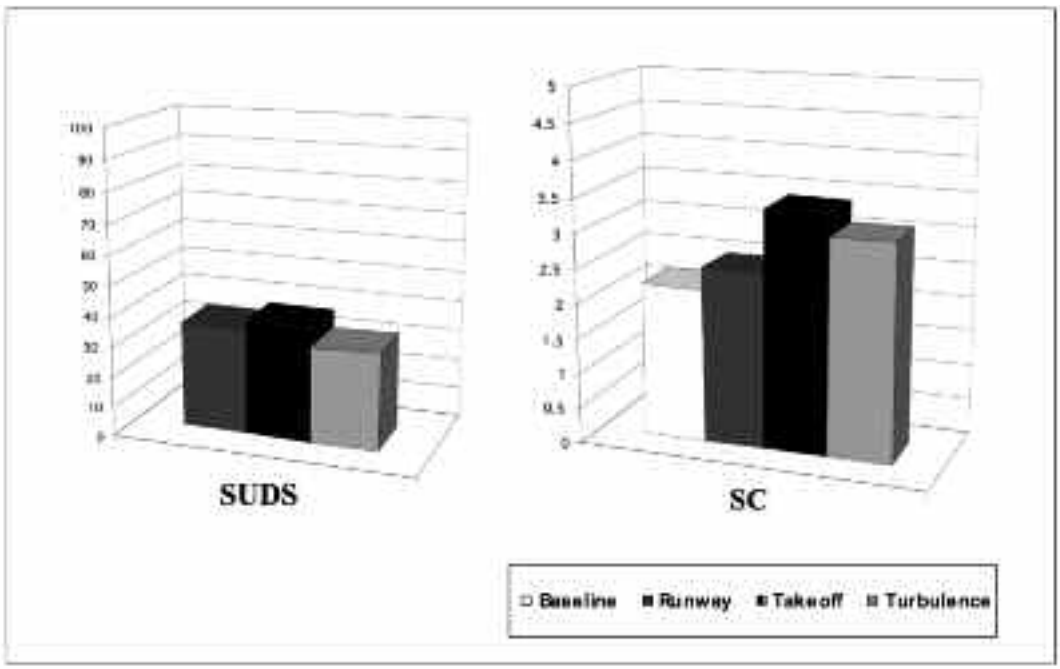

Figure 3. Subjective and Objective data from Session 3:
Subjective Units of Distress (SUDs) and Skin Conductance (SC) Levels.

movement at the beginning of the flight. It was initially hypothesized that Amy was simply looking around the environment, something that was unusual as she typically held her gaze focused directly ahead, at times glancing out the window for brief periods. Upon inquiry, however, Amy revealed that she had felt "sleepy" and "hypnotized" while in the VE, and the head movement was her stretching her neck in an attempt to maintain wakefulness. Additionally, Amy commented again that the noise of the VE "felt too loud."

Amy's SC steadily increased from baseline during the portion of the VR flight that involved sitting on the runway waiting for takeoff. It then decreased steadily for the remainder of the flight. Interestingly, Amy could not remember the turbulence portion of the flight, which typically elicits a high amount of subjective anxiety for her.

Amy experienced immersion in the VE, which was evidenced by her high levels of physiological arousal. As her immersion and anxiety increased, Amy began to defensively dissociate and, as a result, could not recall the most anxiety-provoking part of the flight, the turbulence.
During the remainder of her treatment, Amy gradually learned to be present in the VE without needing to resort to defensive dissociation. This occurred as she began to use the VE as a containing environment for her anxiety so that she could practice new coping skills without feeling emotionally overwhelmed.

Conclusion

VR has typically been thought of as a useful adjunct to traditional cognitive behavioral therapy, however, it is also proving beneficial to psychodynamic therapies. Examining a patient's experience in the virtual world from a psychodynamic perspective can be particularly helpful in understanding the effectiveness of VR-based treatment. Just as in the tradition of Freud, the patient undergoing VR therapy does not have eye contact with the therapist. Without the ability to receive social cues from the therapist, patients often feel much less inhibited in discussing certain topics and opening up to the therapist. These factors may serve to allow relevant issues pertaining to the patient's treatment to surface more quickly than with traditional, face-to-face psychotherapy. In addition, the transference that the patient develops is primarily with the VE, rather than with the therapist. This allows the VE to contain the patient's anxiety and to serve as a transformational object that facilitates learning of new skills and coping techniques.

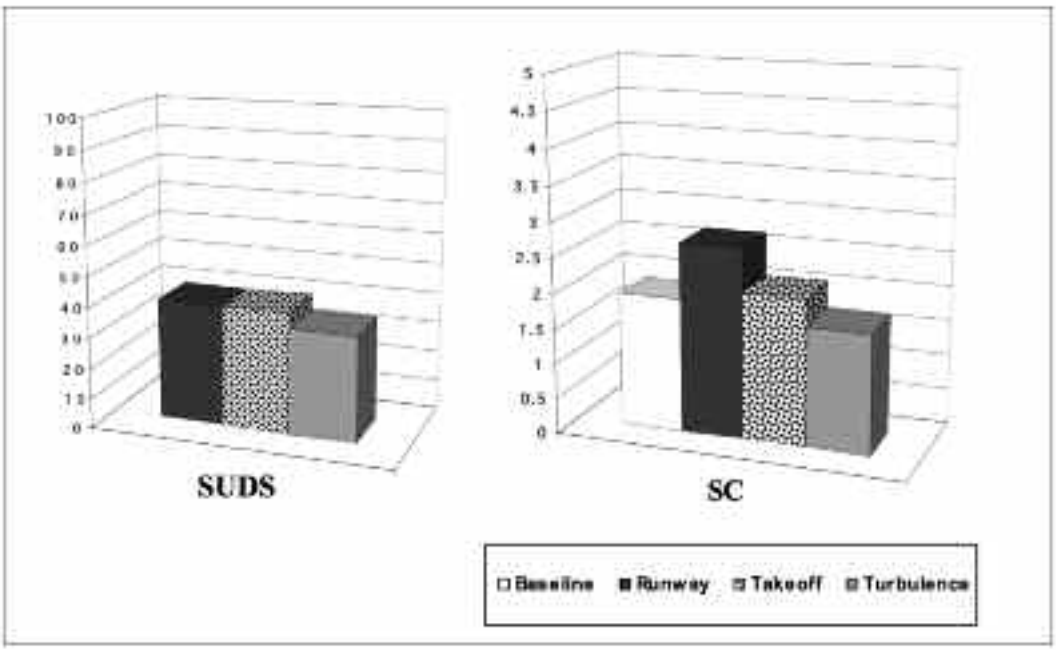

Figure 4. Subjective and Objective data from Session 4:
Subjective Units of Distress (SUDs) and Skin Conductance (SC) Levels.

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ADAPTATION OF THE TRIER SOCIAL STRESS TEST TO VIRTUAL REALITY: PSYCHO-PHSYIOLOGICAL AND NEUROENDOCRINE MODULATION

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The Trier Social Stress Test (TSST; Kirschbaum et al., 1993) is currently the most commonly used psychosocial stressor to generate a response of the axes involved in stress. The TSST has proven effective in the activation of the hypothalamic-pituitary-adrenal axis. In addition, new technologies, such as virtual reality (VR), are being integrated into stress research protocols (Kelly et al., 2007).

To determine whether TSST as applied to VR leads to the sympathetic and neuroendocrine activation in a group of healthy individuals. Also, this study aims to connect this response with different psychological variables regarding stress vulnerability, psychopathology, and personality. Twenty-one university students (6 male and 15 female) were exposed to a modified version of the TSST adapted to a virtual environment (VE), in which they have to deliver a speech. Electrodermal activity and salivary cortisol secretion were simultaneously registered at different instances.

After the task, sympathetic activation was observed in all participants, as well as increase in the cortisol secretion in 14 of the students. This increase was statistically significant in the moment prior to the speech and the moment after in the responder group. In the same fashion, statistically significant differences were found in the responder group only regarding obsession and compulsion scales and extroversion, which were higher in the responder group. Our findings support the use of the TSST paradigm in VR as an experimental situation appropriate to research designs in laboratory aiming to study the modulation of the axes implied in response to stress.

Keywords: TSST, Virtual Reality, Hypothalamic-Pituitary-Adrenal Axis, Psychophysiological Activation, Salivary Cortisol

Introduction

In recent decades, neuroscientific research on stress has notably increased. In order to induce psychophysiological responses to stress similar to those in real life a great number of stressor agents has been used, such as acute psychological stressors that activate the sympathetic-adrenomedullary system and affect the immune system (Cacioppo, 1994). The tasks that have been used most often are public speaking, arithmetic, Stroop test, video-games, problem solving, and reaction time (Moya-Albiol & Salvador, 2001). In the same fashion, response to stress originated in the hypothalamic-pituitary-adrenal (HPA) axis has been widely used in the increase of blood or salivary cortisol levels when an in-

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dividual faces acute stress-inducing situations. In their revision of acute stressors used to activate cortisol secretion, Dickerson & Kemeny (2004) highlight the following stressors used in the laboratory – cognitive tests (e.g. mental arithmetic tasks), Stroop test, time-vigilance tasks, analytic perception tasks, public speaking, combined cognitive and public speaking task, noise exposure, and emotion induction by means of films or images. These authors found that the most effective type of stressor task to generate significant cortisol responses was a combined cognitive and public speaking task, as its size effect was twice as much as for cognitive and public speaking tasks performed separately. Therefore, the Trier Social Stress Test (TSST; Kirschbaum, Pirke & Hellhammer, 1993) has become the psychosocial stressor most used in the laboratory to generate the response of the involved axes. The TSST integrates a public speaking task with an arithmetic task and has proven effective in activating the HPA axis (Kelly et al., 2008; Kudielka, Shcommer, Hellhammer & Kirschbaum, 2004; Williams, Hagerty & Brooks, 2004).

The traditional TSST proposed by Kirschbaum et al. (1993) consists of a brief anticipatory stress period, where the individual must prepare a speech addressing their eligibility for a job. Then, a second phase follows, in which the individual delivers the speech and completes an arithmetic task in front of an audience who has previously been trained to be neutral in both their verbal and nonverbal behavior (Foley & Kirschbaum, 2010). The main components of this task are the social-evaluative and uncontrollable threats, which are necessary for a stressor stimulus or situation to generate cortisol responses (Dickerson & Kemeny, 2004).

Ever since its design, this psychosocial stressor has been used to measure the response to stress in different population groups, such as children (TSST-C, Buske-Kirschbaum et al., 1997), middle-aged adults (Fiocco, Joober & Lupien, 2007) and seniors (Kudielka et al., 1998), and in different pathologies, such as psychiatric patients (Brenner et al., 2009), metabolic syndrome (Chrousos, 2000), systemic hypertension (Esler et al., 2008), systemic erythematous lupus (Pawlak, 1999), and myalgia (Sjörs et al., 2010). In addition, it has been used to study the relationship between stress and several psychological variables, such as depression (Parker et al., 2003), social anxiety (Shirotsuki et al., 2009) or personality features (Kirschbaum, Bartussek & Strasburger, 1992; Pruessner et al., 1997). Despite several studies that have tried to establish a relationship between personality and reactivity to stress, very few have succeeded, which means that only repeated exposure to a stressor (Kirschbaum et al., 1995) and data aggregation (Pruessner et al., 1997) enable the relationship between personality and increased cortisol levels in a stressful situation. However, studies measuring blood or salivary cortisol levels with no manipulation have shown that personality features most closely related to cortisol levels were psychoticism and disinhibition (Ballanger et al., 1983) or anxiety, depression, and extroversion (Dabbs & Hopper, 1990).

Despite the fact that TSST has facilitated a breakthrough in laboratory research on stress, its application needs a wide array of resources including a real audience available for several sessions that must receive some type of honorarium, and the availability of several rooms including a room for the audience and a room for the speakers (experimental subjects). On the other hand, it is essential to bear in mind the variability of the audience, as their attitude may not be neutral or equal for all participants, despite the previous briefing. For this reason, one of the proposals in order to reduce these disadvantages would be introducing other technologies, such as VR, which can act as a neutral tool and saving human and material costs associated with the traditional TSST. In addition, the use of VR provides a measure of human interaction within a dynamic and realist 3-D environment, which facilitates the use of instruments for psychophysiological evaluation (e.g. continuous psychophysiological registration).

To date, few studies have introduced a VR component in order to study psychophysiological and neuroendocrine changes in a stressor task. Regarding psychophysiological activation, Kotlyar et al. (2008) verified the effectiveness in a speech delivered in front of a virtual audience, together with an arithmetic task, in order to generate physiological activation (blood pressure, heart rate, catecholamine in blood and blood cortisol levels) in 12 healthy individuals. The researchers found that the speech increased blood pressure, heart rate, and catecholamine of participants, while no significant changes were recorded in cortisol levels. Regarding neuroendocrine changes, a study by Hemmeter et al. (2005) showed differences in cortisol secretion depending on whether the individuals were exposed to one mental task in a static or dynamic virtual environment (VE). In this

study, four conditions were included: 1) exposure control in a static VE, without cognitive stress; 2) static VE, where participants had to performed a cognitive stressor task: speed and concentration; 3) exposure to a dynamic VE, with objects of different colors and shapes were in motion; and 4) exposure to a dynamic VE, where the participants had to perform the same task as in condition 2). The authors found that the cognitive stress condition in a VE significantly increased cortisol secretion compared with the sole exposition to the virtual (static or dynamic) environment or the performance of the mental task in a static VE. However, it was Kelly et al. (2007) who were the first to use the TSST as a stressor task integrated in VR to measure neuroendocrine changes. In the same study, the TSST was adapted to a VE and its effects were compared with those of the traditional TSST, i.e. an imaginary audience vs. a control group that did not perform the task. The authors found that the traditional TSST produced a higher increase in salivary cortisol levels, even though the imaginary audience and the VR TSST also produced significant neuroendocrine changes compared to the control group. Therefore, they were another instrument for the evaluation of the implied axes in response to stress. Nonetheless, this study did not consider other related variables, such as the immersion of the subject in the VR situation or other closely related psychological factors, such as personality features, stress vulnerability, etc.

Therefore, the main goal of our study is to verify the modulation of the axes involved in the response to stress, i.e. sympathetic activation (by means of a skin conductance test) and the HPA axis (by means of the salivary cortisol level) when exposed to a psychosocial stressor, specifically the virtual reality version of the TSST [TSST (VR)].

Secondly, we aim to establish whether or not that modulation may be connected with the different psychological variables of stress vulnerability and personality, as well as immersion in the said virtual situation.

Methodology

Participants

For the purpose of this study, we recruited 21 Physiotherapy students at the University of Granada; six were men and 15 were women. The mean age of the participants was 24 (Sd=1.2) and mean education was 14.1 years (Sd=0.43). All participants were informed about the study objectives, after which they signed an informed consent form. Exclusion criteria were low cultural level (illiteracy), high blood pressure, heart disease, clinical depression, clinical anxiety or other personality disorders, use of drugs or other substances (amphetamines, alcohol, barbiturates, methadone, muscle relaxants or lithium), obesity, use of contraceptives or menopause. Additionally, menstrual course was controlled in women, considering that salivary cortisol levels are higher in the luteal phase than in the follicular phase (Kirschbaum et al., 1999; Kudielka and Kirschbaum, 2005).

The participants completed a series of psychological questionnaires, after which they were informed about the TSST (VR), which was delivered as described in the procedure section below.

All of the patients gave their signed informed consent to participate in this study, which was approved by the ethics committee in our University and carried out according to the recommendations of the Helsinki Declaration.

Instruments

Semi-structured interview, covering sociodemographics, life and sleep habits, medication, menstrual course, and psychiatric or psychological treatment.

Stress Vulnerability Inventory (Beech, Burns, Scheffield, 1986) in Spanish, validated by Robles-Ortega, Peralta-Ramírez & Navarrete-Navarrete (2006): consists of 22 items and evaluates the individual's predisposition to be influenced by perceived stress. Regarding reliability, Cronbach's alpha was 0.87. Regarding convergent validity, the results show a statistically positive correlation ($p<0.01$) with other evaluation instruments, such as STAI-R, Beck Depression Inventory, Somatic Symptom Scale and SRLE.

Eysenck Personality Questionnaire for Adults, EPQ-A (Eysenck and Eysenck, 1997) composed of 94 items in Yes/No modality. It gives information about three personality variables: neuroticism, extraversion, and psychoticisim, as well as a fourth scale on sincerity. It has satisfactory reliability and validity.

Igroup Presence Questionnaire (Schubert, Friedmann, & Regenbrecht, 2001, IPQ): is a scale to measure the sense of experimental presence in a VE. It consists of a global scale and three subscales: spatial presence, involvement, and experimental realism.

Perceived Stress Scale, PSS, by Cohen, Kamarak, & Mermeistein (1983), Spanish, by Remor & Carrobles (2001) is a self-report instrument evaluating the perceived stress level and the degree in which people find their lives unpredictable, uncontrollable or overcharged, aspects that have repeatedly been confirmed as major components of stress. It consists of 14 items with four response alternatives. The highest score corresponds to the highest perceived amount of stress. The Spanish version of the PSS (14 items) showed an adequate reliability (internal consistency=0.81 and test-retest=0.73), concurrent validity, and sensitivity (Remor, 2006).

Symptom Check-List 90-R, SCL-90-R (Derogatis, 1994) was developed to evaluate symptom patterns of individuals. It is a self-report scale, made up of 90 items with five response alternatives (0-4). The participants must respond according to their feelings over the last seven days, including the administration day. This is evaluated and interpreted according to nine primary dimensions (somatizations, obsessions and compulsions, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) and three global indices of psychological distress (i.e. Global Severity Index, GSI; Positive Symptom Total PST; and Positive Symptom Distress Index, PSDI). This test is administered in order to discard any psychopathologies in the participants, and as a measure of anxiety and depression. It has satisfactory reliability and validity.

Evaluation of the Axes Implied in Response to Stress

Sympathetic activation

Physiological data of the dermal conductance were registered by the Biopac data acquisition system MP150WSW, specifically by acquisition unit GSR100C. It was registered during visualization of the virtual scenarios, taken at baseline three minutes prior to the TSST. Registering continued during the entire performance of the task, divided into three periods – anticipatory stress (5 minutes), public speaking (5 minutes) and the arithmetic task (5 minutes).

Hypothalamic-Pituitary-Adrenal Axis

We collected four salivary cortisol samples and allocated them in four time periods of the study (see Protocol). For the salivary sampling we used Salivettes, consisting of two small tubes and a small piece of cotton. Participants chewed the cotton for 60 seconds and then put it into the Salivette for analysis.

The samples were analyzed at San Cecilio University Hospital by the electrochemiluminescence immunoassay (ECLIA) method, to be used in automatic analyzers Roche Elecsys 1010/2010 and module Elecsys MODULAR ANALYTICS E170.

Protocol

Timetable

The study was performed between 3:30-6 p.m. for all participants. Despite European studies showing that the period where cortisol levels are considered stable is between 2-4 p.m. (Kudielka & Kirschbaum, 2005), we consider that circadian and metabolic cycles in Spain differ from those in other countries. In fact, we believe that the number of sunlight hours and the differing diets would make cortisol levels in humans different than those in other European countries. In order to define the timetable for our study, we performed a pilot study aiming to collect salivary cortisol samples in ten non-smoking participants _ five men and five women – with a mean age of 34.90 (Sd=11.41), every two hours throughout one day, from 8 a.m. to 10 p.m. The description of the daytime cortisol secretion together with the graph (Graph 1) is included in the Results section below.

Virtual Reality-adapted Trier Social Stress Test– TSST (VR)

This program consists of a 3-D screen where a virtual audience is presented; a pair of headphones through which the participant will hear the sounds of the VE; and a microphone, which will be used to make the participant believe that their speech is going to be recorded. Even though it is not recorded, they will only learn this upon completion of the task.

The task consists of several stages. Once it has been explained to the participants, the VE starts being projected. The participant is behind a curtain and can hear noise from the virtual room., then a three-minute psychophysiological adaptation period starts in the VE during which the subject remains immobile.

Over the next five minutes, i.e. anticipatory stress period, the participant must prepare a speech about their own qualities and defects. They will have to elicit them and then explain why they identify with them.

The exposure period starts when the curtain lifts and the virtual audience appears. The participant must then begin their speech. They have previously been informed

that their speech must last five minutes and they must be mindful of both the content and the manner in which they convey the information, as the audience could react according to the quality of the delivery itself. The participant is reminded that they must keep talking during the five minutes. From minute 2 onwards, a change of attitude occurs in the audience, and the original "interested audience" turns into a "restless audience," irrespective of the performance of the participant. This new attitude will continue until the end of the speech.

Once the speech is over, the arithmetic task starts, where the participant must serially subtract the number 13 from 1022 as quickly as possible over the last five minutes. In case of error, they will have to start again.

Cortisol Sampling Moments

After the explanation of the TSST (VR), an initial cortisol sample is taken (pre-exposure cortisol). Then, after the arithmetic task has been completed, another sample is taken (post-exposure cortisol). The third sample is taken 10 minutes after completing the task (cortisol post+10), and the last sample is taken 20 minutes after completing the task (cortisol post+20).

Procedure

At the beginning of the study, the participants received general information and then gave their signed consent. During the laboratory adaption period (one hour), they completed the aforementioned psychological questionnaires, i.e.: Positive Affect and Negative Affect Scale (PANAS-State1), Stress Vulnerability Inventory, Eysenck Personality Questionnaire for Adults (EPQ-A), Perceived Stress Scale, and the Symptom Check-List 90-R. After this stage, they learned what the TSST (VR) was and the stressor task began. Upon completion of the task, and after collection of post-exposition cortisol, the participants completed two questionnaires: PANAS-State2, and the Igroup.

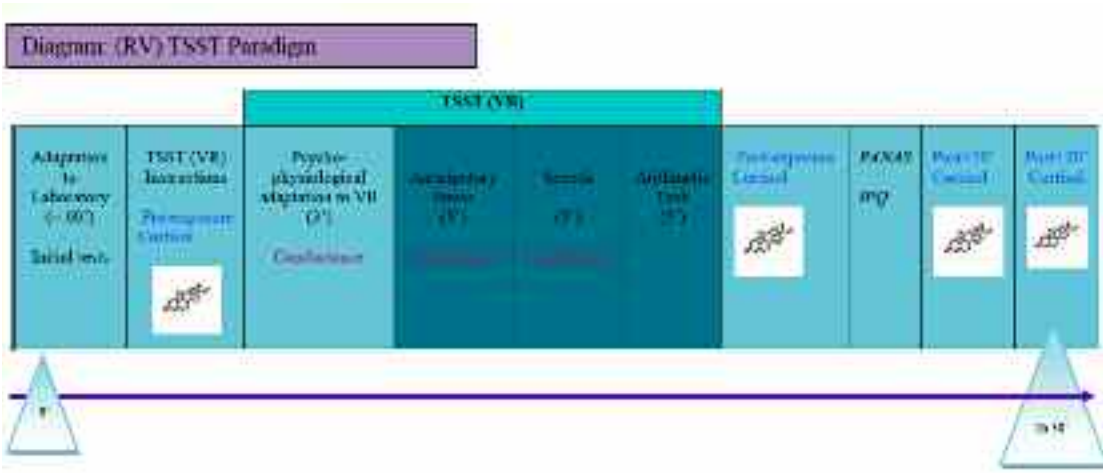


Figure 1. Diagram explaining the (VR) TSST application protocol throughout the whole stay of the participants in the laboratory, indicating duration of each phase, cortisol sampling moments, psychophysiological response, and questionnaires used.

Presence Questionnaire

Once the last salivary cortisol sample was collected, the participants were told that their speech had not been recorded and that the goal of the study was not to analyze their performance in public speaking and the arithmetic task, but to generate a response to stress for its further analysis. The protocol diagram of the TSST (VR) is in Figure 1 below.

Statistical Analyses

In order to establish the daytime cortisol curve in the Spanish population, we performed a pilot study in ten people. For that purpose, mean scores of each sampling moment were graphically represented.

Secondly, in order to establish sympathetic and adrenomedullary activation of the participants in the different moments we performed several T analyses in related samples.

Also, in order to determine the relationship between the different psychological variables (stress, psychopathology, and immersion) and the activation of the HPA axis, we performed a student t for independent samples. Finally, in order to verify the relationship between personality features and the activation of the HPA axis, we performed a contingency table based on a Chi-Square analysis.

Results

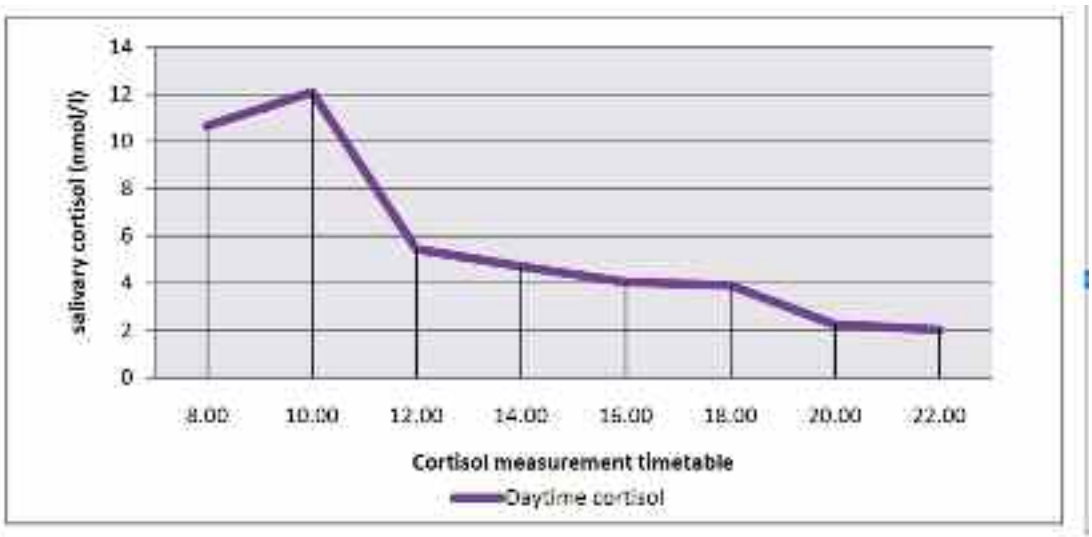
Cortisol Curve

Before presenting the VR paradigm aimed to the activation of stress actuation axes, we performed a research to establish the cortisol curve in the Spanish population. The objective was to determine the moment of the day where cortisol is more stable and set the study timetable accordingly. This allows us to connect cortisol variations with the experimental design and not with the evolution of the daytime cortisol cycle itself. For that purpose, we performed eight cortisol measurements (one every two hours) in a sample of ten people, among which five were men and five were women with a mean age of 34.9 (Sd=11.4). This evaluation was performed in a daytime timetable from 8 am to 10 pm (see Graph 1).

As can be observed, cortisol secretion is represented in a descending curve – the most stable levels correspond to the period from 3:30 p.m. to 6 p.m., together with a steep decrease. Based on these results, we decided to set the timetable for the experimental protocol in this time slot.

Sympathetic Activation

As for the activation of the adrenomedullary axis, we established three time periods, taking mean conductance in each of these moments (psychophysiological adaptation in baseline, anticipatory stress, and speech). The results showed activation of the adrenomedullary axis through the paradigm TSST (VR) in all participants.



Graph 1. Representation of cortisol secretion in healthy people in the period ranging from 8 am to 10 pm.

Highest mean scores in conductance were observed in the preparatory and the speech phase versus baseline. In order to determine whether or not there were statistically significant differences between these scores, we performed two T analyses for related samples, comparing mean conductance in baseline with that in the speech. The results showed statistically significant differences between mean conductance in baseline and mean conductance in anticipatory stress [t=-2.771; p<0.012], the latter being higher (3.13 vs 3.5). Similarly, statistically significant differences were also found between mean conductance in baseline and mean conductance in speech phase [t=-2.89; p<0.009], the latter being higher (3.13 vs 4.05) (see Graph 2).

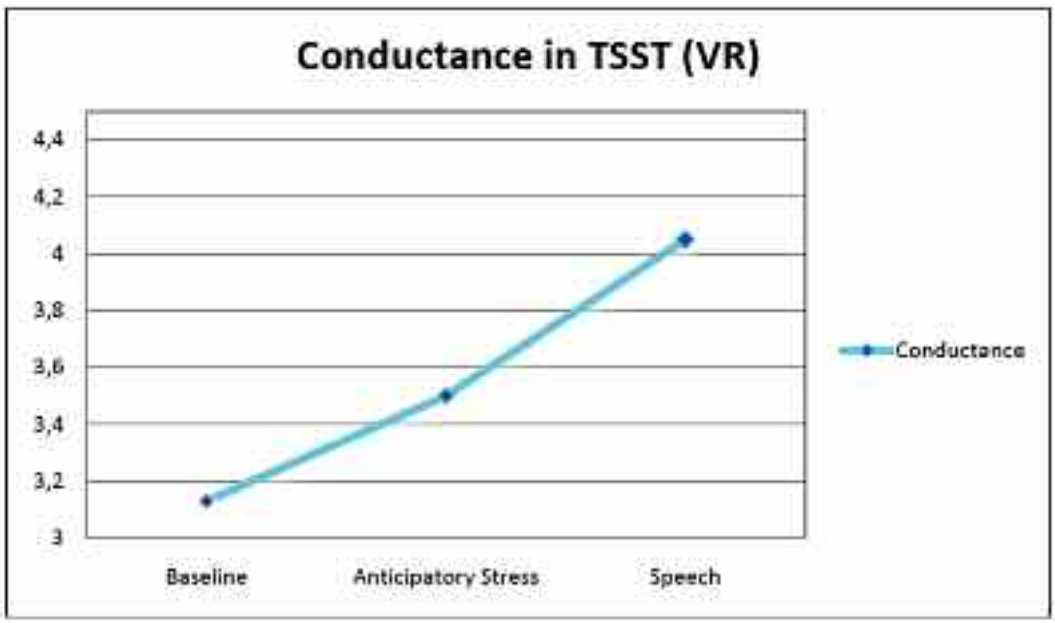
Activation of the Hypothalamic-Pituitary-Adrenal Axis

Regarding the evaluation of modulation of the HPA axis, we took four cortisol measures – before beginning the TSST (VR), immediately after completion of the task, at 10 minutes after completion, and at 20 minutes after completion. The results show that seven of the participants did not present any increase in cortisol secretion after completing the TSST (VR). However, cortisol secretion of the remaining fourteen did increase as a response to stress due to the TSST (VR) paradigm. Representation of both groups is shown in Graph 3.

Regarding the responder group, we found significant differences between pre-and post-exposure cortisol [t=2.32; p<0.007]. However, no differences in cortisol levels were found between the first moment and the moments post +10' and post +20'.

TSST (VR) and Psychological Variables

In order to detect any statistically significant differences between the psychological variables evaluated and the response to stress, we performed several Student t analyses, the independent variable being the response to the TSST (VR) with two levels (responders vs. non-responders), and the dependent variables being the scores of stress vulnerability, perceived stress, and the scores in the psychopathological symptoms in SCL-90. The results showed statistically significant differences between the responders and non-responders in the obsession-compulsion scale in SCL-90 (t=-2.43; p<0.025), the scores of responders being higher than those of non-responders (64.07 vs. 57.85) and marginally significant in the scores for hostility in the same scale (t=-1.90; p<0.073), where the responder group also scored higher (54.38 vs 47.42). No differences in stress variables were found between the groups.



Graph 2. Representation of the sympathetic activation based on mean conductance in baseline, anticipatory stress phase, and speech phase.

Regarding the personality features in EPQ-A (neuroticism, extroversion, and psychoticism), we performed a contingency analysis with Chi-Square and found statistically significant differences between both groups in the variable extroversion, where subjects with increased cortisol levels recorded after the TSST (VR) obtained higher scores (1.6 versus 1.1).

Virtual Environment Immersion

In order to determine whether non activation of the HPA axis could be due to an inadequate immersion in the VR situation, we performed four T analyses for independent samples, the independent variable being the response to the TSST (VR) with two levels (responders and non-responders) and the dependent variables the scores obtained in each of the four IPQ scales (presence perception, spatial presence, implication, and experimental realism). The results showed that there were not statistically significant differences between both groups in either of the variables studied.

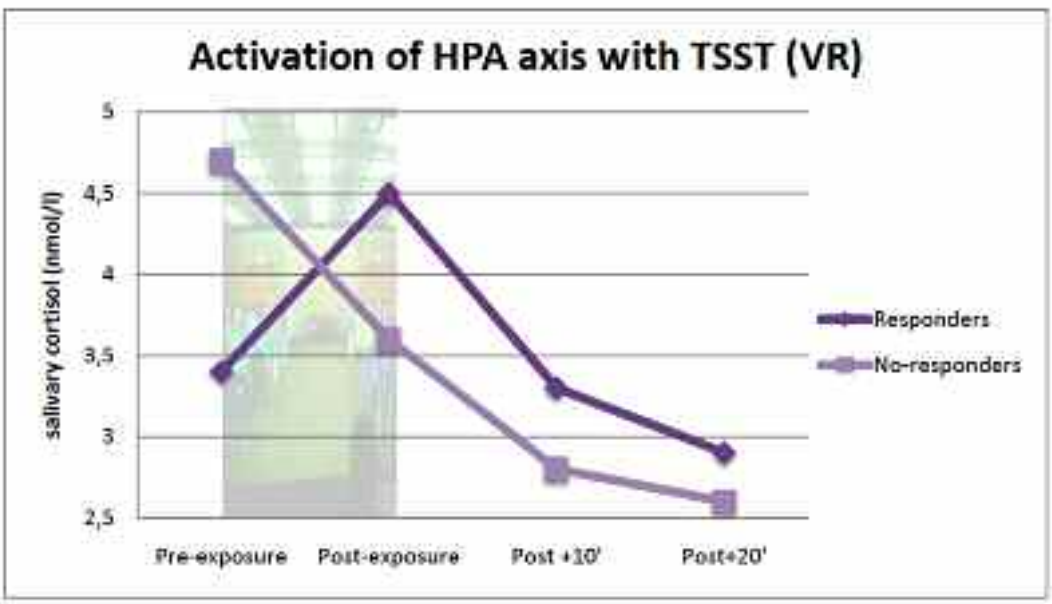
Discussion

The results of our study show that the TSST integrated in a VE acts as a stressor to activate electrodermal responses and increase salivary cortisol levels in the participants. Therefore, this task is presented as a valid instrument for the activation of both responses in a stressful situation.

According to the results obtained in the representation of the Spanish daytime cortisol curve, we find that the most appropriate time to perform a study including measurement of variability of salivary cortisol levels depending on a stressful situation ranges from 3:30-6 p.m., so that variations will be attributed to the stressor and not to the daytime cortisol cycle itself.

As for the activation of the two axes of response implied in response to stress, the data obtained in the sympathetic axis show how the TSST (VR) is effective in the activation of skin conductance, which is a variable that was not previously measured in the study by Kotlyar et al. (2008). These authors had used a stressor in VR to generate physiological changes, obtaining an increase in systolic and diastolic blood pressure, as well as in heart rate.

The results obtained place our study in line with the research by Kelly et al. (2007), who found that the TSST



Graph 3. Representation of the activation of the HPA axis based on salivary cortisol samples taken in four moments: pre-exposure, post-exposure, post+10 minutes, and post+20 minutes in both groups (responders and non-responders).

(VR) was appropriate to produce the activation of the HPA axis, although said activation was inferior to the one generated by a real audience. In contrast, we have found that the TSST (VR) is an appropriate task that can solve some of the limitations of the traditional TSST and becomes a useful tool in stress research.

Nonetheless, our study takes an important step in studying the different psychopathological, stress and personality variables related to the activation of the HPA axis. On the one hand, psychopathological symptoms, such as obsessive-compulsive and hostilities were connected with the activation of the axis. Thus, a higher score in these scales was linked to a higher activation of the HPA axis in a psychosocial stressor. On the other hand, the responder group was found to have a higher score in extroversion than non-responders, which was contrary to the expected. In a study by Dabbs et al. (1990), a salivary cortisol sample was taken in 102 students in order to connect cortisol concentrations with personality features; participants with high cortisol levels scored lower in sociability. However, according to our results, subjects with higher scores in extroversion would more likely seek the approval of others more than those with low scores – activation being even more common in situations involving evaluative threats.

Finally, it is important to highlight that no factor related to VR immersion was connected with the activation of the HPA axis, as no differences were found between the responder and the non-responder group in any of the variables implied in perception of VE presence. Therefore, non activation of this axis observed in some subjects cannot be explained by the artificial nature that is often attributed to VE's.

In the same line, a limitation of this study would be the characteristics of the selected sample composed of physiotherapy students, possessing a University degree related to students with a high academic performance who are used to public speaking situations due to oral expositions in class performed in front of their teachers and classmates. They may have had a chance to develop resources and strategies to counteract the physiological activation in a stressful situation. We hypothesize that activation of response to stress would be higher in a population with an academic level closer to the mean.

In conclusion, this is the first study to evaluate simultaneous activation of the two axes involved in response to stress, the sympathetic and the HPA axis, by means of the TSST (VR), together with other related variables. The findings of this study support the use of TSST (VR) paradigm as an appropriate experimental situation in laboratory research designs aiming to check the modulation of both stress axes.

Acknowledgments

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CYBERPROJECTS

IN THIS FEATURE, we will try to describe the characteristics of current cyberpsychology and rehabilitation research. In particular, CyberProjects aims at describing the leading research groups and projects, actually running around the world, with a special focus on European research.

Roadmap for Robot Helpers

The humble robot cleaning your floor heralds a wave of robot helpers, from miners to surgeons, that could be joining us in the coming decades. How should the European industry prepare for these new markets?

Since the 1980s industrial robots have become commonplace and in recent years cleaning robots have started tidying up in our homes. In 2007 there were an estimated 6.5 million robots around the world and that figure is projected to rise to 18 million by 2011. Europe has a quarter of the world market for industrial robots but how can it ensure that it maintains its position in the future?

The EU-funded CARE project (Coordination Action for Robotics in Europe), coordinated by Rainer Bischoff and Tim Guhl of KUKA Roboter in Augsburg, Germany, was set up in 2006 to create a Strategic Research Agenda (SRA) to guide the development of robotics "We wanted to make sure that a lot of different stakeholders were involved," said Guhl. "And we wanted to have an industrially-driven agenda – that was very important."

The project was run in association with EUROP, the European Robotics Technology Platform, set up to enable European robotics companies to build and maintain leading world positions in all robotics markets for the benefit of European society. More than 130 organizations helped to develop the agenda over a period of three years.

Product Visions

CARE assembled teams of experts in each sector of robotics – industrial, professional service, domestic service, security and space – to think about the kinds of "product visions" that might one day lead to marketable products. A total of 39 were identified, ranging from mining robots to surgical robots and robot teachers.

But when the experts looked closely at the product visions they discovered an alternative way to classify robots, by six cross-sector "application scenarios." These are robotic workers, robotic co-workers, logistics robots, robots for surveillance and intervention, robots for exploration and inspection and "edutainment" robots.

"If you look at each of the application scenarios, their product visions have similar requirements," says Guhl. "But as the product visions come from various sectors it follows that cross-fertilization may be greatly beneficial. The SRA highlights where there are similarities and where the sectors can support each other–where technology developed within space robotics, for example, might become useful for domestic service robotics or the other way round."

Eighteen Technologies

One thing that sets robotics apart from other industries is that there is no single technology called "robotics." In fact, 18 different groups of technologies are identified in the report and many of the product visions make use of all of them. That can make it difficult to know where to focus development efforts. The basic question to ask, says Guhl, is whether a technology is driven by robotics or not.

"Batteries, for example, are very important for mobile robotics," he says. "But a lot of money is already going into developing batteries for the automotive industry and for mobile devices. On the other hand, you have technologies like autonomous navigation. This technology is mostly driven by roboticists, but is also integrated in automobiles which you would normally not classify as robots. So some technologies need to be driven by robotics and some don't."

The agenda lists eight conclusions, or "commandments," that the robotics community needs to adopt if it is to make the most of the available opportunities.

A major challenge in robotics is the integration of the many different technologies into coherent systems, which has implications in many areas such as education. The SRA advises that a European supply chain is needed to reduce dependence on overseas suppliers. Research should concentrate on the key, robotics-driven technologies. Also, it will require more effective communication between academia and industry, and greater cooperation between the traditional sectors to create new markets.

Multitalented Specialists

The multiplicity of technologies also leads to unusual education and training needs. "You don't need specialists in one or two areas to sit around a table and come up with a good product," says Guhl, "You need a number of different specialists, sometimes having a knowledge of numerous disciplines – such as mechatronics engineers – speaking the same language."

Social, legal and ethical issues also need to be anticipated if robots are to play a greater part in our lives and carry out some of the functions normally done by human beings.

The Strategic Research Agenda was published in July 2009 and the CARE project finished the following October. A successor project, euRobotics, began in January 2010, and as Guhl puts it, "get the whole community working together more closely."

Whatever happens, he expects to see many more robots appearing in our day-to-day lives over the next decade or so. "They can help us with caring for people, with making our public spaces safer, with being productive enough to keep manufacturing in Europe, and so on. There is close to no area where robotics can't help in one way or another."

CARE received funding from the ICT strand of the EU's Sixth Framework Programme for research.

For more info: http://www.robotics-platform.eu/ or http://www.eurobotics-project.eu.

Compiled by Giuseppe Riva, Ph.D., and Simona Raspelli, Ph.D.
Istituto Auxologico Italiano
Data provided by ICT Results
(http://cordis.europa.eu/ictresults)

CYBERFOCUS

New technologies are developing at a rapid pace. To help you stay abreast of the latest trends in advanced technologies and healthcare, this feature showcases upcoming, 2009- 2010 events, which will provide you with the opportunity to connect with leading experts worldwide and remain on the cutting edge of the most recent developments.

The CyberFocus column welcomes your contributions. To supply relevant information for this feature, please send an e-mail to: office@vrphobia.eu.

CyberPsychology & CyberTherapy 16
June 20-22, 2011
Gatineau, Canada
www.interactivemediainstitute.com

The Journal of CyberTherapy & Rehabilitation is the official journal of the CyberTherapy Conference. The 16th Annual International CyberTherapy Conference (CT16) brings together researchers, clinicians, policy makers and funding agencies to share and discuss advancements in the growing discipline of CyberTherapy & Rehabilitation, which includes training, education, prevention, rehabilitation, and therapy. The focus of next year's conference is two-fold–first, "Technologies as Enabling Tools" will explore the use of advanced technologies in diagnosis, assessment and prevention of mental and physical disorders. In addition, attention will be drawn to the role of interactive media in training, education, rehabilitation and therapeutic interventions. Secondly, CT16 will investigate the "Impact of New Technologies" and how they are influencing behavior and society through cyberadvertising, cyberfashion and cyberstalking, among others. Technologies featured at the conference include VR simulations, video games, telehealth, the Internet, robotics, brain-computer interfaces, and non-invasive physiological monitoring devices. Conference attendees have the opportunity to play a role in designing the future of mental healthcare. CT16 features interactive exhibits at the Cyberarium allowing participants to experience the technologies firsthand as well as the opportunity to display their exhibits in a forum-type setting.

2010 Conferences

40th European Association for Behavioural and Cognitive Therapies Annual Conference
October 7 - 10
Milan, Italy
http://www.eabct2010-milan.it/

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eChallenges
October 27-29
Warsaw, Poland
http://www.echallenges.org/e2010/

ACM Multimedia
October 29
Florence, Italy
http://www.acmmm10.org/

Global Telehealth
November 10-12
Perth, Western Australia
http://www.hisa.org.au/node/756

HIMSS Middle East
November 8-10
Abu Dubai, UAE
http://www.himssme.org/

Association for Behavioral and Cognitive Therapies (ABCT 2010)
November 18 - 21
San Francisco, California, USA
http://www.abct.org/dMembers/?m=mMembers&fa=Convention

WHCC Middle East
December 5-7
Abu Dhabi, UAE
http://www.worldcongress.com/

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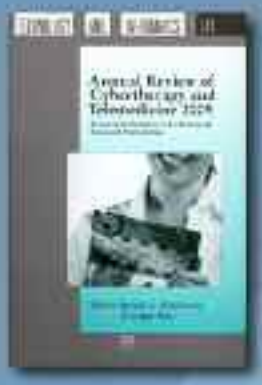

Annual Review of Cybertherapy and Telemedicine 2009
Advanced Technologies in the Behavioral, Social and Neurosciences
Editors: B.K. Wiederhold and G. Riva

$ 167.00

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

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

$24.95

Virtual Reality in the Mental Health arena is barely over a decade old. Because VR is still such a young and focused field, the members of its community have come together as a tight-knit family. In Virtual Healers, Dr. Brenda K. Wiederhold, herself a pioneer of VR, sits down in casual one-on-one interviews with more than a dozen of the top researchers of this select group.

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

$ 19.95

Along with aliens and time travel, virtual reality (VR) is often thought of as a science fiction dream. Though it was developed nearly five decades ago, the use of VR in the private sector, particularly in the field of patient care, has become a possibility only in the past decade. As programmers are creating more detailed and interactive environments, the rapid advancement of technology combined with decreasing costs has turned VR into a promising alternative to traditional therapies.

Virtual Reality Resources
By Brenda K. Wiederhold, PhD, MBA, BCIA

$19.95

We, at the Interactive Media Institute, realized early on that it was relatively difficult for professionals wanting to break into the Virtual Reality (VR) field to locate relevant information. While the material was out there, there was no clear organizational structure or database to link it. To solve this problem, we have put together Virtual Reality Resources, a relevant compilation for researchers and clinicians alike.

CyberTherapy Conference Archives 1996-2005
A Collection of all abstracts from the past 10 years of CyberTherapy
By Brenda K. Wiederhold, PhD, MBA, BCIA

$ 29.95

A decade ago, CyberTherapy, then still in its infancy, only existed as a specialized Virtual Reality and Behavioral Healthcare Symposium at the Medicine Meets Virtual Reality (MMVR) Conference. It is now clear that in 1996, we had only begun to realize what promise might lie ahead for both VR technology and the CyberTherapy Conference.

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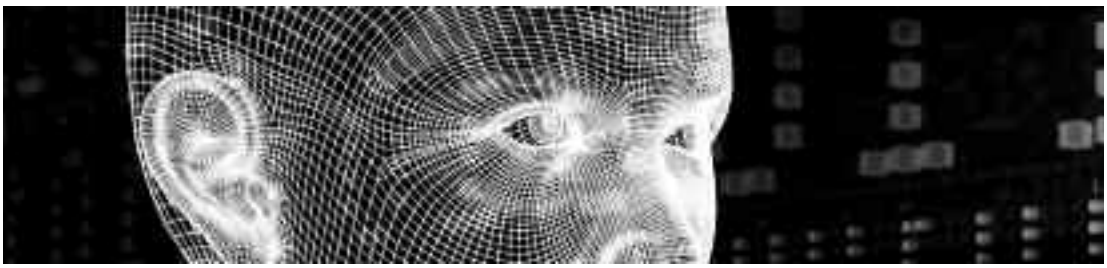

FOR AUTHORS

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BOOK REVIEW
Cyber-Bullying: Legal Implications and Strategies for Schools

***Confronting Cyber-Bullying: What Schools Need to Know to Control Misconduct and Avoid Legal Consequences,* Shaheen Shariff, Cambridge University Press, New York, New York, 2009, 296 pages, $21.99**

The title of this book highlights one of the most common perspectives reported by adults (parents and teachers) – cyber-bullying behaviors are incredibly confronting. The types of cases being reported in the media on an almost daily basis are reaching the point of being overwhelming, scary, and damaging (primarily to the parent-child relationship status). As a result, many parents approach cyber-bullying incidents with an a priori assumption that it is inherently worse than non-cyber behaviors. The phrase, "in my day you would not have seen this," is probably one of the most common things that adults say in relation to cyber-bullying behaviors. However, the danger with this perspective is that parents and educators approach cyber-bullying incidents under the impression that they lack the requisite skills to react to and address these behaviors and are therefore unable to provide support to their children who are being victimized or are engaging in this form of bullying.

This technological disempowerment has resulted in a "digital divide" between parents and their children. The perceived lack of skills has caused many to fear the dangers associated with the Internet, and more broadly technology (which is driven by the predominately negative media attention), resulting in the adoption of reactive and extreme strategies to bullying online. This has had a negative impact on the likelihood that young people who are victimized will share these experiences with parents (Cross et al., 2009). In addition, the public perception of the extreme consequences of cyber-bullying has resulted in the (more likely) less severe psychological responses being overlooked or not taken seriously. Early support for this and the skills issue have been demonstrated in the finding that 46% of young people who were bullied reported that things either stayed the same or got worse after telling an adult (Cross et al.). It may be that the extremely negative consequences represent the potential outcome for those young people most vulnerable (i.e., who may have pre-existing mental health concerns) who are victimized.

In this book, Shariff presents a comprehensive overview of the emerging literature in this area. Unfortunately, this work commenced in 2007 when the field of research around cyber-bullying has grown exponentially since then. The result is that much of the research literature that is presented in this book is outdated. For example, in late 2009, the Journal of Psychology published a Special Issue on cyber-bullying with articles covering some of the most current and innovative theoretical (Dooley et al., 2009a) and empirical work (Spears et al., 2009) on the topic. In addition, several other journals have special issues on cyber-bullying planned for release in 2010 and 2011. Although the significant overlap between online and offline bullying means that the profile of perpetrators and victims is unlikely to differ significantly, there is much more currently known about the psychology of those involved than is reported by Shariff.

Furthermore, given the rate at which technology develops and becomes available to the public, the challenges faced by parents and schools are somewhat different than they were a few years ago. For example, school sectors in Australia are rolling out a one laptop per child program which can be seen as providing students with the means to engage in cyber-bullying behaviors especially as access to technology appears to explain some of the increase in prevalence rates (Cross et al., 2009). In addition, the rise in both awareness and prevalence of cyber-bullying has resulted in schools and education officials being more open to address these behaviors.

Notwithstanding the more current research evidence, Dr. Shariff makes the point in the opening chapter (Cyber Misconduct: Who is Lord of the Flies?, p.5) that

"the argument that cyberspace might in and of itself cause students to engage in bullying does not carry significant weight. Bullying in the physical context has taken place throughout history for years. We cannot blame technology." This is probably one of the most important points in relation to cyber-bullying. The simple fact is that this is not a "new" behavior. Rather, it is an age-old behavior enacted in a new environment. Importantly, Suler (2004) would argue that there are central aspects of the technology that result in reduced inhibition making it easier to engage in these forms of inappropriate behavior.

Despite the overlap between cyber and non-cyber forms of bullying, there are clearly issues related to cyber-bullying that present unique and distinct challenges for those people who are victimized. The only detailed discussion on the topic to date (Dooley et al., 2009a) examines the theoretical construct of bullying and its central tenets (power imbalance, repetition, intention) and applies them in a cyber context. It is clear that there are cyber-bullying related circumstances that present challenges above and beyond the normal scope of non-cyber bullying. This theoretical argument has found support from research conducted both in Australia and Switzerland which demonstrated that cyber-bullying represented an additive effect on poor mental health outcomes independent of non-cyber bullying experiences (Perren, Dooley et al., under review). Those young people who were cyber-bullied in addition to being bullied in non-cyber ways reported significantly higher rates of depressive symptoms than those who were only bullied offline.

Although Shariff bases the above comment on an excerpt from a popular novel, there is emerging research evidence in support of this. For example, a large cross-sectional study involving 7,500 students from schools across Australia (Cross et al., 2009) demonstrated that those young people who were more likely to bully offline were also more likely to bully online, and about 80% of online victims were also offline victims. This seemingly trivial distinction has enormous implications for parents, teachers, school systems, and many others. The most important of these is that if cyber-bullying is addressed as an inappropriate behavior, then it is likely that schools and parents have some strategies that can be adopted to address these behaviors. If the problem is viewed as a technological one, then the solutions must be sought and learned (at least by the majority of parents).

These issues all weigh heavily into recent discussions on the implications, consequences, and legal responsibility/culpability related to cyber-bullying behaviors. Although, as predicted by Shariff, several recent cases related to cyber-bullying have come to the attention of the judicial system and the media. However, it is fair to say that we are still some way off stare decisis (adherence to legal precedence) in relation to cyber-bullying behaviors. Nonetheless, with a recent decision by the California appeals court that cyber-bullying is not protected under the First Amendment protection of free speech (O'Brien, 2010), the legal landscape is changing – at least in the U.S.

This presents an interesting development especially in relation to the discussion in Chapter Four on student free speech (Student Free Expression: Do the schoolhouse gates extend to cyberspace?). Several important developments in relation to online speech have occurred since this book was written which, again, highlight the nature of this quickly changing landscape. For example, in 2009 Liskula Cohen successfully won a landmark case in which Google was forced to reveal the identity of an anonymous blogger who had written defamatory comments about Ms. Cohen (Moses, 2009).

As noted, the main limitation of this book relates to the dated nature of some of the information. This is a reflection on the changing nature of the field as opposed to the quality of the work. The area where this is most apparent is in relation to social networking sites (SNS). The use of SNS has dramatically increased in the past few years, as have the associated risks. Importantly, the developmental patterns of Internet use and SNS have resulted in age-related risks, which present unique challenges to young users (see Dooley et al., 2009b for a comprehensive review of cyber-safety risks). For example, the policy relating to the collection, use, and sharing of private information on Facebook has become a major topic of debate especially as employers use SNS to learn about potential employees. In addition, SNS have increasingly become a vehicle to cyber-bully especially in older adolescents (Cross et al., 2009).

Overall, I would recommend this book to parents and all school staff as a good basis from which to commence discussions concerning cyber-bullying and, more broadly, cyber-safety. The issues raised by Shariff in this book, especially in relation to the legal responsibility of schools, is likely to generate much debate between educators and parents. It is my hope that the following point is made strongly and clearly enough that it influences the development of cyber-bullying prevention and intervention strategies: "actions such as censoring student Web sites, or searching e-mails, for example, are rooted in legally positivist approaches that do not provide the most effective means of preventing cyber-bullying" (p. 243, emphasis added).

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CONTINUING EDUCATION QUIZ

Prepared by Alessandra Gorini, Ph.D.

Learning Ecology Issues of the Mediterranean Sea in a Virtual Aquatic World - Pilot Study (Wrzesien, pg. 11)

If you answer 10 out of 12 questions correctly, you will be awarded one CE credit.

1.Climate changes have a substantial impact on sealife game, as represented by the SVR?
a) yes, but not substantial
b) no impact
c) no relation to the game rules
d) moderate as in reality

2.Can effectiveness of learning by SVR be proved?
a) not yet
b) not with the present program
c) there is no tool to do it
d) it would require questions and answers after the game

3.Can motivation be improved by SVR through action?
a) the study does not allow to assess
b) more tests results are needed
c) yes if through a continous exercise
d) interaction options too much limited

4.Does self confidence develops in relation to other players?
a) only in few cases
b) in all cases
c) it depends on character solidity
d) it may generate frustration

5.Self assessment advisable before starting interaction game?
a) definitely yes
b) irrelevant
c) impact not evaluated
d) negative

6.Theory or playing , which one should prevail?
a) very much related to the person
b) good theory grants interest more (than playing)
c) balancing is essential
d) some people ignore theory

7.Is virtual tutor key?
a) still to be proved
b) it increases confidence of participants
c) it is fundamental
d) it activates competitiveness

8.Should the game be made multiplayer?
a) for future consideration
b) it may generate confusion
c) it would increase potentials
d) much too complicated

9.Is the playing part essential for learning?
a) apparently yes
b) apparently no
c) it contributes to increasing interest
d) absolute necessity

10.Improve/expand checks on learning curve
a) Yes, checks shall be systematic
b) Results on learning are important, if made clear and known
c) Checks may help improving the game
d) Checks may help modifying the game

11.Sealife elements to be enriched?
a) Yes, advisable
b) No, learning would become too difficult
c) Yes, if thought for older pupils
d) Risk of complications

12.Similar applications for other ambients?
a) Effectiveness to be ascertained before further developments
b) Yes, it would increase interested population
c) Irrelevant
d) Wider market

Continuing Education Credits

To qualify for CE credits, readers will need to do the following:

• After reading an article, answer the questions above.

• Send the completed answer sheet, along with payment, to Interactive Media Institute, 6155 Cornerstone Court East, Suite 210 San Diego, CA 92121, U.S.A.

• If you wish to receive a receipt of payment or a copy of the correct quiz answer, please include a self-addressed, stamped envelope.

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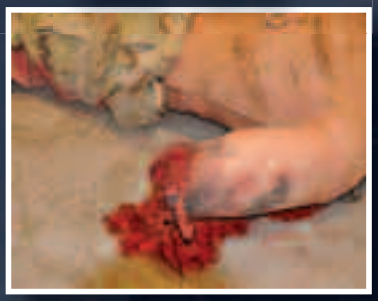

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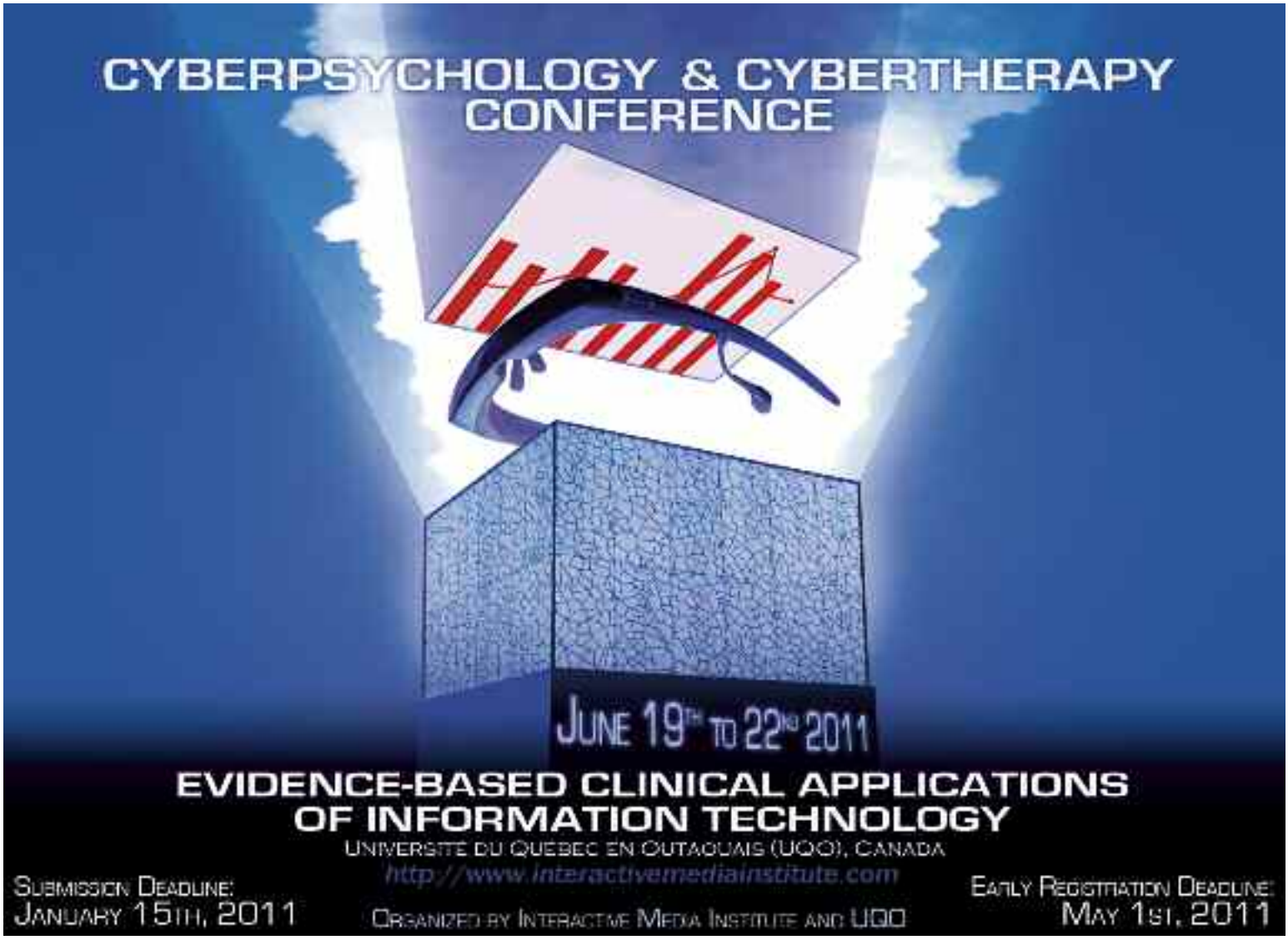
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