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EDITORIAL

As we begin 2009, I want to say "vielen herzlichen Dank" to all those who believed in our new Journal of CyberTherapy & Rehabilitation (JCR) and encouraged its formation. JCR was founded after many requests from the community and exists to support the community. Our inaugural year, 2008, is now behind us, and I am pleased at the reception given by those already in the community, as well as those just discovering the benefits of adding technology to existing healthcare methods and protocols. JCR has thus far published articles by researchers and scientists from around the globe, and is disseminating its newest findings and research through advanced technologies to multiple continents and over thirty-nine countries. Led by an internationally renowned Editorial Board, JCR's authors and board members currently hail from Australia, Belgium, Canada, Croatia, Denmark, Germany, Greece, Israel, Italy, Mexico, the Netherlands, Portugal, South Korea, Spain, Switzerland, the United Kingdom and the United States. JCR is truly international and our aim is to disseminate premier research findings to all corners of the globe.

I am also proud to say that our companion publication, CyberTherapy & Rehabilitation (C&R) Magazine, was launched in December 2008. While JCR is a peer-reviewed, scientific journal, C&R serves as the voice of our association and covers clinically focused and practice-driven articles, congress reports, news and other relevant topics appealing to a wider readership including industry professionals, policy makers, clinicians, and individual citizens.

In 2008, I had the sincere pleasure of participating in many international conferences, in addition to organizing the 13th annual CyberTherapy Conference in San Diego. Each conference was for me an enjoyable learning experience, and I left each full of amazement at how far we have come. It is inspiring to hear both newcomers and veterans of cyber-psychology, therapy, training, and rehabilitation reporting on new discoveries; expanding this seemingly infinite field.

As Editor-in-Chief of the official journal of the 14th annual CyberTherapy & CyberPsychology conference (CT14), I am especially looking forward to the upcoming international conference which is being held in beautiful Lago Maggiore (Verbania), Italy 21-23 June 2009. CT14 has already gained much attention from international organizations and, as in years past, promises to host an international crowd of pre-eminent scientists and industry leaders.

This issue of JCR encompasses research from some of the finest scholars in the field. With submissions detailing some of the most promising applications for technology in therapy, rehabilitation, gaming, and online studies, we are proud to publish studies that have laid the groundwork for this ever-changing field up to this point. This year we are focusing on more in-depth studies, while in 2008, many of our articles served as a review of specialty areas in cybertherapy and rehabilitation. I am grateful for all the authors' hard work, groundbreaking ideas, and scientific rigor in disseminating findings to help progress our community. I am both pleased and honored to publish the articles in this issue knowing full well the time, energy, and countless hours these papers required.

In our first paper, Tarnanas et al. describes the basic system architecture used for virtual reality (VR) emotional human agents and develops a new method of a relative-

scored personality measure. The article discusses the use of VR as a potential tool for personnel screening and selection in organizations.

The second article by King and Delfabbro evaluates the status of heavy game players in comparison with Australian normative data. The physical and mental health of over 400 users, described as "heavy" video game players, was assessed.

Next, Hoffman et al. studies how interactivity influences the magnitude of VR analgesia. Hoffman explores immersive VR as an alternative to traditional pain medications for burn victims during their treatment. The use of a high-tech helmet has broken ground on this interactive vs. non-interactive VR study.

The fourth article by Kott et al. uses a VR system combined with treadmill training for children with cerebral palsy. This pilot study combines treatment with the element of playful gaming to incorporate rehabilitation and technology with a level of fun.

Dr. Griffiths, in our fifth article, examines Internet addiction behavior and the use of Internet help and therapy for those suffering from it. It also investigates various types of online help and therapy available for online problem gamblers and evaluates their overall effectiveness.

Next, Russoniello et al. investigates the effectiveness of casual video games in improving mood and decreasing stress. Russoniello et al. discusses the possible use of games to help treat stress-related medical disorders, including diabetes and depression. This study points to the potential of video games to both prevent and treat stress-related medical orders.

Our final paper, by Zurlo and Riva, discusses electronic brainstorming for creative idea generation. The study examined how the personality traits of group members and the characteristics of the communication process may impact both group creativity and productivity.

Once more, I would like to thank the authors for their incredible work and dedication to this growing discipline. I also want to thank JCR's Associate Editors: Professor Botella, Professor Bouchard, Professor Gamberini, and Professor Riva for their leadership and hard work; as well as our internationally renowned Editorial Board for their many contributions. Our next issue will continue to explore the ways in which technology influences and enhances the healthcare of citizens throughout the world. JCR is interested in original research and ideas for future thematic issues from you, our readers. This is your journal, so please contact us with your interesting manuscripts and ideas. Thank you for your continuing support of JCR. The possibilities and potential for advanced technology in healthcare are unlimited, and I am proud to be a part of such a thriving and groundbreaking community. To employ a famous quote: "Together, we can make a difference!" We can change healthcare as we know it!

Brenda K. Wiederhold, Ph.D., MBA, BCIA
Editor-in-Chief, *Journal of CyberTherapy & Rehabilitation*
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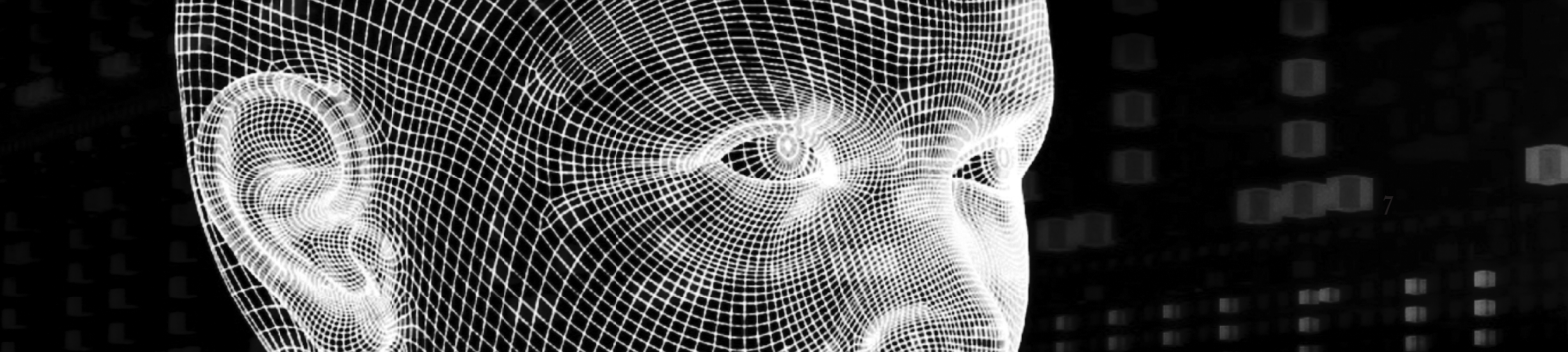

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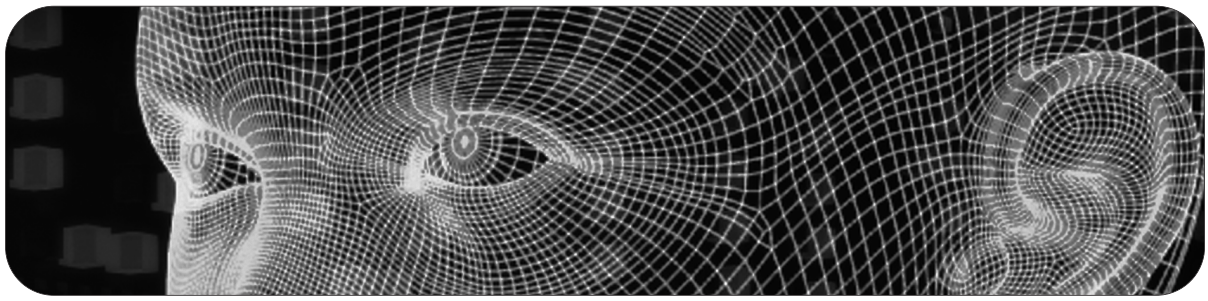

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USING VIRTUAL REALITY EMOTIONAL HUMAN AGENTS AS A RELATIVE-SCORED PERSONALITY MEASURE

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There are a variety of old and recent studies, which indicate that self-report measures of personality appear susceptible to biased responses, especially when administered in competitive environments (e.g., Barrick & Mount, 1996; Ones, Viswesvaran, & Reiss, 1996; Hirsh & Peterson, 2008). According to these studies, respondents can typically selectively enhance their positive traits while downplaying negative ones. Consequently, it can be difficult to achieve an accurate representation of personality when there is motivation for favorable self-presentation. There has been one recent attempt to address the problem of biased responses and the lack of success in detecting and controlling this tendency, by using a new method of comparative scaling techniques, in which each trait domain was scored relative to all the others, rather than being scored separately (Hirsh & Peterson, 2008). Previous research suggests that these relative-scored, or ipsative, survey formats may be less susceptible to distortion than their Likert scored counterparts (Christiansen, Burns, & Montgomery, 2005; Jackson, Wroblewski, & Ashton, 2000). In this paper we introduce a virtual reality strategy for relatively scoring an individual's personality by means of virtual emotional human agents. Over the last five years, the technology for creating virtual humans (VHs) has evolved to the point where they are no longer regarded as simple background characters, but rather can serve a functional interactional role. Our current project involves the construction of a virtual emotional human agent that animates a personality description. The virtual human's personality descriptors used in the current study were taken from the IPIP five factor questionnaires, including the IPIP NEO, BFI, and the Big Five items from the Seven Factor questionnaire. The relative-scored personality strategy used in the project will be comprised of the following three different comparative scaling methods: paired comparisons, forced-choice, and rank order techniques. Inside the virtual world, the participants will have different methods of interacting with the virtual humans relative to the three different comparative scaling methods used. For example in the first relative-scored method, the participants have to design a "custom" virtual human by choosing the most appropriate self-description from two different trait categories (e.g., "I see myself as someone who is depressed" vs. "Am full of ideas" contrasts Emotional Stability with Openness, respectively). In the rank order method, participants will be presented with five animated virtual human's personalities (one from each trait domain) and will be asked to rank them with regards to how well they applied to their own personality. The data collected from this virtual world will not only be the participant's "active" interactions with the virtual humans but also "passive" monitoring and recording of behavioral patterns inside the virtual world during the "active" interaction (e.g. "virtual point of gaze", "point of gaze activity" and "reaction times for the virtual human personality selection process"). Because an individual's score on any personality scale is a function of the true score plus measurement error or response bias, the data collected above offer an additional method of detecting such strategic response manipulations. Overall, then, the present paper aims to describe the basic system architecture used for this virtual reality emotional human agents (VREHA) scored measure of the Big Five, which can be constructed as an alternative to questionnaire responding. As a future study we would like to compare our method with some new personality measures with predictive power, such as the "fake proof" Hirsh and Petersen construct. Herein however we proffer a description of our iterative design process and outline our long-term vision.

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Introduction

The purpose of this article is to introduce virtual reality technology as a potential tool for personnel screening and selection in organizations. Herein we describe some virtual reality assessment methodologies and some current applications. Then we propose specific types of personality traits, skills, abilities, and other characteristics particularly suitable to being assessed using virtual reality technology. We focus on virtual reality emotional human agents (VREHA) that hold the greatest promise in terms of yielding greater validity than more commonly used selection techniques. We hope the present article will stimulate and guide future empirical research on the potential of virtual reality technology as a personnel screening and selection tool.

A critical feature of VR applications is interaction with the VE and with virtual objects within the environment. A number of different types of hardware and software may be used to create VE's with differing capabilities. Many systems consist of a computer with a three-dimensional (3-D) graphics card, hardware devices to measure movement kinematics and/or provide haptic or force feedback, and specialized software. Another important feature of virtual reality is the provision of a sense of actual presence or immersion in the simulated environment. Recent work suggests that physiological measures including heart rate and galvanic skin response correlate strongly with subjective user impressions of immersion.

Several options are available for stimulus display, ranging from flat screen desktop monitors to head-mounted displays (HMD's) to highly immersive VR "caves" that provide multi-person, room-sized 3-D graphics. It turns out, however, that for many purposes, the degree of graphic realism of the VR display is of circumscribed relevance in influencing the subjective feeling of presence in the VE. For example, a number of VR scenarios presented on flat screen or HMD systems designed to treat specific phobias through exposure have resulted in subjective fear responses and elevated physiological indices of distress (and ultimately, have proven successful) despite the fact that the display is not actually "mistaken" for the real world (e.g., Macedonio et al. 2007). On the other hand, there are clearly research questions that warrant the use of more immersive systems. For example, the laboratory of Emily Keshner at Temple University is studying the contribution of visual, tactile, and vestibular cues to balance controls; an area of research for which an immersive "cave" system is well-suited (e.g., Keshner, Dokka and Kenyon 2006). In this regard, displays presented on large (> 48") flat screens have performed with strong ecological validity in several studies with rehabilitation patients (see Buxbaum et al. 2008, for example). Flat screen systems also avoid the "cybersickness" (dizziness, nausea, headache, loss of coordination, and/or loss of balance) frequently encountered with head-mounted displays. An additional difficulty with head-mounted displays is that they must be adjusted to fit a wide range of individual participants, as is often necessary in clinical and research environments.

Many VR systems operate with standard mouse and/or joystick interfaces. In addition, several types of motion-tracking devices may be used to monitor movements of the arms, trunk, and/or legs. Electromagnetic tracking devices are commonly used. Instrumented gloves fitted with vibrotactile devices may be used to provide tactile feedback when a virtual object has been "touched." Robotic arms, hands, or fingers that generate force feedback may also be used.

As pointed out by Holden (2005), the efficacy of various systems depends largely upon how well-versed developers are with the underlying rationale for the particularities of these systems as they relate to the specific deficits of the patient population (e.g., in terms of scientific theories and findings in the domain of motor learning). At the same time, engineering knowledge is required to understand the capabilities and limitations of various technologies. Thus, to be successful, experiments using VR technology require collaboration among clinicians, engineers, and researchers.

The uses of VR in assessment and psychiatric diagnosis

The past decade has witnessed a burgeoning interest in the use of virtual reality (VR) technology for assessment and psychiatric diagnosis. VR applications have a number of desirable features from an assessment perspective. First, VR presents an opportunity to create assessment and diagnosis scenarios that incorporate naturalistic challenges and are highly relevant to real-world functioning. For example, a number of virtual homes, classrooms, cities, and kitchens have been produced, and some are well-correlated with performance in the real-world environment (Rizzo et al. 2004). Second, VR permits experimental control over stimulus timing, visual appearance, auditory attributes, and other stimulus characteristics. These attributes can be

manipulated in service of a number of goals; for example, to optimize similarity to real-world functional environments, parametrically vary or titrate aspects of the stimuli along some desired dimension, and/or test specific hypotheses about the role of various environmental factors in patterns of performance. VR applications also permit delivery of feedback to patients on a desired schedule (e.g., immediately, or with reference to an automated schedule), and provided in the desired sensory modalities, for example, via audition or vision. The virtual environment (VE) created by Dr. Peled and associates allows the diagnosis of schizophrenia by using virtual reality technology to build a complex, multimodal environment in which cognitive functions can be studied (and measured) in parallel (Sorkin et al., 2006). These authors studied sensory integration within working memory by means of computer navigation through a virtual maze.

Several recent VR applications from the Institute of Psychiatry at King's College London are used to study and treat Schizophrenia. In one of them, VR assessment of persecutory ideation was shown to confer particular benefits. Questionnaire assessments of paranoia cannot rule out paranoid thoughts that are grounded in reality (Freeman, 2008). Even interview methods often cannot establish the truth of the claims underlying a suspicious thought. However, if a neutral social situation is presented using VR, any paranoid thoughts that occur are known to be unfounded. Moreover, the person cannot act in a way to elicit hostile reactions from the avatars. In the author's initial work with students, a library scene was used, but subsequently a 5-minute ride on a London underground train between 2 stations has been developed (Valmaggia et al, 2007). Consistent with continuum views of paranoia, it has been shown that approximately one-third of the general population has persecutory thoughts about the computer characters. Validating the methodology, those higher in trait paranoia experienced higher levels of persecutory ideation in VR. In a study of 200 non-clinical members of the general population, comments ranged from positive (e.g., "One guy was checking me out—flattering.") to neutral (e.g., "Didn't think anyone thought anything about me. All getting on with own business. Nobody seemed to notice me.") to paranoid (e.g., "Thought a couple of the men were stuck up and nasty. Lady sitting down laughed at me when I walked past.") (Valmaggia et al., 2007).
The above study can be considered as the most unambiguous demonstration of paranoid thinking in the general public. Significant ascription to the avatars of personalities and mental states is made. Individuals at high risk of psychosis and individuals with persecutory delusions (Freeman et al., in press) have similarly been found to have persecutory thoughts about the neutral avatars. In recent work in the laboratory, individuals who experience auditory hallucinations in social situations have been reporting voices in the virtual train. Environments pertinent to other symptoms of schizophrenia could be developed. VR has already started to be used to assess social perception in people with schizophrenia (Kim et al., 2007). Non-social environments have been successfully used to administer neuropsychological tasks (Sorkin et al., 2005) and to test medication management skills (Kurtz et al., 2007) in individuals with schizophrenia.

Another recent system uses VR to provide an ideal setting to study behavioral and physiological correlates of symptoms. It is relatively simple to record a participant's movement in VR. Eye tracking can also be combined with VR. Measures of arousal such as heart rate, blood pressure, and skin conductance can be taken; an example of the assessment of fear responses in VR is provided by Mühlberger et al. (2007). It is plausible that adaptations of the virtual scenarios, using joysticks for navigation, can be used in functional magnetic resonance imaging studies (Mraz et al., 2003). Intriguingly, individuals who are only thinking about walking have navigated along a virtual street via feedback from electroencephalogram recordings (Pfurtscheller et al., 2006). Physiological and behavioral recordings of interest can then be examined in relation to symptom occurrence.

Examination of differential predictors of individual psychotic symptoms has not yet occurred, presumably because of the diagnostic focus of so much research. In the author's work, there has been interest in identifying not only the causes of psychotic and emotional disorders that are shared but also the factors that are distinct for each condition (Freeman and Garety, 2003). In the large general population study, social anxiety in VR was also assessed. Clustered bivariate logistic regressions were carried out, testing interactions between potential predictors and the type of reaction in VR, paranoid, or anxious (Freeman et al., in press). Anxiety, worry, and depression were associated with both social anxiety and paranoid reactions (i.e., were shared factors). The presence of perceptual anomalies, however, increased the risk of paranoid

reactions but decreased the risk of social anxiety (i.e., it was a differential predictor). The result is consistent with an earlier pilot study (Freeman et al., 2005).

Assessing multiple symptoms in VR provides a powerful method of examining differential predictors. The King's College group concludes that VR provides an excellent method for establishing causal roles. The factor of interest is manipulated and the effects on symptom occurrence in the virtual environment examined. For example, a causal role for anxiety in paranoia could be determined by examining differences in symptom occurrence in VR after randomization to an anxiety-inducing, anxiety-reducing, or control condition. Within- or between-subject designs could be used. Causal roles of medication and illicit substances could be similarly examined. If there is a demonstrated manipulation procedure for the variable of interest, then the short-term effect on symptom occurrence can be examined using VR. There are a number of ongoing studies of this type taking place in the above VR laboratory.

A considerable number of other VR systems have been the subject of at least preliminary research, including systems for detecting navigational deficits in cognitive aging and Alzheimer disease using virtual reality (Cushman et al., 2008) and as a diagnostic tool for depression (Gould et al., 2007). In this last study scientists from the University College of London were using a virtual reality, three-dimensional video game that challenges spatial memory as a new tool for assessing the link between depression and the hippocampus, the brain's memory hub. Spatial memory is the memory of how things are oriented in space and how to get to them. Researchers found that depressed people performed poorly on the video game compared with non-depressed people, suggesting that their hippocampi were not working properly.

Finally, several groups in the U.S. Army are currently interested in developing state-of-the-art training methods that leverage the assets that are available with advanced information technology. The Virtual Reality Cognitive Performance Assessment Test (VRCPAT) group makes use of virtual environments to create a battery of neuropsychological measures to assess the ways in which the structure and function of the brain relate to specific psychological processes and overt behaviors: attention-vigilance, effort, abstraction-flexibility, executive functioning, spatial organization, visual-motor processing, processing speed, visual memory, verbal abilities, and verbal memory and learning (Parson et al., in press).

In general, VE's can be developed to incorporate game-like elements that may improve patient motivation to participate in therapy, and may be used for self-guided independent training for continued practice after discharge from the clinic. Thus, VR appears both well-suited to psychiatric assessment and worthy of additional research.

Practical issues of using Virtual Reality Emotional Human Agents (VREHA) for personality research

Herein we describe the initial plan for developing and using Virtual Reality Emotional Human Agents (VREHA) that will be used for screening personality profiles from a virtual world representation of personality constructs, such as the Big Five personality questionnaire. This is an initial pilot study that will serve as the basis for a longer term research vision, that of creating a comprehensive personality diagnostic virtual world having emotional virtual humans and scenarios that can screen for real world problems in organizations, such as risk for corruption, risk for violence and moral development training. Our long term plan is to also integrate an automated tutor agent that can appear as an interview session to assess the moral development of the trainee and provide feedback as to how a line of virtual scenarios and cases may have properly gathered relevant assessment information in a virtual "crime of opportunity" or predict the risk for future corruption.

Over the last five years, the technology for creating virtual humans (VHs) has evolved to the point where they are no longer regarded as simple background characters, but rather can serve a functional interactional role (Swartout et al., 2006; Gratch et al., 2002). This will be vital to create MH training tools that leverage the use of VHs for applications that require human-to-human interaction and communication. This would open up possibilities for clinical applications that address interviewing skills, diagnostic assessment and therapy training. The USC Institute for Creative Technologies has been conducting similar VH research as part of its primary mission over the last seven years to create highly interactive, artificially intelligent agents to be used for VR military leadership and negotiation training (Rickel et al., 2001). This VH effort is built on prior work

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

Our current project involves the construction of a virtual world with natural language-capable VH agents, which sought to improve the predictive validity of the personality assessment instruments themselves. Specifically, the current pilot project involved the theoretical design and validation of a virtual world relevant for the Big Five personality questionnaire that could prove more resistant to biased responding. VHs with specific personality traits were created and user interactions to those VHs was monitored using a variety of comparative scaling techniques, in which each trait domain was scored relative to all the others, rather than being scored separately.

The first relative-scored method used in our virtual world was Thurstone's (1927) paired comparisons technique. In our pilot experiment, respondents had to make a series of choices between two virtual reality emotional agent (VREHA) personality representations. During each interaction, the participant was asked to choose the most appropriate VREHA self-description from two different trait categories (e.g., "I see myself as someone who is depressed" vs. "Am full of ideas" contrasts emotional stability with openness, respectively). In a single comparison block, one VREHA item was taken from each of the five dimensions. The item from each of the dimensions was then compared to an item from each of the others, leading to 10 comparisons per block. After 100 of these comparisons are made, all five dimensions end up being compared to each of the other ones ten different times. Half of the blocks compared two positive items with each other, while the remaining blocks compared two negative items with each other. Altogether, ten unique items were presented from each of the five dimensions. Domain scores were calculated by summing the number of times that positive items from a given dimension are chosen and subtracting the number of times that negative items from that dimension are chosen. Raw scores had a potential range of -20 to 20.

In the forced-choice method, the VREHA markers were split into five groups of positive items and five groups of negative items. In the positive groups, respondents had to select the 10 most appropriate VREHA personality descriptions from a list of 20 available options. Each group contained four items from each of the five trait dimensions. In the negative groups, only 5 choices were required from a list of 20 items. The difference between positive and negative item groups was intended to make it easier for the participants to choose negative self-descriptions. A total of 200 unique items were included in this section, balanced between each of the five trait dimensions. Domain scores were again calculated by summing the number of positive items selected from each dimension, and subtracting the number of negative items. The potential raw scores range from -20 to 20.

In the rank order method, participants were presented with five VREHA personality descriptions (one from each trait domain) and were asked to rank them with regards to how well they applied to their own personality. In total, twenty groups of five were presented, with ten groups of positive items and ten groups of negative items. Altogether, 100 unique descriptors were displayed. Items were reverse-scored for the order that they were chosen (i.e., items ranked as most applicable were given a 5, and items that were least applicable were given a 1). Domain totals were calculated by summing the positive scores within each dimension and subtracting the negative scores. The potential raw scores ranged from -40 to 40. Altogether, the combined administration time for the three relative-scored methods was approximately 50 min.

For a traditional Likert personality questionnaire, we administered the Big Five Inventory (John, Donahue, & Kentle, 1991). This questionnaire features 44 items across the five trait domains, and requires respondents to rate their agreement with a variety of personality descriptions on a 5-point scale (e.g., "I see myself as someone who is a reliable worker").

Two main findings from our pilot experiments provide some strong support for the robustness of the VREHA-scored personality virtual world against Big Five questionnaires. First, the VREHA-scored Big Five dimensions were not correlated significantly with the single factor extracted from the fake-good BFI and hypothetically indexing positive self-presentation. Second, the VREHA-scored questionnaire was not susceptible to the potential for producing positive bias that was apparently characteristic of speakers with increased English fluency.

On a theoretical note, each of the composite domain scores derived from the VREHA measure represents the relative strength of a given trait, as compared to the relative strength of that trait in others. In other words, a high conscientiousness score on the virtual world indicates that such an individual places a greater within-person emphasis on conscientiousness, compared to other individuals. The current study thus suggests that the relative strength of different VREHA personality traits within an individual can still be an effective personality predictor. The fact that such within-person ranking of personality traits is an effective predictor of personality deserves attention in future research. It is worth noting, however, that the high correlations between Likert and VREHA-scored Big Five dimensions also suggests that within-individual trait rankings converge considerably with absolute trait scores rated across individuals.

Conclusion

Balancing ecological validity and control in psychological testing is a challenge. We have explored the use of Interactive Virtual Environment Technology to create an environment for psychological testing. We believe that Virtual Reality Emotional Human Agents (VREHA) will play an important role in the future of personality research and personnel selection. A comparison with some new measures such as the Hirsh and Peterson "fake proof" measure of Big Five (Hirsh & Peterson, 2008) could help extend the research of VREHA as a personality predictor. The use of virtual reality emotional human agents could be implemented in several ways. In addition, the use of virtual reality emotional human agents illustrating common problems such as acting out, transference, intrusive questions, or seductive behavior would allow residents to have an experience of these anxiety-provoking situations in a simulated setting before they occur in their practice. Finally, performance in VREHA scenarios could be used as an additional source of data for the assessment of resident competency in the psychotherapy domain.

It is worth noting that relative-scored, or ipsative, techniques have been severely criticized for some of their mathematical shortcomings, such as range restriction and reduced variance. There is thus some real cost to be paid for accruing the benefits of potentially increased validity. Whenever an increased score is observed in one dimension, a lower score is necessarily observed in another dimension. The resultant collinearity between domains could make the VREHA-scored survey format problematic for multiple regression and factor analyses. Consequently, such attempts are most useful when a single domain can be used for predictive purposes, without attempting to combine it with any of the other domains. VREHA should also not be relied upon to assess the relationships between traits, because these are necessarily forced to be more negatively correlated with each other than would be the case for a non-ipsative measure.

Overall, then, the present study provides evidence that the VREHA-scored measure of the Big Five can be an alternative to questionnaire responding. Perhaps individuals motivated to employ Big Five trait questionnaires might choose between the Likert and VREHA-scored measures, according to their explicit purposes. The former may well prove more effective under two conditions: first, when the goal is to assess the statistical nature of the relationship between different traits, as the correlation between these traits is not exaggerated by the administration methodology and second, when the relationship between a criterion external to the test is to be measured under conditions when the test-takers are not motivated to look good. The VREHA-scored measures, by contrast, may be particularly useful when prediction under motivated conditions is the aim. Further research is required in order to show whether the VREHA methodology is likely to be useful, for example, under competitive, zero-sum conditions where respondents will be motivated towards favorable impression management.

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THE GENERAL HEALTH STATUS OF HEAVY VIDEO GAME PLAYERS: COMPARISONS WITH AUSTRALIAN NORMATIVE DATA

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The health-related quality of life among heavy users of electronic entertainment has not been well described in literature. This research examined the general health status of heavy video game players. "Heavy" video game playing was defined as (a) playing for over 30 hours per week, (b) playing for at least 4 days per week, and (c) playing for an average duration of 3 hours in a typical sitting. A total of 411 participants were drawn from video game outlets and gaming cafes, and administered a survey package. The heavy playing subgroup (N=45) scored significantly lower on measures of physical functioning, mental health, vitality, general health and social functioning than normal Australian adults. The majority of this subgroup also did not meet national guidelines for weekly exercise and reported some sleep-related problems.

INTRODUCTION

Video game playing is an increasingly prevalent national pastime. However, among health professionals and the lay public, there is concern that frequent sedentary behavior associated with screen-based entertainment like television and video games may displace regular physical activity and therefore contribute to general health problems such as obesity. In the last two decades, numerous studies have examined patterns of video game play among children and adolescents to identify the effects, if any, of video game playing on general health, emotional well-being and development. Previous research has identified a weak relationship between television and video game use and health risks by taking an epidemiological approach, such as surveying large random samples of schoolchildren (e.g. Wake, Hesketh & Waters, 2003). In these studies, individuals commonly report low to moderate television or video game use, typically 30 to 120 minutes per day. In explaining the apparent lack of a strong statistical relationship between sedentary behavior and obesity, Vandewater, Shim and Caplovitz (2004, p. 83) stated:

It could be that the youth obesity status is linked to television only at the highest levels of such use (e.g. 20-30 hours or more weekly) as some research has indicated.

Little is known regarding the health-related quality of life in persons who report playing video games on a more frequent basis, i.e. over 30 hours per week. Thus, the present study sought to investigate the general health status of this subgroup of "heavy" video game players, and consider their general health profile in the context of the normal Australian adult population.

Vandewater, Shim and Caplovitz (2004) advanced three main hypotheses concerning why television and video game use may be related to obesity and other health problems. The first is known as the "couch potato" hypothesis, a theory which has been termed an "intuitive belief" (Tremblay & Willms, 2003), which states that sedentary behavior displaces physical activity, thereby directly decreasing (or perhaps reducing opportunities for) energy expenditure. This hypothesis provides the most commonly used rationale for health-oriented studies of media use and is widely cited within the mass media.

The second hypothesis attempts to link television and video game use to increased risk of unhealthy food consumption. It is thought that children who spend a lot of time watching television or playing video games are more

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likely to consume calorie-dense snacks and other foods whilst participating in these activities. Also implicit in this hypothesis is the assumption that commercials on television promote the consumption of unhealthy foods, like sugary cereals and fast food burgers, leading children to seek out these foods or request them from their parents. This hypothesis is perhaps less applicable to video games due to the lack of in-game advertising, although the video game medium has greater potential to influence children's attitudes to food given its interactive nature (Gee, 2003).

The third hypothesis states that television and video game use may decrease metabolic rate, to a greater degree than simply resting or sleeping. Klesges, Shelton and Klesges (1993) found some support for this hypothesis in a sample of 8 to 12 year old children, but later attempts to replicate their results have generally not been successful. On a related note, researchers have questioned the amount of energy that is typically expended whilst playing video games. There is evidence that energy expenditure more than doubles when playing "active" video games compared with sedentary ones (Lonnington-Foster et al., 2006), despite the fact the intensity of this exercise is not high enough to contribute towards the recommended daily amount of exercise for children (Graves, Stratton, Ridgers & Cable, 2008).

Research to date has yielded mixed results for each of these hypotheses. Empirical studies that employ correlational designs have tended to report weak bivariate relationships between media use and measures of adiposity (e.g. body mass index, skinfold thickness, etc.) when controlling for variables like social capital and physical activity. A meta-analysis by Marshall, Biddle, Gorely, Cameron, and Murdey (2004) reported that "a statistically significant relationship exists between TV viewing and body fatness among children and youth although it is likely to be too small to be of substantial clinical relevance" (p. 1238). Vandewater et al. (2004) also concluded that the data available to date do not support the notion of turning off electronic media as being the "magic bullet" that will reduce the prevalence of youth obesity. In reality, childhood obesity has occurred as the result of a confluence of complex environmental factors, including increased availability of calorie-dense foods, decreased parental supervision, increased motorized transport, and other similar factors (Biddle et al., 2004).

There is ongoing debate over the significance of electronic media habits among obese youth, but little is known concerning the health-related quality of life among adolescents and adults who play video games as a major part of their daily lives. Recent research has suggested that between 5 and 12% of video game players play video games, particularly online games, to an excessive degree (Griffiths & Hunt, 1998; Griffiths, Davies & Chappell, 2004; Fleming & Kraut, 2007; Grüsser, Thalemann, Albrecht & Thalemann, 2005). However, at present, there is a dearth of documented evidence regarding the general health effects associated with this kind of heavy play.

Black, Belsare, and Schlosser (1999) presented 21 clinical cases (16 men, 5 women) of individuals who reported compulsive computer use. Actual weekly playing time varied among participants because they were selected on the basis of psychological "dependency" on computers, rather than time spent playing. The participants' reported range of "inessential" computer time was quite variable, ranging from 7 to 60 hours per week. Black et al. reported that their "compulsive" playing group did not report health problems (as measured by the SF-36) greater than the general U.S. population, although their mental health status was relatively lower (which may be related to their computer dependency). This research offered some insights into the self-reported health status of heavy computer users, but their sample was relatively small and was not entirely composed of "heavy" users. Other studies have reported adverse heath effects of playing video games, including sleep deprivation (Tazawa & Okada, 2001), wrist and neck pain (Burke & Peper, 2002), and repetitive strain injuries (Ramos, James & Bear-Lehman, 2005).

This research was intended to provide a much-needed insight into the general health of heavy video game players, with reference to normative data on Australian adults. On the basis of the extant literature on media use and obesity, it was predicted that heavier use of video game technologies would be associated with greater general health problems, such as being overweight and general physical functioning. We also predicted that heavy video game players would score significantly lower on measures of general health, and report substantially more poor health-related behaviors, than the normal Australian population.

METHOD

Procedure

Participants were obtained by approaching the patrons of various video game retail outlets, Internet cafes, and LAN gaming businesses in the city of Adelaide, South Australia. Permission was obtained from the owners or organizers prior to data collection. Participants were approached by the first researcher and informed of the purpose of the study, and told that their responses would be completely confidential. Participants who agreed to take part in the study signed a consent form and were given a paper-and-pencil survey to complete on their own. Approximately 98% of individuals who were asked to participate accepted the invitation. This sampling method was based on previous research that has investigated excessive gambling among patrons of gambling venues (e.g. Griffiths, 1991; Ladouceur & Dube, 1995). This approach is particularly useful for identifying frequent players. The present study was part of a larger research project examining patterns of video game playing among young adults.

Materials

Video Game Play Survey. This survey was designed for the purpose of the present study and was similar in design to other video game frequency measures (e.g., see Salmon, Bauman, Crawford, Timpero & Owen, 2000). The survey measured a person's duration of play (in hours) on different video game systems for each day of the week in a typical week (i.e., Monday to Sunday). Days of the week were distinguished to account for players with variable playing patterns, such as players who may play for a longer session on the weekend or on a particular night of the week. The "typical week" referred to a typical week in the last three months. By adding together all weekly session durations, this measure yielded an overall estimation of hours spent each week playing video games. An average "weekday" and "weekend" session could also be computed. Additional questions asked participants how many years in their lifetime they had played video games, and how many video games they were playing concurrently.

Short Form-36 Health Survey (SF-36). The SF-36 is a multi-purpose, short-form health survey composed of 36 questions (Ware, 2000). The test yields an eight-scale profile of scores as well as physical and mental summary measures. The SF-36 has been used in over 1000 empirical studies. The measure has demonstrated moderate to strong internal consistency. In addition, studies have shown that the SF-36 has high content, construct, concurrent, and predictive validity (Anderson, Laubscher & Burns, 1996; Sanson-Fisher & Perkins, 1998; Watson, Firman, Baade & Ring, 1996). Higher scores on each of the test's subscales indicate higher degrees of general health and well-being.

Kessler Psychological Distress Scale (K10). The K10 is a brief, 10-item measure of psychological distress, suitable for clinical and epidemiological purposes (Kessler et al., 2002). Andrews and Slade (2001) reported that the K10 has high convergent validity and the test is suitable for assessing morbidity in the Australian population. The K10 yields a score from 10 to 50, with higher scores indicating a greater presence of psychological distress.

General health survey. Nine self-made questions were developed for the purposes of the present study. The questions were based on standard health questions used in epidemiological research. The questions queried participants' exercise habits (i.e. "how often do you exercise for 30 mins per day?"), alcohol consumption (i.e. "on how many days of the week do you drink alcohol?" and "how many standard drinks do you consume in a typical sitting?"), as well as cigarette use and caffeine consumption. Participants were also asked their height (in centimetres) and weight (in kilograms) in order to calculate their Body Mass Index (BMI).

Sleep Hygiene Index (SHI). The Sleep Hygiene Index is a 13-item measure of sleep quality and sleep habits (Mastin, Bryson & Corwyn, 2006). Mastin et al. (2006) reported that the SHI is strongly correlated with other measures of sleep quality and demonstrates strong test-retest reliability. The SHI yields an overall score between 13 and 65, with higher scores indicating poorer sleep hygiene.

RESULTS

Table 1 presents a summary of the demographic information for the overall sample. Consistent with previous studies of the video game playing population (Griffiths, Davies & Chappell, 2003), the mean age of the participants was 20.3 years (SD = 5.1). The majority of the

participants were single (N = 258) and reported having a white, English-speaking background (N = 376). In general, participants were studying towards or had completed their secondary school education (N = 209) or undergraduate degree (N = 114), were unemployed (N = 112), or working on a casual basis (N = 198). A typical week of video game playing was reported to be 17.8 hours on either a personal computer and/or dedicated games console, with an average playing session lasting 2.0 hours (SD = 1.4) on a weekday and 2.9 hours (SD = 2.3) on the weekend.

Table 1. Demographic information across three video game playing groups based on weekly use

Video game playing (hours per week)							
Demographic		0-20		21-34		35+	
Gender		N	%	N	%	N	%
Male	(336)	203	60	88	26	45	22
Female	(75)	69	92	4	5	2	3
Age							
14-17	(123)	88	72	22	18	13	11
18-21	(161)	100	62	41	25	20	12
22-25	(75)	49	65	17	23	9	12
Over 25	(52)	35	67	12	23	5	10
Relationship Status							
Single	(259)	164	63	63	38	31	12
Partnered/Married	(152)	107	70	29	19	16	11
Highest Education							
High School	(214)	139	65	44	21	31	22
Undergraduate	(171)	109	63	47	27	15	9
Postgraduate	(26)	24	92	1	<1	1	<1
Employment							
Unemployed	(113)	65	57	29	26	19	17
Casual or Part-time	(206)	144	70	39	19	23	11
Full-time	(90)	62	69	24	27	4	4
Yearly income							
<$20,000	(281)	181	64	62	35	38	14
20,000 to 30,000	(35)	27	77	6	17	2	6
30,000 to 40,000	(32)	17	53	13	41	2	6
> $40,000	(63)	47	74	11	18	5	8

Note: Percentages refer to % of demographic subgroup, not overall sample.

The overall sample of 411 participants was analyzed to identify any relationships between media use, measures of adiposity and general health and well-being. Table 2 presents a summary of the bivariate relationships between all measures of video game use, including mean playing session duration and overall weekly use, and all continuous heath-related variables. With the exception of a weak positive correlation between video game usage and decreased mental health, there were no significant correlation relationships.

Table 2. Correlations between video game use and measures of general health and well-being

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Total weekly hours													
2. Mean weekday session	.81**												
3. Mean weekend session	.80**	.74**											
4. Physical Functioning	-.04	-.06	-.08										
5. Role-Physical	-.01	-.02	.01	.36**									
6. Bodily Pain	.01	.00	.00	.22**	.34**								
7. General Health	-.05	-.05	-.06	.41**	.25**	.19**							
8. Vitality	-.03	-.00	-.05	.36**	.28**	.28**	.44**						
9. Social Functioning	.02	.01	.03	.12**	.27**	.28**	.16**	.24**					
10. Role-Emotional	-.03	-.06	-.07	.22**	.35**	.20**	.23**	.33**	.34**				
11. Mental Health	-.10**	-.12**	-.11**	.22**	.32**	.18**	.40**	.52**	.28**	.42**			
12. BMI	-.01	.07	.05	.31**	-.11**	.02	-.13**	-.06	-.05	-.02	.00		
13. K10	.08	.13**	.13**	-.14**	-.36**	-.30**	-.40**	-.64**	-.33**	-.53**	-.74**	.02	
14. Sleep	.08	.03	.10	.19**	-.20	-.29**	-.18**	-.23**	-.16**	-.29**	-.23**	-.10**	.32**

** $p < .01$

Identification of a heavy video game playing subgroup

Following Vandewater et al.'s (2004) recommendation that researchers should investigate health among heavy users of media, a subgroup of heavy players was identified. At present, there are no formal guidelines for what constitutes "heavy" involvement in video games. As a conservative example, Fotheringham, Wonnacott, and Owen (2000) considered people who played for more than eight hours per week as distinct from more casual players. Some researchers have argued that it is more meaningful to consider what people are sacrificing to play video games, rather than imply potentially "problem" involvement on the basis of time spent playing alone (Charlton & Danforth, 2007). Recent studies

have identified a minority of players, typically players of online role-playing games, who play for over 30 hours per week (Griffith, Davies & Chappell, 2004; Yee, 2006). To identify this subgroup, and to avoid selecting individuals who played heavily on only one or two days per week, participants were selected on the basis of fulfilling all of the following criteria:
(a) playing at least 30 hours of video games per week
(b) playing at least four days each week
(c) playing for a mean duration of 3 hours in a typical sitting

The heavy subgroup (N = 45) was overwhelmingly male (98%) and reported a mean age of 20.1 years (SD = 3.9). In terms of other demographic information, 66% were single, 77% had completed high school or TAFE, were either unemployed (40%) or working on a casual basis (46%), and tended to earn less than $20,000 (75%). Overall, with the exception of being more male-oriented, the "heavy" subgroup resembled the demographic profile of the overall sample.

Comparisons with Australian norms

Table 3 presents a comparison of the SF-36 subscale scores between the heavy playing group and the normal Australian population. Given the heavy group was 98% male and 95% fell into the "16 to 24 years" age group category, these data were compared with Australian normative data for 16-24 year old males. The size of the differences between the heavy playing group and the Australian norm for "Physical Functioning", "Mental Health", "Vitality", "General Health" and "Social Functioning" was small to moderate (Cohen's d = .27, .30, .36, .44, and .51, respectively).

The heavy playing group reported a mean BMI of 25.1 (SD = 5.4). This score corresponds very closely with the cut-off value between the "normal" and "overweight" range for Australian adults. In terms of the distribution of BMI scores, 55% of the scores fell into the "18.5 to <25" range (i.e. normal) and 31% fell into the "25 to <30" range (i.e. overweight). This figure is highly comparable with Phongsavan et al.'s (2006) Australian population data, which stated that 49% of over 12,000 Australian adults fell into the normal category, and 32% fell into the overweight category. The heavy playing group's BMI distribution also aligned closely with 2004-05 National Health Survey data, which found that 63% of males and 59% of females were of acceptable weight, and 32% of males and 37% of females were overweight (Australian Bureau of Statistics, 2006).

In terms of self-reported psychological distress, the heavy playing group reported an average K10 score of 16.8 (SD = 7.2). Of the 45 participants, 55% scored in the "0-15" range (i.e. low risk) and 23% scored in the '16 to 21' range (i.e. moderate risk). Phongsavan et al. (2006) reported comparable prevalence figures of 67% and 21% in these respective categories.

Table 3. Heavy video game players' SF-36 subscale scores compared with Australian normative data

	Heavy Video Game Players (N = 45)		Australian Population Norm [a] (N = 561)		Cohen's d
SF-36	Mean	SD	Mean	SD	
Physical Functioning	91.7	12.6	94.7	9.7	.27
Role-Physical	92.8	18.9	88.8	26.8	.17
Bodily Pain	86.3	16.8	82.6	22.1	.19
General Health	67.5	19.4	75.8	18.6	.44
Vitality	61.0	17.8	67.7	19.2	.36
Social Functioning	78.3	22.9	89.3	19.1	.51
Role-Emotional	84.4	30.2	89.1	27.1	.16
Mental Health	72.3	18.0	77.7	17.7	.30

[a] Data from Behavioural Epidemiology Unit, South Australian Health Commission.

Meeting recommended health guidelines

The heavy playing group were asked how often they physically exercised for a period of at least 30 minutes. The most common responses were "less than once per week" (24%) and "one or two days per week", followed by "three or four days per week" (20%) and "do not exercise" (18%). The National Physical Activity Guidelines for Australia recommend exercise of at least a moderate level on most days of the week for a total of 30 minutes or more. Therefore, less than 15% of the heavy playing group met this exercise requirement. Whilst this figure is quite low, it is in fact comparable with recent Australian normative data that reported that approximately 33% of adults are sedentary (i.e., do not exercise).

In terms of alcohol use, 42% of the heavy group reported to not drink alcohol at all and an additional 44% drank alcohol no more than two days per week. Of those who drank, 50% consumed less than four standard drinks in a typical sitting. Approximately 40% of the group reported to drink more than four standard drinks in a typical sitting, which is classified as a potentially risky drinking behavior by the National Health and Medical Research Council. Less than 10% of the heavy playing group reported smoking cigarettes in the last 12 months.

Additional health information

There are currently no formal guidelines for healthy caffeine consumption due to the varying effects that caffeine has on different people's psychophysiology. Also, caffeine consumption is difficult to measure accurately, due to the varying amount of caffeine in different beverages and foods. Despite this limitation, total reported caffeine intake was fairly uniform within the heavy playing group. Only 15% reported to not drink caffeine, whilst the majority (70%) reported to consume caffeine on three to seven days of the week. These participants tended to drink between one to four caffeinated drinks on those days (80%). Shirlow and Mathers (1995) have found that daily caffeine consumption over 250mg (i.e. approximately four cups of coffee) is associated with physical symptoms of indigestion, palpitations, tremor, headache, and insomnia. Two of the 45 participants reported caffeine consumption at this level.

Sleep quality, an important aspect of general health, was also assessed. The heavy subgroup reported a mean score of 30.2 (SD = 7.1) on the Sleep Hygiene Index (SHI). Normative data for the SHI is currently unavailable, and the authors of the test have not specified how raw scores should be interpreted. Thus, in qualitative terms, this value indicates that participants tended to experience poor sleep hygiene "some of the time".

DISCUSSION

The present study was one of the first to examine the informed general health status of heavy video game players. It was found that those individuals who reported playing over 30 hours per week scored lower on measures of physical functioning, mental health, vitality, general health, and social functioning than normal Australian adults. The majority of the heavy playing group did not meet the national guidelines for weekly physical activity and reported some occasional difficulties with achieving high sleep quality. However, the "heavy" playing group did not differ from normative levels on measures of bodily pain, or physical and emotional role functioning. In addition, the BMI distribution of the heavy playing group did not differ greatly from established population levels.

The "couch potato" hypothesis predicts that increased time spent engaged in sedentary activities increases the risk of associated health problems, particularly overweight. The literature to date has produced mixed, if unconvincing, results with regard to this largely intuitive claim. As Biddle et al. (2004) have stated, the youth obesity problem has been the result of a complex constellation of lifestyle and environmental factors, rather than any single factor. In the present study, there was no significant correlation between video game playing and all measures of health and well-being, except for a weak but significant positive correlation with decreased mental health. This lack of association supports the argument that video game playing may play a limited role in promoting obesity in young people.

The self-reported general health status of highly frequent video game players (i.e. "heavy" users) was compared with the normal Australian adult population. This group showed small to moderate differences on some measures of general health, notably social functioning, compared with normal Australian adults. The degree of clinical significance of these results is a question worthy of debate. Jacobson, Follette, and Revenstorf (1984) operationalised clinical significance as the extent to which therapy (or some other intervention) moves someone outside the range of the dysfunctional population or within the range of the functional population. In the context of the present study, clinical sig-

nificance refers to the degree of difference between the distribution of the observed group and the distribution of the normal population. In essence, does the heavy playing sample differ in any significantly identifiable way from the nor mal population? This research suggested that the heavy playing group does differ from the normal population to a "moderate" extent in terms of self-reported general health, vitality, and social functioning. The size of this "effect" is quite substantial and therefore this may be suggestive of a clinically significant difference.

Explaining these moderate SF-36 group differences is difficult using the size-limited available data. On a measure of physical activity, the majority of the heavy playing group (>85%) did not meet national recommended guidelines, which suggests that the group's lower general health may also be related to lack of physical exercise. However, it should be noted that the heavy group's distribution of BMI scores and exercise patterns resembled closely that of the normal Australian population. It should also be noted that the largest between-group difference was on the social functioning subscale, which may suggest that part of the appeal of video games to this group is their facilitation of easier social interaction options (e.g. communication via online chat, text-based messaging, etc.). Future work using larger samples is needed in order to delineate these complex motivations to play video games from their associated health-related correlates.

The heavy playing group reported some occasional difficulties in obtaining good sleep hygiene. This finding may provide further evidence that increased use of screen-based technologies can have a deleterious effect on sleep quality. The potentially harmful effect of late night video game playing on sleep quality deserves further empirical attention, particularly among heavy users. Recent research has identified a strong association between sleep quality and general health factors, including BMI (Kohatsu et al., 2006). Higuchi, Motohashi, Liu, and Maeda (2005) found that video game playing directly before bed time can affect sleep latency and REM sleep.

The heavy group did not differ greatly from the population norms on the K10 scale, which suggests that psychological distress is not a defining characteristic of this subgroup. It may be speculated that this result suggests that the heavy playing group's engagement in video games may represent more of a healthy obsession, rather than being an escape from pre-existing emotional problems. In terms of alcohol use, the majority of the heavy playing group reported to drinking only infrequently. However, a large number reported to "binge-drink" on those occasions, a risky health behavior which has been observed previously in young male populations (Bonomo et al., 2004). No unusual patterns of cigarette or caffeine use were identified.

The present study had a number of limitations. Like many epidemiological studies, this study was correlational in nature and thus cannot make statements with regard to causality. This research examined video game use only and not other forms of screen-based entertainment, like television and the Internet. Subrahmanyam, Greenfield, Kraut and Gross (2001) have reported that, in many households, computers and television are used simultaneously, and computer use may even lead to an increase in television viewing. The reliance on self-report is another problem in survey-based research. It has been shown that people tend to overestimate their height and underestimate their weight, thus affecting BMI estimates. Charlton and Danforth (2007) have noted that individuals tend to overestimate the amount of time they spend playing video games. Therefore, the heavy group may not actually play as consistently as they reported. Although, it may be argued that, in relative terms, they played more often than the overall sample.

In summary, this research has found that heavy video game players, who are largely males in their early 20s, score significantly lower on some general health factors than the normal Australian adult population. Further, the majority of our heavy video game playing subgroup did not meet national guidelines for weekly exercise and reported sleep hygiene difficulties. These findings add to the developing literature on excessive video game playing, and the broader study of youth obesity. This study suggests possible intervention strategies for individuals who play video games to excess. For example, it may be that general health factors and lack of engagement in physical activity leads to increased participation in sedentary activities, like video games, for long periods. Therefore, psychologists should consider health-related interventions for problem users of video games in addition to regular psychotherapeutic techniques. Whilst there is no definitive link between media use and obesity, this research offers some clinically relevant insights into the potential health difficulties faced by a small but growing segment of the population.

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INTERACTIVITY INFLUENCES THE MAGNITUDE OF VIRTUAL REALITY ANALGESIA

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Despite medication with opioids and other powerful pharmacologic pain medications, most patients rate their pain during severe burn wound care as severe to excruciating. Excessive pain is a widespread medical problem in a wide range of patient populations. Immersive virtual reality (VR) distraction may help reduce pain associated with medical procedures. Recent research manipulating immersiveness has shown that a high tech VR helmet reduces pain more effectively than a low tech VR helmet. The present study explores the effect of interactivity on the analgesic effectiveness of virtual reality. Using a double blind design, in the present study, twenty-one volunteers were randomly assigned to one of two groups, and received a thermal pain stimulus during either interactive VR, or during non-interactive VR. Subjects in both groups individually glided through the virtual world, but one group could look around and interact with the environment using the trackball, whereas participants in the other group had no trackball. Afterwards, each participant provided subjective 0-10 ratings of cognitive, sensory and affective components of pain, and the amount of fun during the pain stimulus. Compared to the non-interactive VR group, participants in the interactive VR group showed 75% more reduction in pain unpleasantness ($p < .005$) and 74% more reduction in worst pain ($p < .005$). Interactivity increased the analgesic effectiveness of immersive virtual reality.

Keywords: Virtual Reality, Analgesia, Distraction, Immersiveness, Attention

Perspective: Pain during medical procedures such as severe burn wound care is often excessive. Adjunctive use of immersive virtual reality can substantially reduce the amount of procedural pain experienced. The results of the present study show that a more immersive interactive VR system reduced pain more effectively than a less immersive, non-interactive VR system.

Introduction

Despite aggressive use of pharmacologic analgesics, excessive pain during medical procedures performed on awake patients remains a widespread medical problem.[1,2] Although increasing the dose of analgesics (e.g., opioids) often increases analgesia, side effects of the pain medications (e.g., nausea, constipation, cognitive dysfunction, disturbance of sleep cycles, etc) become increasingly problematic with higher opioid analgesia doses.[2] Adjunctive use of psychological techniques such as distraction may help reduce patient suffering without increasing side effects.

Immersive virtual reality (VR) distraction provides computer-generated multi-sensory input (sight, sound, manual interactivity) to participants. There is growing clinical evidence that adjunctive use of VR reduces pain during interventions as disparate as burn-wound dressing changes, endoscopic urological procedures, and dental pain.[3,4,5,6,7,8] Laboratory studies provide converging evidence that VR reduces pain. Functional brain imaging (fMRI) studies reveal that significant reductions in subjective pain ratings during VR immersion are accompanied by similar decreases in pain-related brain activity.[9] And opioids + VR reduce pain ratings and pain-related brain activity more than opioid analgesia alone.[10]

Pain requires attention.[11] Hoffman, Patterson and colleagues[7] propose that VR is unusually attention grabbing,

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attracting the spotlight of attention into the virtual world, leaving less attention available to process incoming pain signals. As a result, many patients subjectively feel less pain, and spend less time thinking about their pain during medical procedures.

More immersive VR hardware is more effective at reducing pain.[12,13,14] Hoffman, Seibel et al,[12] showed that increasing the objective immersiveness of the VR system hardware increased the amount of VR analgesia obtained. In their study, one out of three healthy volunteers receiving thermal pain stimuli reported clinically meaningful reductions in pain (> 30% reductions) during VR via less immersive VR goggles (narrow field of view). In contrast, two out of three participants reported clinically meaningful reductions in pain in a group wearing a more immersive (wide field of view) VR helmet.[12]

Towards the goal of creating an immersive VR system,[15] in the present study, our interactive VR group used a VR system designed 1) to shut out physical reality (helmet and headphones that exclude sights and sounds from the real world), 2) to provide converging evidence to multiple senses, (both sights and sounds), 3) to provide a surrounding/panoramic view rather than limited narrow field of view, 4) to be vivid/high resolution, and 5) to permit the participant to interact with the virtual world via a trackball. Subjects in our non-interactive VR group used the same system, except with no trackball and thus no means to look around, aim and shoot to interact with objects in the virtual world. Slater and Wilbur[15] define VR immersion as an objective, quantifiable description of what a particular VR system can provide to a participant. Immersion is different from presence in VR, the subjective psychological illusion of going into the virtual world. According to Slater and colleagues, presence is a psychological state of consciousness. Interactivity contributes to the objective immersiveness of a VR system. The current study is designed to isolate the influence of interactivity on analgesic effectiveness. Interactivity was the only factor manipulated.

Materials and Methods

Subjects

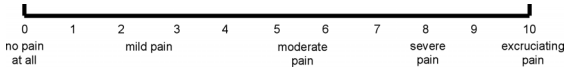
Twenty-one subjects, 18–19 years of age, participated in a randomized, double-blind, between groups design comparing interactive VR vs. non-interactive VR. Both written and verbal informed consent were obtained using a protocol approved by the University of Washington's Human Subjects Review Committee.

Measures and Procedures

Experimental thermal pain model

Controlled thermal pain stimulation was applied using a commercially available Medoc TSA II thermal pain stimulator (www.medoc-web.com) designed to provide noxious heat stimulation over a range of 0–50°C.[16,17,18] The stimulus temperature (mean = 46°C, range = 44-48.5°C in the present study) was individually determined for each subject using the psychophysical method of ascending levels.[9,13] A 30-sec heat stimulus (always 44°C for the first stimulus) was delivered through a thermode attached to the foot, and the subject was asked to rate the stimulus using a 0–10 graphic rating scale (see below). With the subject's permission, the temperature for the next stimulus was then increased by 1°C (or less, if the patient was approaching his/her maximum) and again rated their pain. This sequence was repeated until the subject reported a stimulus that was "painful but tolerable." The final stimulus temperature selected for the baseline pain condition (30-sec thermal stimulus without distraction) also served as the pain stimulus temperature during the subsequent VR intervention phase of the study protocol (30 sec of thermal pain during VR distraction).

After each pain stimulus, subjects received the following instructions prior to answering six separate subjective queries assessed with similar 0–10 graphic rating scales as shown below: "Please indicate how you felt during the past 30-sec pain stimulus by making a mark anywhere on the line. Your response does not have to be a whole number."



(1) "Rate your WORST PAIN during the most recent pain stimulus." (0 = no pain at all, 1–4 = mild pain, 5–6 = moderate pain, 7–9 = severe pain, 10 = excruciating pain).

(2) "How much TIME did you spend thinking about your pain during this most recent pain stimulus?" (0 = none of the time, 1–4 = some of the time, 5 = half of the time, 6–9 = most of the time, and 10 = all of the time).

(3) "How UNPLEASANT was the most recent pain stimulus?" (0 = not unpleasant at all, 1–4 = mildly unpleasant, 5–6 = moderately unpleasant, 7–9 = severely unpleasant, and 10 = excruciatingly unpleasant).

(4) "How much FUN did you have during the most recent pain stimulus?" (0 = no fun at all, 1–4 = mildly fun, 5–6 = moderately fun, 7–9 = pretty fun, 10 = extremely fun).

(5) "To what extent (if at all) did you feel NAUSEA as a result of experiencing the virtual world?" (0 = no nausea at all, 1–4 = mild nausea, 5–6 = moderate nausea, 7–9 = severe nausea, and 10 = vomit).

(6) "While experiencing the virtual world, to what extent did you feel like you WENT INSIDE the virtual world?" (0 = I did not feel like I went inside at all, 1–4 = mild sense of going inside, 5–6 = moderate sense of going inside, 7–9 = strong sense of going inside, 10 = I went completely inside the virtual world).

Such pain rating scales have been shown to be valid through their strong associations with other measures of pain intensity, as well as through their ability to detect treatment effects.[19,20] The specific queries used in the current study were designed to assess the cognitive component of pain (amount of time spent thinking about pain), the affective component of pain (pain unpleasantness), and the sensory component of pain (worst pain). Nausea was assessed in an effort to identify the incidence of this component of simulator sickness sometimes associated with VR use.[21] A single rating was used in the present study to assess the user's sense of presence in the virtual world.

Experimental group: VR helmet + interactivity with trackball

The VR system consisted of a Dell 530 workstation with dual 2 GHz CPUs, 2 GB of RAM, a GeForce 6800 video card, Windows 2000 operating system, and SnowWorld 2003 software (www.vrpain.com). The SnowWorld virtual environment presents a virtual arctic canyon to the user, complete with flowing river below, blue sky above, and terraced canyon walls to the sides containing virtual penguins, igloos, and snowmen. Soothing music and accompanying arctic sounds (e.g., the river) accompany the visual input (see Figure 1). Subjects in both treatment groups wore both a Kaiser SR-80 high-resolution head-mounted display with custom blinders to block subjects' view of the real world, and noise-canceling headphones that provided background music and sound effects while excluding extraneous sounds of the immediate laboratory environment (see Figure 1).

Figure 1. Image on left by Stephen Dagadakis, UW, copyright, Hunter Hoffman, UW, shows the 2003 version of SnowWorld, (designed by Hoffman at the University of Washington, www.vrpain.com, and created by Jeff Bellinghausen and Chuck Walter from Multigen, Brian Stewart from SimWright Inc., Howard Abrams (freelance worldbuilder), and Duff Hendrickson, UW). Image on right (photo by Dagadakis, copyright Hoffman ,UW) shows an undergraduate wearing a Rockwell Collins SR80 VR helmet with 80 degrees diagonal field of view.

Table 1

Pain Unpleasantness		
	Non-interactive Group	Interactive Group
Baseline (B)	5.89 (1.85)	5.95 (0.75), F(1,19) < 1, p = .92 NS, MSE = 1.77
During (VR)	5.03 (2.05)	2.53 (1.90), F(1,19) = 8.42, p < .01, MSE = 3.84
B minus VR	.86 (1.39)	3.42 (1.97), F(1,19) = 11.11, p < .005, MSE = 3.06
Worst Pain		
	Non-interactive Group	Interactive Group
Baseline (B)	5.84 (1.42)	5.75 (.75), F(1,19) < 1, p = .85 NS, MSE = 1.17
During (VR)	5.02 (2.05)	2.54 (1.70), F(1,19) = 9.19, p < .01, MSE = 3.44
B minus VR	.82 (1.38)	3.21 (1.64), F(1,19) = 12.45, p < .005, MSE = 2.35
Time Spent Thinking About Pain		
	Non-interactive Group	Interactive Group
Baseline (B)	7.22 (2.14)	6.27 (1.50), F(1,19) = 1.43, p = .25 NS, MSE= 3.22
During (VR)	4.39 (2.46)	2.11 (1.48), F(1,19) = 7.01, p =.016, MSE = 3.80
B minus VR	2.83(1.93)	4.16 (1.59), F(1,19) = 2.99, p = .10 NS, MSE = 3.03
Fun		
	Non-interactive Group	Interactive Group
Baseline (B)	3.22 (1.59)	2.79 (2.12), F(1,19) < 1, p = .26 NS, MSE = 3.67
During (VR)	5.06 (1.48)	6.24 (2.15), F(1,19) = 2.02, p =.172, MSE = 3.58
B minus VR	1.83 (.90)	3.45 (1.53), F(1,19) = 7.86, p = .01, MSE = 1.71

Table 1. The amount of VR analgesia in the Non-interactive VR Group vs. the Interactive VR Group. Values are means for 9 and 12 subjects in the Non-interactive VR and Interactive VR groups respectively (with SD of the means shown in parentheses after each mean). Values for analgesia are calculated as the difference between baseline scores and scores during VR (B minus VR).

Subjects in both treatment groups "glided" through the virtual world along a pre-determined path. Subjects in the interactive group could adjust their view of the vir- tual environment (e.g., subjects saw the sky when they looked up, a canyon wall when they looked to the left, and a river when they looked down). Subjects could target and shoot virtual objects on the canyon walls by moving the trackball. This interactive condition also included sound effects (e.g., a splash when a snowball hit the river; an animated green-, blue-, or white-colored explosion when a snowball hit the target). SnowWorld was specifically designed to have a simple human-computer interface for burn patients who often have reduced attention resources and limited dexterity available during wound care (due to pain, opioid medications, and burn injuries to the hands).

Control group: VR helmet with no interactivity

The non-interactive VR system (hardware and software) in this group was identical to the interactive VR system, with the exception that subjects could not interact with the virtual world (i.e., could not use the trackball to look around the virtual world or target/shoot virtual targets).

Data analysis

Data for each outcome variable were analyzed using SPSS by One-Way ANOVA, and are reported as means with SD in parentheses after each mean.

Results

The baseline (i.e., with no VR) thermal pain stimulation temperatures were equivalent for the interactive and non-interactive groups [mean temperature of 46.0 ˚C (SD = 1.1 ˚C) and 46.2˚C (SD = 1.1˚C) respectively, $F(1,19) = .10$, $p = .75$ NS]. The VR analgesia scores (baseline pain minus pain during VR) were calculated for each individual (max possible difference = 10) for each of the three pain ratings, (i.e., worst pain, pain unpleasantness, and time spent thinking about pain). These VR analgesia scores were analyzed using between-groups analysis via One-Way ANOVA, with alpha = .05. The results are summarized in Table 1.

As can be seen in more detail in Table 1 (B minus VR), subjects in the interactive VR group reported a significantly larger reduction in pain unpleasantness during VR compared to subjects in the non-interactive VR group [mean = 3.43 (1.97) vs. .86 (1.39) respectively], $F(1,19) = 11.11$, $p < .005$, MSE = 3.06.

Subjects in the interactive VR group reported a significantly larger reduction in pain intensity (ie., worst pain) during VR compared to subjects in the non-interactive VR group [mean = 3.21 (1.64) vs. .82 (1.38) respectively], $F(1,19) = 12.45$, $p < .005$, MSE = 2.35.

Subjects in the interactive VR group did not report a significantly larger reduction in time spent thinking about pain during VR, compared to subjects in the non-interactive VR group [mean = 4.16 (1.59) vs. 2.83 (1.93) respectively], $F(1,19) = 2.99$, $p = .10$ NS, MSE = 3.03.

Subjects in the interactive VR group reported a significantly larger increase in "fun" in VR compared to subjects in the non-interactive VR group [mean = 3.45 (1.53) vs. 1.83 (.90) respectively], $F(1,19) = 7.86$, $p = .01$, MSE = 1.71.

And no significant difference between the groups was found for ratings of how present participants felt in virtual reality [4.1 (1.7) vs. 3.0 (2.0) for non-interactive and interactive respectively, $F(1,19) = 1.82$, $p = 0.19$, NS, MSE = 3.57], or how nauseous participants felt in virtual reality, nearly zero nausea [.04 (.05) vs. .08 (.17) for non-interactive and interactive respectively, $F(1,19) < 1$, $p = .50$ NS, MSE = .014].

Discussion

In this study, we compared the relative effectiveness of VR distraction using an interactive VR system vs. a non-interactive VR system. Results showed more pain reduction during interactive VR than during non-interactive VR. Compared to the non-interactive group, the interactive VR group reported 32% more reduction in time spent thinking about pain, 75% more reduction in pain unpleasantness, 74% more reduction in worst pain, and 47% more increase in fun during VR. Our findings using a highly immersive VR system with 19-20 year old college students during thermal pain are consistent with those reporting enhanced analgesia when interactivity is added to a less immersive VR system using a video game in children experiencing cold pressor pain.[22] The results of the present study provide converging evidence for the importance of subject interac-

tion with the virtual world for maximizing the amount of VR analgesia, and implicate involvement of an attentional mechanism in VR analgesia.

Increasing the immersiveness of the VR system significantly increased the analgesic effectiveness without a significant increase in presence ratings (see also Hoffman et al).[12] Pain ratings may be more sensitive to manipulations of the immersiveness of VR hardware, compared to the single VAS presence rating scale typically used in most VR analgesia studies. In the studies to date, manipulations of the immersiveness of VR systems consistently affected the amount of pain reduction achieved. Several custom VR systems that don't allow head movements (using a mouse or trackball to look around and interact with the virtual world, as in the present study) have achieved large reductions in pain (e.g, water friendly fiberoptic VR goggles,[3] fMRI magnet friendly fiberoptic VR goggles,[9,10] and articulated arm mounted VR goggles).[4] Unlike interactivity and helmet quality, we speculate that head tracking may be one factor affecting the immersiveness of the VR system that does not strongly affect analgesia.

Research is needed to further explore what elements of immersive VR are dispensible and how to maximize VR analgesia. The present results support the notion that maximizing the immersiveness of the VR systems will help maximize VR's analgesic effectiveness. Future studies exploring how to best combine VR and pharmacologics in a multimodal approach to analgesia are justified.

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COMBINING A VIRTUAL REALITY SYSTEM WITH TREADMILL TRAINING FOR CHILDREN WITH CEREBRAL PALSY

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This pilot study is a report of the combination of a virtual reality (VR) system with treadmill training for children with cerebral palsy. The VR system includes an element of gaming to serve as a playful context to motivate the children to walk for longer periods of time in treatment sessions. The children all expressed pleasure in reaching the goal of saving the princess after walking for 9 hours. The intensive treadmill practice helped the children make significant changes in walking performances (p=.02) and capabilities (p=.05) as measured by the Standardized Walking Obstacle Course and Gross Motor Function Measure-88, respectively. This virtual reality system, in the form of DVDs, provides additional support for the feasibility and use of a virtual reality system in locomotion rehabilitation.

INTRODUCTION

The development and value of walking is taken for granted by most people. For the child without developmental disabilities, walking is a skill demonstrated at about 12 months of age (Stout, 2006). While a new walker may be a bit unsteady at first, with unlimited practice the child soon develops stability and ease of mobility that carries her from one place to another without much thought. For many individuals with cerebral palsy (CP), the ability to walk may not be a skill that is easily developed. Approximately 30% of individuals with CP do not have the ability to walk. Of the 70% who do walk, many have limitations in their walking ability (Beckung, Hagberg, & Uldall, 2008). Some individuals may also regress in their walking abilities limiting their mobility especially out of the home (Day, Wu & Strauss, 2007).

Repetitive practice of the pattern of walking is what takes a toddler from the initial unsteady steps of walking to fully mature walking at 7 years of age (Stout, 2006). Once that toddler learns to initially walk, upright mobility on two legs is the preferred pattern of movement. This accounts for endless hours of practice making walking automatic and allowing for variations of its components, such as speed, to be expressed with ease. While repetitive practice is not the only component that improves a skill like walking, it is still a key component for motor learning (Valvano, 2005).

For the individual with CP, it may be very difficult to learn the initial pattern of walking due to lack of motor control and coordination. Frequently children with CP receive physical therapy services to help them learn the pattern of walking, with the therapist compensating for the child's limitations (Olney & Wright, 2006). The physical therapist acts to facilitate balance control, weight shifting, and forward progression of the legs. A limitation of this method is inherent in the coordination of elements by both the therapist and child. The physical therapist may impose a walking rhythm upon the child that is not the child's own. A major restriction of this method may be that the move-

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ments of the child are not self-driven, so that adequate motor learning does not occur (Valvano, 2005). Once the child with CP learns to walk, the task may be so difficult that he or she may not get enough practice to express variations in speed or cadence.

Adding treadmill training to the therapy session is a way to decrease some of these variables. As a therapeutic tool, the treadmill affords repeated practice of the rhythmical pattern of walking allowing the child to express the natural rhythm inherent in his individual pattern. The treadmill provides a moving walkway where a child learns to adapt to environmental changes of speed, incline, time on task, and the amount of support provided (Biodex Gait Trainer 2TM). The treadmill has been identified as a feasible tool for use with children with CP (Richards, Malouin, & Dumas, 1997). While it provides a means to incorporate best practice for motor learning, it is most beneficial if the child will walk for prolonged periods of time on a more daily basis. Current literature cites a range of training time in one session from 4 to 43 minutes with the average range between 20-30 minutes (Damiano & DeJong, 2009) over 3 to 4 months of training to achieve positive outcomes (Schindl, Forstner, & Kern, 2000; Song, Sung, & Kim, 2003; Cherng, Liu, & Lau, 2007).

Virtual reality (VR), the simulation of a real or imaged environment, has the potential to provide a playful context for the practice of walking on the treadmill. It has been identified as a tool in locomotor rehabilitation for adults and children with neurological disorders (Deutsch, Merians, & Adamovich, 2004; Sveistrup, 2004). VR can enhance practice on a physical level by making it more meaningful and challenging through stimulation of cognition, mood, and social interactions (Sveistrup, 2004). Various applications of virtual reality systems have been reported in locomotion therapy with adults to demonstrate its feasibility. These applications have included a visual display that supplies cues to start and keep walking and real-time interactions between a subject walking on a treadmill and a visual scene (Sveistrup, 2004).

The purpose of this pilot study was to determine the impact of a virtual reality system with a gaming element plus treadmill training on the walking performance and capabilities of children with CP. The treadmill training time was 9 hours over 10-12 sessions. Walking performance was measured using the Standardized Walking Obstacle Course (SWOC) (Held, Kott, & Young, 2006) and capabilities were measured using dimension E (walking, running, jumping) on the Gross Motor Function Measure-88 (GMFM) (Russell, Rosenbaum, & Avery, 2002). Both are valid tools for measurement in children with CP (O'Neil, Fragala-Pinkham, & Westcott, 2006). It was hypothesized that children would walk faster and take fewer steps on the SWOC and increase their scores on the GMFM-88 after training.

METHODS

Participants

The children were recruited through physicians in the Department of Physical Medicine and Rehabilitation at Eastern Virginia Medical School (EVMS). Children were invited to participate if they were between 4 and 15 years of age, had a medical diagnosis of cerebral palsy, no cardiopulmonary co-morbidity, the ability to stand and ambulate independently without an assistive device other than orthoses, and could follow simple instructions. This study received Institutional Review Board approval from EVMS; no data were collected until the informed consent was signed by the parent.

The participants in this study were 5 males, mean age 7 years 5 months (SD 2 years 3 months), mean height of 47.3 inches (SD 5.6 inches) inches, and mean weight of 55.5 lbs (SD 24.1 lbs). Each child's mobility was initially classified as Level I or II according to the Gross Motor Function Classification System (GMFCS) (Palisano, Rosenbaum, & Walter, 1997). Children at level I, ages 4 through 18 years, walk with no physical assistance or use of a hand-held mobility device and demonstrate some advanced locomotor skills such as running and hopping with limitations in speed, balance, and coordination. Children at level II, ages 4 through 18 years, walk with limitations and have restricted performances of advanced locomotor skills. They may also choose to use hand-held mobility devices or wheeled mobility for longer distances. No child presented with a crouched gait or had orthopedic surgeries within the previous year. Table 1 presents characteristics for these children.

Table 1. Characteristics of the Participants

Participant Number	Age (years, months)	Height (inches)	Weight (pounds)	Gross Motor Function Classification System	Medical Diagnosis
1	8.0	47.0	43.0	I	Spastic Diplegia
2	4.4	39.5	39.0	I	Left spastic hemiplgia
3	5.10	42.0	37.5	II	Spastic Diplegia
4	9.0	50.0	62.0	I	Spastic Diplegia
5	10.4	54.25	101.0	II	Spastic Triplegia

EQUIPMENT

The equipment for the treadmill training included DVDs and player, Biodex Gait Trainer 2 treadmill, and a large flat screen monitor. The DVDs were the means by which the virtual environments were presented during the training. The investigator controlled the treadmill and DVD player. The treadmill was set for 5, 10 or 15 minutes of walking to coincide with the DVD times of 5, 10 or 15 minutes. If the child needed to rest before the set time was completed, the DVD would be paused. There was no direct interaction between the child and progression of the DVD or treadmill. The DVDs contained a child's story that included a princess and a dragon integrated with an element of gaming to be used as reinforcement. At the start of the DVD, the child met the princess, saw the dragon come and whisk her away, and got instructions to walk to save the princess (the goal of the game). During the final DVD the child defeats the dragon. The child's efforts at walking were reinforced at uneven intervals along the way by characters who deliver supportive messages such as "You are doing good, keep walking to save the princess" and by earning points (Figure 1).

The points accumulate in the concrete form of cardboard diamonds and coins that adhered by Velcro to a magic shirt. The magic shirt was worn by the child, while training, to help the child feel more immersed in the game.

VIRTUAL REALITY SYSTEMS

A more complete description of the development of this system can be found in the 13th Annual Cybertherapy and CyberPsychology Conference proceedings (Kott, DeLeo, & Lesher, 2008). To give the impression of walking in different environments, two different DVD scenarios were developed and integrated. One scenario shows a brick path in a town setting that includes a virtual castle, a variety of buildings, natural objects, and characters that appear on the left and right sides of the screen. The second scenario is set in a forest with diverse trees, rocks, and characters moving in and out.

Starting from these two segments, the objects, characters, and color of the pathway were randomly applied, so the child moves from towns to the forests and back. These rendered images were combined into a movie with background music (purchased in compliance with copyright laws) and superimposed bonus point messages applied on a predetermined time schedule. There were 15 DVDs packets (containing 5, 10 and 15 minute segments) for a total of 9 hours of treadmill training. The DVDs were different lengths of time because the children had different initial walking capabilities and were allowed to rest at the end of each DVD. The initial DVD had the child walking out of the castle to get to the pathway. The last DVD had the child walking into a cave to defeat the dragon.

Figure 1: Narrating characters present in the DVDs

OUTCOME MEASUREMENT

Testing on the Standardized Walking Obstacle Course (SWOC) and on the items of the Gross Motor Function Measure-88 (GMFM) occurred prior to the first session of treadmill training and immediately after the last session of training. All testing was completed by a physical therapist with over 30 years of pediatric experience assisted by physical therapy students trained in the testing methods.

The SWOC is a designed low pile carpeted walkway (39.5" long and 36" wide) with three turns (300, 700 and 900), chairs at each end, and standard placement of obstacles and directions for measurement. Children walked under three conditions, with arms free (walk), while carrying a tray (walk tray), and while wearing shaded glasses (walk glasses), and completed two practice and six measured trials. A trial consisted of standing up, walking the course in one direction, and sitting down. Data included the time (taken via a digital stopwatch) and the number of steps required to complete the trial (Held, Kott, & Young, 2006).

Dimension E of the GMFM has 24 items that were tested, including walking forward and backward, stepping over an obstacle, ascending and descending stairs, walking on a straight line, kicking a ball, running, hopping and jumping. Four levels of skill capability (0 through 3) are possible for each of the items, where 0 means the task can not be initiated, 3 means the task is completed to criteria, and 1 or 2 are partial performances of the item. The sum of all the skill levels is obtained with a minimal possible score of 0 and maximal possible score of 72, with the results reported as a percentage of 72 (Russell, Rosenbaum, & Avery, 2002).

TREADMILL TRAINING

Each child's initial walking speed in miles per hour, on the treadmill, was calculated using the averaged time in seconds needed to complete the SWOC path on the two trials of the walk condition. Each child was able to stand unsupported on the treadmill, but an adult either stood or sat behind the child while on the treadmill to ensure safety. The treadmill also had a Lanyard which was attached to each child's shirt while walking. If the Lanyard was unattached, the treadmill would stop. After initial testing, each child was introduced to the story and walked a total of 10 or 15 minutes, as tolerated, the first day.

The child's walking tolerance was monitored by comparing resting heart rate with heart rate taken while on the treadmill or immediately after stopping, as well as verbal request or facial or body gestures that indicated that the child needed to rest. Because each child could walk, no physical assistance was given, but verbal cues were provided to take bigger steps if the child's step lengths were unequal. The unequal steps were noted through visual feedback on the treadmill console, which was turned so that only the investigator could see it. When the step lengths were equal, the treadmill noted "good job", and the investigator would convey this information to the child.

On the second and third days of training, each child walked from 45 to 60 minutes in segments of 5, 10 or 15 minutes. At the end of each DVD, the child rested until resting heart rate returned. Speed was increased by the investigator in increments of 0.1 mph for approximately every 15 minutes of training, until the child met maximal tolerated speed, which was determined by an increase in heart rate to 65% of calculated maximum (Roitman, Herridge, & Kelsey, 2001) or the speed beyond which the child's gait pattern deteriorated. This speed was then held constant for the rest

of the training sessions. For the fourth through ninth or tenth sessions, each child walked for 60 minutes each session. During the tenth or eleventh session, the child walked 45 or 50 minutes in the session. On the last day of training before post-testing, the child completed just 10 or 15 minutes of walking to save the princess, then participated in post-intervention testing.

STATISTICAL ANALYSIS

Dependent variables were time and number of steps averaged over two trials for each condition of the SWOC and the percentage scores for dimension E of the GMFM-88. Pre and post intervention means and standard deviations were calculated. A Wilcoxon Signed-Rank Test ($p<.05$) was used to test for significant differences between pre and post intervention scores. This was done using SPSS version 14.0.

RESULTS

For the measures of the SWOC, there were decreases in mean time pre-testing to post-testing for each condition (Table 2), indicating an increase in the walking speed of the participants. The increased speed was only statistically significant for the condition of walk glasses ($p=.02$).

Table 2. Means (SD) for time (seconds) for each condition of the Standardized Walking Obstacle Course

Condition	Pre-test	Post-test	p
Walk	20(9)	18(7)	.11
Walk Tray	27(13)	22(10)	.07
Walk Glasses	21(9)	18(7)	.02*

*Significant

There was an average decrease by 2 in the mean number of steps for each condition, indicating an increase in the length of each step. The decrease in number of steps was not statistically significant for any of the conditions (Figure 2).

Figure 2: Mean Number of Steps by Condition on the Standardized Walking Obstacle Course

For the measure of dimension E of the GMFM-88, there was a significant increase (Z=-1.6, p=.05) in percentage of items accomplished from pre-test 56% (SD 24%, range 27-89%) to post-test 64% (SD 17%, range 42-89%). The change in treadmill training speed was also significant (Z= -2.0, p=.02) from the initial session average of 1.2 mph (SD 0.6, range 0.8-1.9 mph) to the final average speed of 2.0 mph (SD 0 .7, range 1.1-2.9 mph).

DISCUSSION

This virtual reality system was a successful engagement tool to get children to walk for longer periods in one treatment session. While this study had participants with cerebral palsy, children with other types of disabilities that impact walking may also benefit from the system. Each of the children expressed pleasure at saving the princess. One child commented at the end, "I really did it"! It should be noted that by coincidence all the participants were males 10 years of age or younger in this study; it is unknown whether females and children older than 10 would have the same interest in this story. Additionally, some children expressed frustration at times that it was taking a long time to find the princess and they wanted to speed up the video by walking faster. However, the speed the child walked was not correlated to the speed of progression in the DVD. Using a DVD to deliver the VR scenarios made the system easy to operate and available for use in settings other than a research laboratory. A more interactive tool, however, might enhance motivation and keep the child interested in treadmill training on a regular basis.

The results from this study support the use of treadmill training to improve walking in children with cerebral palsy under 10 years of age (Blundell, Shepherd, & Dean, 2003). While not all the measures on the SWOC showed statistically significant changes, all subjects walked faster (time decreased an average of 15% over the three conditions) while taking fewer steps (steps decreased by 6% in each condition) after undergoing the training. This type of training has the potential to make walking more efficient as well as becoming a lifelong aerobic activity for an individual with limitations in more advanced locomotor skills. Additionally, walking for 9 hours significantly improved the performance of the skills measured by dimension E on the GMFM-88. The GMFM-88 dimension E has been shown to be responsive to change in children at GMFCS level I and II with a large effect size if change scores were 6.5 and 4.5 respectively (Oeffinger, Bagley & Rogers, 2008) and improve with treadmill training (Damiano & DeJong, 2009).

This study supports the use of short-term intensive training to effect changes in the walking in children with CP. All the changes occurred in 3-4 weeks (11-12 sessions) of treatment time when the speed of the treadmill was incrementally increased and the child was able to stay focused to walk for 60 minutes at a time. Previous studies of treadmill training used 3-4 months of treatment to achieve success (Schindl, Forstner, & Kern, 2000; Song, Sung, & Kim, 2003; Cherng, Liu, & Lau, 2007). Long-term retention of the improvements needs to be further evaluated.

All subjects walked faster and took fewer steps following the intervention. The SWOC was chosen as a tool because of its low cost, ease of use in any physical therapy clinic, and the clinically relevant measures of time and number of steps in walking (Held, Kott, & Young, 2006). Failure to show statistically significant changes on the SWOC could be due to the small number of subjects in the study, but it could also reflect the limitation of the SWOC to pick up differences in performances. Gait assessment using an electronic walkway such as the GaitRite System (Cir Systems, Inc) for recording spatial and temporal parameters would be more sensitive to changes in performance (Wondra, Pitetti, & Beets, 2007) and could be used in future studies.

Most likely the changes that were noted occurred because strength was improved in the lower extremity muscles enough to demonstrate skills the child may already have learned. For example, one child could not alternate feet while stair climbing before the training, but could do it after. While strength was not measured in this pilot study, previous research has linked changes in skills with strength training in children with cerebral palsy (Blundell, Shephard, & Dean, 2003; Dodd, Taylor, & Damiano, 2002).

A limitation of the current study was the lack of a measure to determine whether the changes in walking performance and locomotor capacity in children with CP resulted from musculoskeletal and cardiovascular training effect or whether neurologic changes occurred that affected the children's motor control ability. In addition, there was no control group that received treadmill training without VR. Therefore, the added value of VR cannot be evaluated. At

the very least, it appeared that the use of VR kept the children engaged in treadmill walking long enough to benefit from the training.

CONCLUSION

Creating a playful context, through the use of a virtual reality system, improved the practice of walking while on the treadmill for children with cerebral palsy. This increased practice improved walking performance and capabilities for the children involved in this study. This virtual reality system, in the form of DVDs, provides additional support for the feasibility and use of a virtual reality system in locomotion rehabilitation. It is a system that could be used for treadmill training in the home or community with convenience and decreased costs when compared to a clinic-based setting.

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INTERNET HELP AND THERAPY FOR ADDICTIVE BEHAVIOR

Mark Griffiths, Ph.D.

Counselling and psychotherapy have entered the computer age. Psychological advice, help and treatment for those with addictive behaviors are no exception. The paper overviews the main issues in the area and approaches the discussion acknowledging that online therapy has to be incorporated within the overall framework of the need for clinical assistance. The paper also provides brief overviews of what types of online help and therapy are available. This paper makes particular reference to online help for problem gamblers and will overview a recent study that evaluates the effectiveness of an online help and guidance service for problem gamblers.

Keywords. Online therapy, Online help, Addiction, Problem gambling, GamAid

Internet help and therapy for addictive behavior

Many therapists remain suspect about the new and growing field of 'behavioral telehealth'. Some have claimed that Internet therapy is an oxymoron because psychotherapy is based upon both verbal and nonverbal communication (Segall, 2000). Since online relationships can be as real and intense as those in the face-to-face world (Griffiths, 2001), there is little surprise that clinicians are beginning to establish online therapeutic relationships.

To date there have been a growing number of non-empirical papers about various issues concerning online therapy, including challenges and initiatives in this growing field (Sanders & Rosenfield, 1998; Griffiths, 2001; Ritterband, Gonder-Frederick, Cox, et al, 2003; Carlbring & Andersson, 2006), ethical issues (Bloom, 1998), mediation of guidance and counselling using new technologies (Tait, 1999), and perspectives on family counselling (Oravec, 2000). There have also been a growing number of empirical reports utilising online therapy. These include its use in providing cognitive behaviour therapy for depression and social phobias (Carlbring, Westling, Ljungstrand, et al, 2001; Andersson, Bergström, Holländare, et al. 2005; Andersson, Carlbring, Holmström, et al, 2006; Andersson, 2009; Berström, Hollander, Carlbring, et al, 2003; Carlbring, Gunnarsdóttir, Hedensjö, et al, 2007; Spek, Cuijpers, Nyklicek, et al, 2007; Titov, Andrews & Schwencke, 2008), treating anxiety and panic disorders (Klein & Richards, 2001), eating disorders (Winzelberg, Eppstein, Eldredge, et al, 2000; Celio, Winzelberg, Wilfley, et al, 2001; Zabinski, Pung, Wilfley, et al, 2001; Robinson & Serfaty, 2001), stress disorders (Lange, Rietdijk, Hudcovicova, et al, 2000; Lange, Van De Ven, Schrieken, et al, 2000; Zetteqvist, Maanmies, Ström, et al, 2003), back pain (Buhrman, Faltenhag, Ström, et al, 2004), insomnia (Ström, Pettersson & Andersson, 2004), public speaking (Botella, Baños, Guillén, et al, 2003; Botella, Hofmann & Moscovitz, 2004; Botella, Guillén, Baños, et al, 2007), and individuals with recurrent headaches (Stroem, Pattersson & Andersson, 2000; Andersson, Lundström & Ström, 2003). These empirical studies tend to show significant improvements for those treated using online therapy.

Psychological advice, guidance, help, and treatment for addicts are no exceptions. This paper therefore gives an overview of some of the main issues involved. The paper also makes particular reference to online help for problem

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gamblers and provides an overview of a recent study by the author that evaluates the effectiveness of an online help and guidance service for problem gamblers.

Background:

Online therapy and addictive behavior

For the fifth time in a week, a 32-year old man comes home very late from a 12-hour drinking session. Unable to sleep, he logs onto the Internet and locates a self-help site for alcoholics and fills out a 20-item alcohol consumption checklist. Within a few hours he receives an e-mail that suggests he may have an undiagnosed drinking disorder. He is invited to revisit the site to learn more about his possible drinking disorder, seek further advice from an online alcohol counselor and join an online alcoholism self-help group.

On initial examination, this fictitious scenario appears of little concern until a number of questions raise serious concerns (Rabasca, 2000a). For instance, who scored the test? Who will monitor the self-help group? Who will give online counselling advice for the alcohol problem? Does the counselor have legitimate qualifications and experience regarding alcohol problems? Who sponsors the website? What influence do the sponsors have over content of the site? Do the sponsors have access to visitor data collected by the website? These are all questions that may not be raised by an addict in crisis seeking help.

The Internet could be viewed as just a further extension of technology being used to transmit and receive communications between the helper and the helped. If addiction practitioners shun the new technologies, others who might have questionable ethics will likely come in to fill the clinical vacuum. It has been claimed that online therapy is a viable alternative source of help when traditional psychotherapy is not accessible. Proponents claim it is effective, private and conducted by skilled, qualified, ethical professionals (King, et al., 1998). It is further claimed that for some people, it is the only way they either can or will get help (from professional therapists and/or self-help groups).

Types of 'Online Therapy'

There appear to be three main types of website where psychological help is provided - information and advice sites, websites of traditional helping agencies and individual therapists (Griffiths & Cooper, 2003) although in this paper, sites will be categorized in terms of their primary function. That is: 1) information dissemination, 2) peer-delivered therapeutic /support / advice (such as a self-help support group) and 3) professionally delivered treatment. Psychological services provided on the Internet range from basic information sites about specific disorders, to self-help sites that assess a person's problem, to comprehensive psychotherapy services offering assessment, diagnosis and intervention (Rabasca, 2000a).

Information dissemination: These are sites mainly dedicated to educational and awareness raising issues. They are often in the form of webpages that provide easily understandable pieces of helpful information on a range of disorders, self-help checklists, and links to other helpful websites. There appear to be numerous places to get information about addiction and addiction-related problems. Quality information websites are hosted by a variety of sources including individuals who serve as their own 'webmaster' to not-for-profit organisations to private companies. Some illustrative examples of these are listed in the next section.

Peer-delivered therapeutic support and advice: These sites are often set up by traditional helping agencies that have expanded their services to include an online option for clients. Typically, this is done by e-mail and is usually free of charge (for example, the Samaritans). Other examples include various 12-Step groups who meet online. Many online therapy services are available for those suffering almost any kind of addiction. In the world of online therapy, a person can be alone in their living room while they attend an AA meeting joined by a couple of dozen people from various countries, or be visiting an Internet counsellor in the United Kingdom without having left their home in the United States. There are a number of 12-Step groups that meet regularly in this way and they are often open for 24 hours a day. Cooper (2001) reported that about 70% spoke of how they benefited from their exposure to and involvement with GAweb, an online peer support group.

There are a number of very good reasons why the Internet is an excellent medium for most forms of self-help. Research has consistently shown that the Internet has a disinhibiting effect on users and reduces social desirability (i.e., users do not alter their responses in order to appear more socially desirable). This may lead to

increased levels of honesty and, therefore, higher validity in the case of self-disclosure. As well as disinhibition effects, the Internet is a non-face-to-face environment that is perceived by many users as anonymous and non-threatening. The Internet may, as a consequence, provide access to 'socially unskilled' individuals who may not have sought help if it were not for the online nature of the self-help group.

There are also generalist type services (usually e-mail only) in which people usually require a one-off piece of advice from someone who may have no psychological training. These services are usually (but not always) free of charge and may be part of an online magazine. It is highly unlikely that the sort of general advice given at these sites will be of much help to addicts as their problem is, by its nature, very specific. The most help they would probably get is an onward referral (e.g., to a face-to-face self-help group such as AA, GA, etc.).

Professionally delivered treatment: These sites are becoming more and more abundant and can be set up by individual counselors and/or psychotherapists. They usually operate in one of two ways - either by written answers to e-mail inquiries or a real-time conversation in an Internet chat room. Professionally delivered treatment is mainly available from individual practitioners' websites. There are a few examples of not-for-profit organisations beginning to offer these types of services. Thus far, for-profit companies appear to primarily use the Internet for information dissemination and for promoting their face-to-face services.

Many therapists have now set up their own Internet sites to deliver behavioral services although the number of sites that specialize in addictions appears to be growing all the time. The kinds of services offered vary in type and expense. They can include 'ask five questions for free'-type sites, therapists moderating a group chat online, e-mail correspondence, private instant messaging, and/or video-conferencing.

Advantages of Online Therapy for Addicts

There are many advantages and disadvantages of online therapy. The main ones have been overviewed elsewhere (Griffiths, 2001; Cooper & Griffiths, 2003) and are outlined below in relation to gambling addicts to give the reader specifics in relation to a particular type of problem. However, it is assumed that almost all of these advantages and disadvantages apply to other types of addiction. Here are the main advantages:

Online therapy is convenient: Online therapy is convenient to deliver, and can provide a way to seek instant advice or get quick and discreet information. Online therapy avoids the need for scheduling and the setting of appointments, although for those who want them, appointments can be scheduled over a potential 24-hour period. For gambling addicts who might have a sense of increased risk or vulnerability, they can take immediate action via online interventions, as these are available on demand and at any time. Crisis workers often report that personal crises occur beyond normal office hours, making it difficult for people to obtain help from mental health clinicians and the like. If a problem gambler has lost track of time at the casino only to depart depressed, broke, and suicidal at 4am in the morning, they can perhaps reach someone at that hour who will be understanding, empathic and knowledgeable.

Online therapy is cost effective for clients: Compared with traditional face-to-face therapies, online therapy is cheaper. This is obviously an advantage to those who may have low financial resources. It may also allow practitioners to provide services to more clients because less time is spent travelling to see them. Since there are financial consequences for a gambling addict, cheaper forms of therapy such as online therapy may be a preferred option out of necessity rather than choice. The cost factor is particularly important in countries where people are often forced to pay for health care (for example, in the United States). Arguably, one needs Internet access, but this too is becoming more freely available, and conceivably, even those who are homeless would be able to utilize such services through places like public libraries.

Online therapy overcomes barriers that otherwise may prevent people from seeking face-to-face help: There are many different groups of people who might benefit from online therapy. For example, those who are: (i) physically disabled, (ii) agoraphobic, (iii) geographically isolated, and/or do not have access to a nearby therapist (military personnel, prison inmates, housebound individuals etc.), (iv) linguistically isolated, and (v) embarrassed, anxious, and/or too nervous to talk about their problems face-to-face with someone, and/or those who have never been to a therapist before might benefit from online therapy. Some, like those

with agoraphobia and/or the geographically isolated, might be more susceptible to activities like online gambling because they either tend not to leave home much or they do not have access to more traditional gambling facilities (such as casinos, bingo halls, racetracks and so forth). It is clear that those that are most in need of help (whether it is for mental health problems, substance abuse or problem gambling) often do not receive it.

Online therapy helps to overcome social stigma: The social stigma of seeing a therapist can be the source of profound anxiety for some people. However, online psychotherapists offer clients a degree of anonymity that reduces the potential stigma. Gambling may be particularly stigmatic for some because they may find it is a self-initiated problem. Others have found that the issue of stigma has caused some problem gamblers to avoid seeking treatment (Hodgins & el-Guebaly, 2000). Furthermore, in an exploratory study, Cooper (2001) found that there was a correlation between higher levels of concerns about stigma and the absence of treatment utilization, and that lurking (i.e., visiting but not registering presence to other users) at a problem gambling support group website made it easier for many to seek help including face-to-face help.

Online therapy allows therapists to reach an exponential amount of people: Given the truly international cross-border nature of the Internet, therapists have a potential global clientele. Furthermore, gambling itself has been described as the 'international language' and has spread almost everywhere within international arenas.

It would appear that in some situations, online therapy can be helpful - at least to some specific sub-groups of society, some of which may include addicts. Furthermore, online therapists will argue that there are responsible, competent, ethical mental health professionals forming effective helping relationships via the Internet, and that these relationships help and heal. However, online therapy is not appropriate for everyone. As with any new frontier, there are some issues to consider before trying it. The next section briefly looks at some of the criticisms of online therapy.

Disadvantages of Online Therapy

The growth of online therapy is not without its critics. The main criticisms (Griffiths & Cooper, 2003) that have been levelled against online therapy include:

Legal and ethical considerations: Since cyberspace transcends state and international borders, there are many legal and regulatory concerns. For example, client/doctor confidentiality regulations differ from one jurisdiction to another. It may not be legal for a clinician to provide chatroom services to patients who are in a jurisdiction in which the clinician is not licensed. Furthermore, some patients may be excluded from telehealth services because they lack the financial resources to access the Internet. One potential ethical and legal dilemma is the extent to which service quality can be ensured. It is possible that individuals who register to provide counselling services online do not have the qualifications and skills they advertise. They may not even be licensed to practice. There are also issues regarding the conduct of practitioners engaged in all forms of telecommunication therapy. For example: issues of informed consent, the security of electronic medical records, electronic claims submissions, etc. (Foxhall, 2000).

Confidentiality: Online therapy may compromise privacy and confidentiality, particularly if a skilled computer 'hacker' is determined to locate information about a particular individual. No online therapist can confidently promise client confidentiality given the limitations of the medium. However, there are some sites that offer secure messaging systems that offer the same level of protection as banking institutions.

Severity of client problems: Some clients' addiction problems may be just too severe to be dealt with over the Internet. To some extent, there can always be contingencies, but because people can come from anywhere in the world and have a multitude of circumstances, online clinicians may be hard-pressed to meet everyone's needs.

Client referral problems: One obvious difficulty for the counsellor is how to go about making a referral for an addict in a faraway town or another country.

Establishing client rapport: It could perhaps be argued that there might be difficulty in establishing a rapport with someone that the therapist has never seen. This is an interesting area where clearly more information is needed. One might also argue that because the addict is in a more equal relationship with the therapist, they will feel more comfortable. Coupled with this, online therapy leads to a loss of non-verbal communication cues such as particular body

language, voice volume and tone of voice. Furthermore, the lack of face-to-face interaction between addict and therapist could result in a wrong referral or diagnosis.

Commercial exploitation: Consumers theoretically are not always as anonymous as they might think when they visit health sites because some sites share visitors' personal health information with advertisers and business partners without consumers' knowledge or permission (Rabasca, 2000b). In relation to gambling addicts, this is a real issue. By virtue of posting to places such as GAweb with an accurate e-mail address shown, online casinos have the potential to collect such information in order to later send junk e-mail promoting their casino websites.

Convenience: Although convenience was outlined as an advantage in the previous section, it can also have a downside. For instance, it may mean that the addict is less likely to draw on their own existing coping strategies and use the online therapist as a convenient crutch (something which is actively discouraged in face-to-face therapy).

Online help for problem gamblers: The *GamAid* case study

Wood and Griffiths (2007) reported one of the first ever studies that evaluated the effectiveness of an online help and guidance service for problem gamblers (i.e., *GamAid*). The evaluation utilized a mixed methods design in order to examine both primary and secondary data relating to the client experience. In addition, the researchers posed as problem gamblers in order to obtain first hand experience of how the service worked in practice.

GamAid is an online advisory, guidance and signposting service whereby the client can either browse the available links and information provided, or talks to an online advisor (during the available hours of service), or request information to be sent via email, mobile phone (SMS/texting), or post. If the problem gambler connects to an online advisor then a real-time image of the advisor appears on the client's screen in a small web-cam box. Next to the image box is a dialogue box where the client can type messages to the advisor and in which the advisor can type a reply. Although the client can see the advisor, the advisor cannot see the client. The advisor also has the option to provide links to other relevant online services, and these appear on the left hand side of the client's screen and remain there after the client logs off from the advisor. The links that are given are in response to statements or requests made by the client for specific (and where possible) local services (e.g., a local debt advice service, or a local Gamblers Anonymous meeting).

The first part of the evaluation process involved the use of an online survey to be completed by clients accessing *GamAid*. The online survey automatically appeared after the client logged off following communication (i.e., on online chat) with an advisor. The online survey comprised a 15-item questionnaire containing questions that directly related and mapped on to the *GamAid* aims and objectives. *GamAid* 's objectives are to:

- Provide a crisis management service which will primarily be used by online gamblers
- Provide 24- hour, seven day per week, access to the service
- Provide advisors that listen to, identify, and understand client needs
- Provide useful and relevant referral to online counsellors where necessary (for instance, through Gambling Therapy, another therapeutic branch of the Gordon House Association)
- Provide useful signposting to other relevant services (e.g., local support groups).

Also during the evaluation period, the researchers logged onto *GamAid* a total of 10 times posing as either problem gamblers needing help, or as a person seeking help/guidance for someone else. The purpose of this part of the evaluation was to get some kind of first-hand understanding of the user perspective of clients interfacing with the service. This was also used to identify any technical issues. The evaluation of *GamAid* in this part of the evaluation was therefore necessarily interpretative. All advisors were aware before the start of the study that some of the evaluation team would be posing as problem gamblers and all accepted this as a legitimate part of the evaluation process. Finally, the research team were given access to all of *GamAid* 's secondary data obtained from *GamAid* advisors relating to usage figures, gender, preferred form of gambling, etc.

A total of 80 clients completed an in-depth online evaluation questionnaire, and secondary data were gathered from 413 distinct clients who contacted a *GamAid* advisor.

Wood and Griffiths (2007) reported that the majority of clients who completed the feedback survey were satisfied with the guidance and "counselling" service that *GamAid* offered. Most participants agreed that *GamAid* provided information for local services where they could get help, agreed that they had or would follow the links given, felt the advisor was supportive and understood their needs, would consider using the service again, and would recommend the service to others. Furthermore, the addition of being able to see the advisor via a web-cam was reassuring. Being able to see the advisor enabled the client to feel reassured, whilst at the same time, this one-way feature maintained anonymity, as the advisor cannot see the client.
It is important to note that *GamAid* is an advisory, guidance and signposting service and not a traditional "treatment" service. Advisors communicate with clients in order to provide reassurance and to give advice rather than offering a counselling service. However, some clients may view this form of help as "treatment" and/or some form of "online counselling".

The evaluation found that the majority of those who responded to the online feedback survey agreed that *GamAid* helped them to consider their options, made them more confident in help, helped them to decide what to do next, made them feel more positive about the future, provided useful information for local help which they intended to follow up through the links provided.
An interesting aside is the extent to which *GamAid* was meeting a need not met by other gambling help services. This was examined by looking at the profiles of those clients using *GamAid* in comparison with the most similar service currently on offer, that being the UK GamCare telephone help line. The data recorded by *GamAid* advisors during the evaluation period found that 413 distinct clients contacted an advisor. The types of gambling engaged in and the preferred location for gambling showed little similarity to the data collected in the two British national prevalence surveys to date (Sproston, Erens & Orford, 2000; Wardle, Sproston, Orford, Erens, Griffiths, Constantine & Pigott, 2007). Unsurprisingly (given the medium of the study), online gambling was the single most popular location for clients to gamble with 31% of males and 19% of females reporting that they gambled this way. By comparison, the GamCare helpline found that only 12% of their male and 7% of their female callers gambled online. Therefore, it could be argued that the *GamAid* service is the preferred modality for seeking support for online gamblers. This is perhaps not surprising given that online gamblers are likely to have a greater degree of overall competence in using, familiarity with, and access to Internet facilities. Problem gamblers may therefore be more likely to seek help using the media that they are most comfortable in.

GamAid advisors identified gender for 304 clients of which 71% were male and 29% were female. By comparison, the GamCare helpline identified that 89% of their callers were male and 11% were female. Therefore, it would appear that the *GamAid* service might be appealing more to women than other comparable services. There are several speculative reasons why this may be the case. For instance, online gambling is gender-neutral and may therefore be more appealing to women than more traditional forms of gambling, which (on the whole) are traditionally male-oriented (with the exception of bingo) (Wardle et al, 2007).

It is likely that online gamblers are more likely to seek online support than offline gamblers. Women may feel more stigmatised as problem gamblers than males and/or less likely to approach other help services where males dominate (e.g., GA). If this is the case, then the high degree of anonymity offered by *GamAid* may be one of the reasons it is preferred. Most of those who had used another service reported that they preferred *GamAid* because they specifically wanted online help. Those who had used another service reported that the particular benefits of *GamAid* were that they were more comfortable talking online than on the phone or face-to–face. They also reported that (in their view) *GamAid* was easier to access, and the advisors were more caring.

One of the key strengths of the study was that it used a variety of methods to collect data and information including an online survey, secondary data from online advisors, and anonymous trials and testing of the services. There are, of course, a number of weaknesses of the study. The overall response rate of clients completing the online questionnaire was only one in five clients (19.4%). The reasons for low response rate are unknown, but similar rates have been found for other investigations using both online and offline surveys (Sheehan, 2001). Those who responded to the survey were a self-selecting sample and as such may

not be wholly representative of the population of clients who used the service. Interestingly, the response rate for females (41%) was much higher than that of males (15%). This finding has also been noted for other online research studies that have examined sensitive issues. This may be indicative of a more general preference by females in using this type of communication media. For example, a lot of research into excessive Internet usage has shown that women are often more likely than men to complete online surveys (Widyanto & Griffiths, 2006). Another weakness is that it was unknown whether clients concurrently accessed other services during the evaluation period.

Although there are clearly issues surrounding self-selection, online questionnaires are particularly useful for the discussion of sensitive issues that participants may find embarrassing in a face-to-face situation (such as problem gambling). The nature of this medium means that a relatively high degree of anonymity can be maintained, and participants may feel more comfortable answering sensitive questions on their computer than in a face-to-face situation. The survey data were necessarily self-report although the collection of the data online may have lowered social desirability and increased levels of honesty. *GamAid* appears to meet the stated aims and objectives of the evaluation. However, it is evident that a longer-term follow-up evaluation study is needed to determine the effectiveness of the service over time.

Conclusions

Online therapy may not be for all addicts and those participating should at the very least be comfortable expressing themselves through the written word. In an ideal world, it would not be necessary for those in serious crisis - some of whom could be addicts (where non-verbal cues are vital) - to need to use computer-mediated communication-based forms of help. However, because of the Internet's immediacy, if this kind of therapeutic help is the only avenue available to individuals and/or the only medium that they are comfortable using, then it is almost bound to be used by those with serious crises. Rigorous evaluation studies are needed (particularly given the rate at which new sites are springing up). These refer not only to sites that specifically deal with addictions, but all sites.

It could be the case that online therapy's most effective use might be as either a way of communicating information in response to clients' statements and questions, or a form of 'pre-therapy'. This latter suggestion is interesting, as it has traditionally been assumed that for 'pre-therapy' to occur, the client and practitioner must be in the same room. However, it could equally be argued that websites could be used to augment treatment. Websites could provide cognitive information to supplement treatment or provide instant peer support groups when addicts need most help. For instance, addicts desiring more anonymity than is possible at a 12-Step meeting can use chat rooms. Furthermore, public message boards and e-mails can provide greater efficiency and productivity than in-person visits to a self-help group.

There is a paucity of empirical data that assesses the efficacy and feasibility of online therapy for addicts. To date, the limited studies carried out (mostly with very small sample sizes) have focused on client and provider satisfaction with the technology rather than the effectiveness of the technology in delivering services. Future research should address the following areas (all of which could involve addiction research):

- The differential effects of various online therapeutic interventions among clinical populations. There would be great benefit from learning much more about counselling versus online peer-support groups.

- The effect that online therapy has on therapeutic relationships. Such relationships will be much more equal in future with the therapist being more of a coach to a much more informed consumer.

- Whether or not providers and consumers find online therapy interventions accessible and desirable.

- Whether or not demographic characteristics (like socio-economic status, ethnicity, culture, geographic location, age, and gender) affect a patient's access to and acceptance of online therapy and if so, how and why. The same questions could also be applied to therapists regarding their acceptance and receptivity. Miller (1989) has written about how positive expectations of therapists have contributed to improved patient outcomes. If clinicians did not believe in online help but were forced to provide it by their employer, would this be subtly communicated to the clients and their treatment undermined?

This paper has demonstrated a need for evaluative research regarding online therapy, particularly since there is a lack of an evidence-base to govern this growing practice. Furthermore, papers like this aim to help to engage awareness-raising activities and thereby alert clinicians to the future possibilities of practice behavior. After all, clinicians have been constantly striving to better serve their clients from the earliest days of mental health practice. It seems apparent that the Internet and computer-mediated communication are here to stay. Therefore, there is a need to focus on exactly how these innovations will impact on our field, keeping clients' best interests in mind.

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THE EFFECTIVENESS OF CASUAL VIDEO GAMES IN IMPROVING MOOD AND DECREASING STRESS

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Stress related medical disorders such as cardiovascular disease, diabetes and depression are serious medical issues that can cause disability and death. Techniques to prevent their development and exacerbation are needed. Casual video games (CVGs) are fun, easy to play, spontaneous and are tremendously popular. In this randomized controlled study we tested the effects of CVGs on mood and stress by comparing people playing CVGs with control subjects under similar conditions. Electroencephalography (EEG) changes during game play were consistent with increased mood and corroborated findings on psychological reports. Moreover, heart rate variability (HRV) changes were consistent with autonomic nervous system relaxation or decreased physical stress. In some cases CVGs produced different brain wave, heart rate variability and psychological effects. These finding have broad implications which include the potential development of prescriptive interventions using casual video games to prevent and treat stress related medical disorders.

Keywords. Casual Video Games, Electroencephalography (EEG), Heart Rate Variability (HRV), Psychological Mood

BACKGROUND

According to the Casual Video Game Association there are more than 200 million casual game players worldwide. Gamers from a multitude of cultures, ages, and lifestyles play electronic casual games using consoles, PCs and online communities, handhelds and mobile phones. One example of the popularity of casual video games can be found in the fact that Microsoft Solitaire for Windows is the most commonly opened application on Windows XP (Casual Games Association, 2008). Casual video games sometimes referred to as coffee-break or web games are a booming business that is expected to grow to $55 billion by 2009 (JWT Intelligence, 2006).

Casual video games (CVGs) defy a standard definition because of the diverse nature of the games. Instead the Casual Games Association, 2007 offers a functional definition that asserts that CVGs must be considered fun, quick to access, easy to learn, and require no previous special video game skills, expertise, or regular time commitment to play. CVGs are based around familiar game concepts that consumers played as children in arcades. They are usually easy to pause, stop and restart. Casual games are usually played in short increments at home and at work. Some people, however, play for hours on end (Casual Games Market Report, 2007).

According to anecdotal evidence and survey research, people play CVGs for varied reasons including cognitive exercise, fun, relaxation, and to reduce stress and improve mood. The Casual Games Association says CVGs are viewed as important in stress reduction during lunch or after work and CVG play has begun to replace TV in this respect. A survey of gamers conducted in 2006 (n= 2,191) revealed that casual game players (71% daily use) view CVGs as more important in their leisure time activities than TV, reading, or spending time with family and friends. The survey also found that 88% of respondents derived stress relief from playing. While casual gaming is popular among all groups they are particularly attractive to women over 30. Retired men and woman also represent a large group of casual gamers (Casual Video Games Association, 2007).

Stress and Health

A strong link between physical health and stress was established more than a quarter century ago when researchers

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noted that exacerbation of tumor growth occurred following acute exposure to uncontrollable stress (Sklar & Anisman, 1979; Sklar & Anisman, 1981). It was postulated that stress influenced neurochemical, hormonal and immunological changes which, in turn, exacerbated the tumor growth but the mechanisms were not well understood. Researchers exploring underlying causation began focusing on the physiology of emotional response to psychosocial stimuli adding to the understanding of how neurochemical, hormonal and immunological changes occur and contribute to dysfunction. These insights have led to the current theory on human reactions to stress now characterized as the "defense/fight or flight" and "defeat/immobilization" responses (Folcov, 1988). In this model limbic-hypothalamic patterns of response are integral and serve to protect a person from adverse stimuli by mobilizing biochemicals to aid in the response (Kudielka & Kirscbaum, 2007). Untoward stress or "distress" has a deleterious impact on people and can directly affect both psychological and physical conditions. If stress is not ameliorated it will contribute to the development and/or exacerbation of illness and disease (Sapolski, 2004).

The term allostasis relates to a person's ability to adapt to adverse stimuli (McKewen, 1998). Allostatic load is considered the neurochemical, hormonal and immunological costs of adapting to stress (Sternberg, 1997). The allostasis model consists of four different causes of allostatic load that require biological responses. 1. Frequent exposure to stress 2. Inability to habituate to repeated challenges 3. Inability to terminate a stress response and 4. Inadequate allostatic response (Webster, Tonelli & Sternberg, 2002). Under normal circumstances a person can manage their allostatic load. However too often the demands of life overwhelm a person's normal coping abilities and additional help is needed. Unfortunately, these self prescribed interventions often involve potentially devastating after effects i.e. the use of food, alcohol or drugs. Hence, people need to learn and practice healthy methods to decrease stress and improve mood.

Psychological experiences can cause or be caused by stress. Fear is a good example because it can be either real or imagined. The body reacts as if it were real regardless. This experience in turn influences immune function and ultimately the course of a disease. For instance, when a person encounters a stressful circumstance, cortisol increases turning up energy producing mechanisms, while inhibiting less essential functions. Specifically, cortisol has a significant effect on numerous processes including metabolism, fluid regulation, emotional and cognitive functioning and the immune system (Thayer & Sternberg, 2006). Researchers applying the Tier Social Stress Test for example, found cortisol levels increased two to three-fold in about 70-80% of subjects within 1 to 20 minutes after task demonstrating a link between a psychosocial task and allostatic response (Hjemdahl, 2002). When this short-term response is not curtailed through the hypothalamic-pituitary-adrenal (HPA) feedback loop or when the demand exceeds the person's capacity to respond, a number of changes occur which can sometimes lead to physical and mental illness (Adinoff, Iranmanesh, Veldhuis & Fisher, 1998).

Stress and Mood

Everyone at some point experiences sadness or the blues. There are multiple causes for these feelings including situational circumstances such as losing a loved one, a job or even by the weather which when wet and dreary can cause a condition known as seasonal affective disorder syndrome (SADS). Generally people will find social support, or a coping activity that help them to improve their mood. These activities vary from shopping to movies, exercise, and recreational activities. The growing use of CVGs may be directly related to their ability to assist in decreasing stress and improving mood without the potential negative side effects of other choices.

Depression is a clinical term used to describe extreme negative mood characterized by persistent sadness and impairment in functioning. According to the National Institute of Mental Health approximately 20.9 million American adults, or about 9.5 percent of the U.S. population age 18 and older in a given year, have a mood disorder. Major depression affects 14.8 million adults and is the leading cause of disability for ages 15-44. Dysthymic disorder affects approximately 1.5 percent of the U.S. population age 18 and older in a given year or 3.3 million American adults. The median age of onset of both disorders is approximately 30 years (National Institutes of Mental Health, 2008).

While individuals experiencing depression do not all exhibit the same symptoms or the intensity, frequency and duration there are commonalities that provide criteria to define the disorder and those are: persistent sad, anxious or

"empty" feelings; feelings of hopelessness and/or pessimism; feelings of guilt, worthlessness and/or helplessness; irritability, restlessness; loss of interest in activities or hobbies once pleasurable, including sex; fatigue and decreased energy; difficulty concentrating, remembering details and making decisions; insomnia, early–morning wakefulness, or excessive sleeping; overeating, or appetite loss; thoughts of suicide, suicide attempts.

Stress and depression are inexorably intertwined. The combined effect has dramatic physical and psychological consequences. It is important therefore to develop and test new interventions to determine if they can decrease stress and/or improve mood. These interventions may eventually help people manage their allostatic load and help ameliorate symptoms of stress related medical disorders like cardiovascular disease and depression.

Preliminary evidence suggests that non-pharmacological interventions can help facilitate ANS and HPA balance and thereby decrease stress and improve mood. For example mindfulness-based stress reduction significantly improved quality of life, symptoms of stress and sleep in those with early stage breast and prostate cancer (Carlson, Speca, Patel & Goodey, 2003). When researchers measured cytokine changes they found that T cell production of IL-4 increased and IFN-y decreased. In addition, NK cell production of IL-10 also decreased, prompting them to conclude that there was a shift from one immune profile associated with depressive symptoms to a more normal immune profile. Using the same intervention another study reported an overall reduction in mood disturbance (65%) and a (31%) decrease in stress symptoms (Speca, Carlson, Goodey & Angen, 2000).

Other novel interventions like music have been shown to positively affect the immune system. Significant increases in secretory immunoglobulin-A (S-IgA) were found after listening to recorded, classical music (Abrams, 2001) and using music as a vehicle for relaxation, researchers found IL-6 levels were significantly lowered afterwards whereas IL-1b, Il-10 remained unchanged (Stefano, Zhu, Cadet, Salamon, Manitone, 2004). Esch and colleagues report that complementary and alternative medicine (CAM) therapies are important in producing ANS & HPA balance as well as positively impacting the immune response (Esch, Massimo, Bianchi, Zhu & Stefano, 2003; Esch, Fricchione & Stefano, 2004).

Recreational activities provide a wide array of health benefits and, as a result, have been used by humans since the beginning of recorded history for excitement, relaxation, fitness, sport, meditation and fun (O' Morrow, 1989). Among the numerous studied benefits are social interaction and physical activity(Wankel, L. M., & Berger, B. G. 1990), mental distraction (Wassman & Iso-Ahola, 1985), and laughter (Stone, 1992). In general, good things happen to people when they are having fun. Psychological constructs attempting to explain the benefits of recreation include a positive mental state coupled with a feeling of relaxation and being in balance. One psychologist called this hyper-focused state "flow," noting that participants in a variety of recreational activities consistently report positive mental outcomes (Csikszentmihalyi, 1997). The physiological processes that underlie the psychological balanced state known as flow are very important as knowledge of them will help with the understanding of these types of interventions but we are just beginning to see the connections.

A preliminary link between the HPA (hypothalamic-pituitary-adrenal) axis, mood and recreation has been established with decreases in cortisol and mood reported after therapist directed recreational activity (Russoniello, 1991; 2008). According to the findings of these studies, which involved adults being treated for acute alcoholism, recreational activities can decrease stress and improve mood. The findings revealed that plasma cortisol levels were significantly lowered after participation in low physical intensity board games/card games and produced an autonomic nervous system relaxation response. Casual video games have become the board and card games of today. Many are very similar to the board games of yesteryear, they are simply modernized for today's Internet based world. This study tested whether there would be a similar autonomic nervous system response while playing CVGs. If there is a consistent integrated positive HPA axis response while playing casual video games similar to board games then this poses the intriguing possibility of prescribing CVGs to ameliorate stress related medical disorders.

Formal research surrounding video gaming has been focused primarily on negative effects such as violence and addiction (Anderson & Bushman, 2001; Lee & Vessey, 2000; Clay &. Richards 2005; Funk, 2005; Wallenius, Punamäki & Rimpelä. 2007). There are just a few studies

that mention positive effects of gaming such as a means to; develop social relationships (Hutchinson, 2007), facilitate education (Simpson, 2005) development skills and multi-tasking (Agosto, 2004). Little is known about the positive health effects of CVG play and even less about the physiological processes or health benefits that underlie participation.

METHODS

The purpose of the study was therefore to determine whether casual video games could improve mood and/or decrease stress in players using valid and reliable psychological and physiological measures. Specifically this study tested whether playing three popular casual video games; Bejeweled 2 (BJW 2), Bookworm Adventures (BWA) and/or Peggle (PGL) could change the autonomic and central nervous systems consistent with decreased stress and improved mood.

Subjects

One hundred and forty three (n=143) participants were recruited for the study and one hundred and thirty four (n=134) were included in the data analysis. Nine participants were excluded, as data was unsalvageable due to improper data collection (sensor came off, software was mistakenly not started). There were 57 females and 44 males. The average age of all participants was 24 years. Participants were recruited from fliers placed in and around the campus community. Most of the subjects were students, faculty members and staff at the university. The study was explained to the participants who signed an informed consent form before being included. Participants then supplied demographic information and completed the Profile of Mood States questionnaire. At this point, an envelope with random assignments was opened by the participants. This revealed their designated group. If assigned to the experimental group participants chose one of three casual video games to play. If assigned to the control group participants completed an Internet task that involved searching for articles on health related topics and placing them in a folder on the desktop.

Experimental participants chose which game that they wanted to play from three popular video games that met the functional definition of a CVG. BJW 2 is a matching, sequencing game where participants string together jewel-like objects for points. PGL is a pachinko/pinball type of game that allows participants to gain more control as they clear strings of multi-colored balls for points and BWA is a crossword/scrabble type puzzle game where participants gather points by building words and progress through an animated adventure. Once a game was chosen, sensors were connected and signals were checked, participants played the game uninterrupted for twenty minutes.

The control participants were seated in front of the same computer in the same chair and hooked to measuring equipment in the exact manner as the experimental group. The control group was then instructed to surf the internet looking for articles related to health and to put them into a file on the desktop for twenty minutes.

Measurement of Mood

It was hypothesized that playing casual video games would result in decreases in left frontal alpha power, increases in right frontal alpha power and overall alpha symmetry when compared to controls. Increases in alpha power in the left hemisphere are associated with negative mood, depression and avoidance/withdrawal behaviors. Conversely, decreases in left alpha power improve mood and decrease avoidance/withdrawal behaviors. Decreases in right hemisphere alpha power are also associated with negative mood. Conversely, increases in right alpha power improve mood and increase approach/engage behaviors. The ratio between right and left brain alpha has also been used to measure emotional stability/mental relaxation (Davidson, 1988: Fox, 1991 and Monastra, 2003).

Some therapies have been successful in helping people change dysfunctional brain activity associated with depression and stress to positive states associated with relaxation and alertness (Field, Grizzle, Scafidi, Abrams, Richardson, Kuhn, & Schanberg, 1996; Field, Grizzle, Scafidi, & Schanberg, 1996; Field, Ironson, Scafidi, Nawrocki, Goncalves, Pickens, Fox, Schanberg & Kuhn, 1996 and Marshall & Fox, 2000). In this study the effects of CVG play on mood were tested to determine if they would produce similar results using EEG measurements and following the alpha/mood assessment protocol established and tested by Davidson (1988). Changes in the CNS or alpha brain wave activity were recorded using a 10 channel electroencephalography device (Mind Media Corporation, 2008).

All participants were prepared by locating and marking F3, F4 and CZ using the 10/20 standard measurement cap. The sensor placement sites were cleaned using alcohol

pads. Active EEG leads were placed at F3 and F4. The reference sensor was placed at CZ. The ground lead placed on C7. Signal impedance was kept below 25,000K Ohm per manufacturers recommendations for alpha recordings. In addition, the EEG signal was visibly inspected prior to recording for extraneous signal noise. If necessary, adjustments were made before data recording began.

PROFILE OF MOOD STATES

To quantify emotional changes participants completed a self-administered psychological assessment of mood using the Profile of Mood States (POMS) assessment. The POMS (McNair, Lorr & Droppleman, 1981), is a factor analytically derived inventory that measures six subscales: tension, depression, anger, vigor, fatigue, and confusion and can be used with "Last Week" and "Right Now" administrations. Internal consistency for the POMS has been reported at .90 or above. Test re-test reliability is reported between .68 and .74 for all factors. Construct and predictive validity have been established in four areas: brief psychotherapy, controlled outpatient drug studies, studies of response to emotional conditions and studies of concurrent validity coefficients and other POMS correlates (McNair, Heuchert & Shilony, 2003).

Measurement of Physical Stress

Heart Rate Variability (HRV) is a physiological measurement that directly reflects a balance of the autonomic nervous system regulation, which has control over the human body. HRV is a multidimensional measurement of sympathetic and parasympathetic nervous system innervations of the heart. HRV reflects the state of sympathetic (stress, anxiety) or parasympathetic (relaxation, calmness) activation in the body. Heart rate variability (HRV) is considered a marker of cardiac parasympathetic and sympathetic activity and is of great interest to health care practitioners (Malliani, Lombardi & Pagani, (1994); Kleiger, Stein, Bosner & Rottman, (1992); Pomeranz Macaulay & Caudill, (1985).

Heart rate variability (HRV) provides an accurate assessment of autonomic nervous system stress based upon variability in the inter-beat interval of heart beats (Task force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). A robust HRV is associated with balance between the sympathetic and parasympathetic branches of the autonomic nervous system (ANS). In this study HRV changes were used as a measure of ANS change (Hayano, Sakakibarea, & Yamada, Yamada, Mukai, Fujinami, Yokoyama, Watanabe & Takata, 1991). HRV was recorded during the entire session using a small ear clip sensor. Both time and frequency parameters of HRV were used to determine the effects of CVGs on the ANS.

HRV was recorded using photoplethysmography (PPG) technology. PPG was developed in the 1960's and 1970's by psychophysiology researchers. PPG is based upon the premise that all living tissue and blood have different light-absorbing properties. PPG works by placing a photocell clip on the participant's ear that converts light to electrical energy. The blood in the ear lobe scatters light in the infrared range, and the amount of light reaching the cell is inversely related to the amount of blood in the ear lobe. Hence, when blood vessels in the earlobe dilate, the increased blood flow allows less light to reach the photocell, when blood vessels constrict, blood flow is decreased and increased light reaches the photocell (Cohen, 1995).

PPG measures pulse volume or phasic changes, which are related to beat variations in the force of blood flow. These beat-to-beat changes in peripheral blood flow reflect the heart's interbeat intervals similar to ECG. PPG therefore, gives summary information reflecting both cardiac and blood vessel components and is an accurate measure of cardiac function when compared to electrocardiography (Cohen, 1995; Russoniello, Mahar, Rowe, Pougatchev & Zirnov, 2003).

STATISTICAL ANALYSIS

A repeated measures design was employed to study the impact of different games on the variables and to contrast with the control group. Since the experimental and the control group both did activities requiring similar physical and cognitive involvement, and the study was exploratory in nature, the level of significance was set at p=<.1. The least significant difference (LSD) was used for the post hoc analysis. Cohen's Delta or d (Cohen, 1988) is a measure of effect size or the standard mean difference. Cohen's d is a standard measure used to calculate treatment effect and describes differences in means relative to an assumed common variance. According to Cohen, effect size changes can be classified as: small (.20); medium (.50); and large (.80). In this study Cohen's d was used to show large changes otherwise not detected due to large variances.

RESULTS

Participating in CVGs produces changes in brain waves consistent with improved mood. Remarkably, different games affected brain waves in unique ways. For example BJW 2 players (Table 1) experienced significant decreases in left alpha power when compared to controls. Participants who played PGL experienced significant increases in right alpha power while playing (Table 2) but did not statistically differ from the control group due to very large variations in individual brain waves. Cohen's d, used to statistically equalize differences between groups (d= 1.8), illustrates there was a very large difference between PGL and control groups.

Table 1

Left Alpha Changes	md	sd	df	p
Control Group (n=22)	.99	1.5	25	.50
Bejeweled 2 (n=28)	-3.3	1.3	31	.014†

†Significantly differs from control p=.032

Table 2

Right Alpha Changes	md	sd	df	p
Control Group (n=22)	.427	10	21	.996
Bejeweled 2 (n=29)	17.9	9	28	.048

Table 3

Right/Left Alpha Ratio Changes	md	sd	df	p
Control Group (n=22)	.17	.19	21	.37
Bejeweled 2 (n=26)	.31	.19	25	.093†

†Significantly differs from control p=.071

Playing BWA significantly improved the right/left brain alpha ratio (Table 3) another indicator of improved mood and the changes were significantly different from control. All three games improved mood and affected alpha brain wave activity differently.

Changes in psychological mood reported on the POMS corroborated EEG findings as the overall impact of all three games significantly differed from the control group (p=.007). BJW, BWA and PGL pre-post game changes and comparisons with the control group are presented in (Table 4).

Table 4

Overall POMS Changes	md	sd	df	p
Control Group (n=31)	2.6	2.4	30	.284
Bookworm Adventures (n=29)	7.9	2.5	28	.000
Bejeweled II (n=38)	-11.3	2.3	37	.002†
Peggle (n= 36)	-14.9	2.3	35	.000††

†Significantly differs from control p=.009

†† Significantly differs from control p=.000

Individual POMS subscales, tension, depression, anger, vigor, fatigue and confusion changed as follows.

Participants reported significant decreases in POMS tension (Table 5) after each game. Overall, CVGs reduced tension versus control (p=.003). Participants that played PGL reported the largest decreases in tension.

Table 5

Changes in Tension	md	sd	df	p
Control Group (n=31)	-1.6	.70	30	.022
Bookworm Adventures (n=29)	-7.9	2.5	28	.005
Bejeweled II (n=38)	-11.3	2.2	37	.000
Peggle (n= 36)	-14.9	2.3	35	.000†

†Significantly differs from control p=.026

Participants reported decreases in the POMS Depression sub scale scores after all three games (Table 6). While none of the games statistically differed from the control, secondary analysis with Cohen's d revealed large decreases in depression scores after all three, PGL (d= 1.4); BWA (d= 1.2); BJW 2 (d= 1.1) games when compared with the control group.

Table 6

Changes in Depression	md	sd	df	p
Control Group (n=31)	-1	.58	30	.084
Bookworm Adventures (n=29)	-1.7	.59	28	.004
Bejeweled II (n=38)	-1.6	.52	37	.002
Peggle (n= 36)	-1.8	.53	35	.001

POMS Anger scores decreased after all three CVGs (Table 7). BJW 2 and PGL significantly differed from the control group. The reductions in anger are contradictory to the notion that all video games provoke violence.

Table 7

Changes in Anger	md	sd	df	p
Control Group (n=31)	-.77	.56	30	.169
Bookworm Adventures (n=29)	-1.0	.58	28	.076
Bejeweled II (n=38)	-2.2	.50	37	.000††
Peggle (n= 35)	-2.1	.53	34	.000†

†Significantly differs from control p=.084.
††Significantly differs from control p=.069.

The overall effect of all three CVGs and control in increasing vigor was statistically significant (p=.018). Individual games changes are presented in Table 5. Changes in vigor after playing BJW 2 were statistically different from the control group.

Table 8

Changes in Vigor	md	sd	df	p
Control Group (n=31)	-1.4	.79	30	.180
Bookworm Adventures (n=29)	-1.5	.72	28	.865
Bejeweled II (n=38)	-.14	.81	37	.037†
Peggle (n= 36)	-.34	.74	35	.643

†Significantly differs from control p=.007

The overall effect of CVGs on fatigue versus control was statistically significant (p=.061). Individual games changes are listed in Table 9. BJW 2 and PGL both had significant positive impacts on fatigue versus control.

Table 9

Changes in Fatigue	md	sd	df	p
Control Group (n=31)	-1.4	.53	30	.010
Bookworm Adventures (n=29)	-.18	.55	28	.001
Bejeweled II (n=38)	-2.8	.48	37	.000†
Peggle (n= 36)	-3.6	.49	35	.000††

†Significantly differs from control p=.053

††Significantly differs from control p=.003

The overall effect of all three games on confusion (Table 10) was statistically significant (p=.09). BWA, BJW 2 and PGL all significantly decreased confusion when compared with the control group. The improvement in cognition was very dramatic and begs the question of whether these games could assist in Alzheimers and other dementia type disorders.

Table 10

Changes in Confusion	md	sd	df	p
Control Group (n=31)	-.26	.46	30	.576
Bookworm Adventures (n=29)	-1.2	.48	28	.010†
Bejeweled II (n=38)	-2.0	.42	37	.000††
Peggle (n= 36)	-2.3	.43	35	.000††

†Significantly differs from control p=.025
††Significantly differs from control p=.000

PHYSICAL STRESS CHANGES

In this study the game BJW 2 had the greatest impact of all three games on physical stress. Participants who played BJW 2 experienced statistically significant decreases in ANS activity with corresponding increase in variables associated with positive cognitive engagement. All HRV parameters changed significantly when measured pre-post game play including TP (p. = 003). When compared to control participants BJW 2 players experienced decreases in: heart rate (d= 1.3), VLF (d= 1) and corresponding increases in LFN (d= 1.6) and LF/HF ratio (d= 1.2). These findings support the theory that some CVGs do decrease physical stress and presents a possibility that CVGs produce a "more power with less effort" ANS effect.

Table 11. Heart Rate Variability Changes

Control n=30	md	se	df	p	B II n=40	md	se	df	p
HR	-.82	.61	29	.184		-1.6	.53	39	.003
TP	488	151	29	.002		394	130	39	.003
VLF	-106	100	29	.290		-198	87	39	.024
LFN	1.8	2.7	29	.521		5.8	2.4	39	.015
HFN	1.7	2.7	29	.533		6.3	2.3	39	.008
HF/LF	-.24	.32	29	.46		.6	.28	39	.034†

†Significantly differs from control (p= .051)

DISCUSSION

Changes in EEG recorded in this study support the hypothesis that playing a CVG of your choice can improve your mood and decrease your stress. Remarkably all three games had different yet complimentary mood lifting effects. BJW 2 decreased left alpha brain waves associated with a decrease in withdrawal and depressive type behaviors and PGL increased right alpha brain wave activity associated with excitement or euphoric behaviors. BWA on the other hand increased the stability of alpha brain waves between the left and right side of the brain.

The POMS scores on Total Mood Disturbance significantly changed for all three games supporting the theory that while there were effects on brain wave activity in different parts of the brain, the end result was improved perceived mood. Significant subscale changes in anger, tension, vigor, depression, fatigue and confusion by different games and not by others again seems to infer that there are specific changes associated, to a degree, with particular games and not so much with others. If these finding are consistently upheld then protocols with treatment specificity could be developed to take advantage of CVGs that produce specific results.

Changes in HRV during BJW 2 were consistent with a recent report by Peng, Henry, Mietus, Hausdorff, Khalsa, Benson, & Goldberger, (2004) in which they revealed that TP and low frequency norms increased while very low frequency activity decreased after the relaxation response and meditation exercises. When changes after BJW 2 were compared with the control group a similar "more power with less exertion" profile emerged, which provides a potential framework for future research.

Many modern medical disorders are stress related and the need for effective interventions that are low cost and help ensure compliance is high. The potential of CVGs to become an intervention is encouraged by the results of this study. Future studies can build upon this work by studying the impacts of CVG play on conditions such as depression, anxiety, autism, and stress related medical disorders such diabetes and cardiovascular disease.

The limitations of this study included a lack of measurement for respiration and the variability of physiological data which, in some cases, made it difficult to determine changes if they existed. In future studies blue tooth technology should be used to reduce lead noise. Respiration rate should be recorded to determine its impact on HRV variables. When possible neuroendocrine markers like cortisol or salivary amylase should be added to get a psychoneuroendocrine picture of changes.

Finally, psychophysiological measurement provides a method for understanding the mind/body effects of games and can therefore help in game modification and development. For instance while a person is being measured physiologically their reactions to different aspects of the game are recorded. These can be relaxing or stressed reactions or they can be excitement. Depending on the goal of the game a programmer could increase or decrease the amount of a certain variable (i.e. music, visuals etc.) to increase or decrease the effect. A game that is physiologically tailored to meet individual specific human needs seems plausible in the near future.

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ONLINE GROUP CREATIVITY: THE LINK BETWEEN THE ACTIVE PRODUCTION OF IDEAS AND PERSONALITY TRAITS

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This article extends the findings in electronic brainstorming about the impact of personality traits on productivity and creativity in a web-based context of synchronous electronic brainstorming (instant messaging, MSN messenger). The sample included 60 students (M= 20, F= 40, average age of 18 years old) from a graphic advertising school. Participants were randomly assigned to ten groups of six subjects each. Each group was asked to solve the shipwreck task using MSN messenger (text communication only), to identify which objects and which actions were required to survive on a desert island after a shipwreck.

Results showed that group productivity and group creativity are strictly related both to the personality of the users and to the characteristics of the communication process. On the one hand, extroverted personality had a positive influence on the active production of ideas online. On the other, the choice of specific words able to convey real-time feedback and strengthen discussion was a predictor of productivity and creativity performance. These findings provide some useful recommendations for improving productivity and creativity in the context of computer-supported collaborative tasks over the Internet.

INTRODUCTION

Group creativity has quite short background history of research and studies. From the middle of the 90's, literature started to show an interest in it. At the beginning, attention focused on how the group was a restriction and limitation on individual production. During this period, organizations started to focus on group work and collaboration and with Osborn (1963), the literature's attention focused on a defined technique of idea generation which could improve individual creativity: brainstorming[1]. One of the reasons why Osborn (1957, 1963) believed idea groups would be highly creative is that he assumed there would be a great deal of stimulation by mutual associations. The intuition that groups might facilitate (or "prime") their members to think thoughts they might not have had in the context of solitary brainstorming is reminiscent of the notion from cognitive psychology that certain ideas are more accessible than others (Tulving & Pearlstone, 1966). The concepts we have stored in our long-term memory can be thought of as being connected in a semantic network in such a way that related concepts are more strongly connected and thus more likely to activate each other (Collins & Loftus, 1975). Thus concepts that are more closely connected to those that are currently active should be more accessible than those that are less strongly related to current ideas. This way of representing the idea-generation process also implies that it is situation or context-dependent: the ideas currently accessible depend upon what is currently active in working memory.

The central assumption underlying our study is that idea generation is essentially a cognitive or mental process that

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[1]Group brainstorming is a popular technique for creative idea generation developed by Osborn (1957).
This technique consists in following a set of rules designed to establish a non-evalutative setting and to enhance the idea generation process: (a) criticism is ruled out, (b) free thinking is welcome, (c) quantity is wanted, and (d) combination and improvement are sought

occurs within the individual group member's mind. However, this individual-level cognitive process is strongly affected by other group members, in particular by communication within the group. The SIAM, Search for Ideas in Associative Memory (Nijstad, Diehl & Stroebe, 2003), is based on Raaijmakers and Shiffrin's (1981) SAM (Search of Associative Memory) model of memory retrieval. Following SAM, SIAM assumes two memory systems: a limited capacity short-term memory (STM), in which conscious operations are performed, and an unlimited long-term memory (LTM) system, in which previously acquired knowledge is stored.

According to SIAM, brainstorming is a repeated search for ideas in associative memory. Ideas are generally new solutions to a problem and therefore cannot be directly retrieved from memory.

In general, ideas of others stimulate idea generation (cognitive stimulation) because less time is needed to assemble search cues and search memory for problem-relevant knowledge (Paulus, Nijstad, 2003). Depending on the semantic content of stimulus ideas, two types of effect are possible. First, ideas of others can activate knowledge that otherwise would not be accessible (cf. Brown et al., 1998; Higgins, 1996; Tulving & Pearlstone, 1996; Paulus & Brown, 2003). This is likely to happen when stimulus ideas are semantically diverse. On the one hand, stimulus ideas are generated because the (limited) range of knowledge remains highly accessible throughout the session. This leads to productivity gain as long as the possibilities of generating additional ideas within this limited knowledge domain are not exhausted. On the other hand, stimulus ideas may also interfere with individual train of thought (cognitive interference). With the term "train of thought" we mean a rapid accumulation of semantically related ideas. When stimulus ideas activate an image that is at odds with person's thought, it may be prematurely aborted. This may lead to shorter trains of thought, loss of potential ideas, and increased switching domains (Nijstad, Diehl & Stroebe, 2003).

Paulus et al. (1996) demonstrated that the shared performance feedback increased productivity, compared to the "no feedback" condition. Taken together, these results suggest that techniques which provide a real-time – or a delayed performance feedback – seem particularly useful for improving productivity because they create many opportunities for social comparison within the group. Thus, the social comparison process is not only useful in evaluating oneself accurately by viewing the performance of group members, but also in improving one's productivity in the group through comparison with (slightly) more productive participants (e.g., Monteil & Huguet, 1999).

Researchers have long considered how to optimize communication to improve group creativity, but the general conclusion of this research is that due to problems in the communication process, people generate fewer ideas when they work together in groups then when they work separately and later pool their ideas (i.e., in "nominal groups"; see Mullen, Johnson, & Salas, 1991; Paulus, Larely, & Ortega, 1995).

A very consistent finding in this literature is that a number of people working individually (nominal groups) can produce more ideas and more good ideas than can an equal number of people working in a group (Mullen, Johnson, & Salas, 1991). One important cause for this productivity loss in groups is mutual production blocking (Diehl & Stroebe, 1987). Usually, only one group member speaks at a given moment, so group members must often wait for their turn before they can express their ideas. It has been shown that group members cannot think effectively while waiting for their turns, and that the blocking effect is thus due to cognitive interference (Diehl & Stroebe, 1991; Nijstad, 2000).

For this reason, brainstorming groups are more productive when they are provided with continuous public display of the ideas generated by anonymous group members projected at the front of the electronic meeting room. Paulus et al. (1996) demonstrated that shared performance feedback increased productivity, compared to the "no feedback" condition. In this study, members of same group can instantly give feedback to the other members on what they have just typed, creating opportunities for social comparison within the group. The social comparison process is not only useful for evaluating oneself accurately by viewing the performance of group members, but also for improving one's productivity in group through comparison with (slightly) more productive participants (e.g. Monteil & Huguet, 1999).

THE STUDY

In our study we used a commercial Web-based instant messaging client (MSN messenger) to enable and support idea production within a group context. The following hypotheses were tested:
- the quality of conversation, assessed by word association and semantic context is a predictor of productivity and creativity performance;
- the personality traits of the members of the group, and in particular the Extroversion trait, is a predictor of productivity and creativity performance.

Sample
The sample included 60 students (M= 20, F= 40, average age of 18 years old) from a graphic advertising school with a previous knowledge of instant messaging tools.
Participants were randomly assigned to ten groups of six subjects each. All groups were divided into two computer classes. All group members were anonymous inside each group. We decided to use anonymous conditions in mediated communication to reduce production blocking (Dihel & Stroebe, 1991), evaluation apprehension (e.g. Brown & Paulus, 1996; Connolly, Jessup, & Valacich, 1990 Diehl & Stroebe, 1987), and social comparison (Shepphered, Briggs, Reining, Yen, & Nunamaker, 1996).

Synchronous electronic brainstorming tool
In the study we used the Windows XP version of MSN messenger, Microsoft's instant messaging (IM) service, which provides text messaging and voice calling. For Windows XP, the IM client is Windows messenger.

The collaborative task
The collaborative task used in the study is a modified version of the shipwreck task (cfr. Jones-Pfeiffer, The Annual Handbook for group facilitators). This is a collaborative task used to evaluate the decision-making skills of a group. We chose this task to avoid the use background knowledge, and to stimulate divergent thinking.

In the task we presented a shipwreck close to an apparent desert island. The group was asked to choose, by discussing on MSN messenger (text communication only), which objects and which actions were required to survive on the desert island after the shipwreck. The duration of the task was 45 minutes. The conversations produced have been saved and analyzed using T-LAB software.

Questionnaire
All the subjects were submitted to the Eysenck Personality Questionnaire (R Short Scale), a 48- item self-report personality inventory based on Hans Eysenck's factor analysis of personality which assumes three basic factors (the two most important being extroversion to introversion and neuroticism). The Eysenck's standardized scores (Extroversion: mean =13.40, SD = 5.50; Psychoticism: mean = 6.37, SD = 4.19; Neuroticism: mean = 11.59, SD = 5.49) were used to identify the extroverted subjects (subjects with a score higher than the standardized mean plus two times the standard deviation).

Productivity analysis
To measure the production level for each group we calculated:
- *a performance index:* two judges (blind to experiment conditions) counted the numbers of actions and words typed for each group member;
- *a productivity index:* the same judges identified the number of non-redundant significant (related to the task) ideas produced by each group. This last measure was used by previous studies to examine productivity in groups (Dennis & Valacich, 1993; Diehl & Stroebe, 1991; Galluppe et al., 1994). To rank the groups we used the tertiles as cut-off scores: groups with a productivity index lower than the first tertile (33%) were ranked as "low"; groups with a productivity index higher than the second tertile (66%) were ranked as "high".

Conversation analysis
For the analysis of the conversations we used T-LAB software (http://www.tlab.it). This is an all-in-one set of linguistic and statistical tools for text analysis which are used in research fields like Semantic Analysis, Content Analysis, Perceptual Mapping, Text Mining, Discourse Analysis.

In this study we used the following tools:
- *tools for word co-occurrence analysis:* association indexes, comparisons between word pairs, co-word analysis and concept mapping, sequence analysis, concordances;
- *tools for thematic analysis of the context units:* thematic analysis of elementary contexts (i.e. of chunks, sentences or paragraphs), sequences of themes, thematic classification of documents, key contexts of thematic words.

RESULTS

In Table 1 we divided the groups according to their productivity and performance scores.

First, we investigated whether the performance scores in the different productivity groups (low, medium, high) differ from one another. The data showed a significant connection between productivity and performance: the highest productivity group produced more ideas. To better understand if these differences are related to the characteristics of the interaction within the different groups we used T-Lab tools.

Table 1. Productivity and Performance Scores

LEVEL OF PRODUCTIVITY	CUT OFF POINT	PERFORMANCE SCORE	GROUP
LOW	0%(31)	31	9
		37	10
		38	8
MEDIUM	33%(38,97)	39	7
		41	3
		45	1
HIGH	66% (46,88)	47	6
		51	4
		52	2
		64	5

THEMATIC CLUSTER ANALYSIS

First, we checked how co-occurrence relationships determined the local meaning of selected words (ideas). Second, we identified thematic clusters each of which:

a) consisted of a set of elementary contexts (i.e. sentences, paragraphs or short texts like responses to open-ended questions) characterized by the same patterns of key-words; b) was described through the lexical units (words, lemmas or categories) and the variables (if present) most characteristic of the context units from which it is composed.

The results of the analysis for each of the productivity groups are reported in the next pages.

High productivity:

The most frequent headword produced by the high productivity group is "okay" (123 occurrences); this word underlines a correct response to an idea presented from a different member of the team or a sign of the focused attention on the other's contribution.

The second more frequently produced word is fire (91 occurrences). The word "fire" results fundamental to survive on island; the highest frequency for correlation index is "switch on", which it is quite intuitive; after this word members of the high performance group identified other survival actions which are shaped in the interaction of words coming from more members, within a group.

Table 2. Thematic cluster: Headword "fire" and respective correlations

HEADWORD	CORRELATION.	OCCURENCE	ASSOCIATION
Switch on	0,4952	28	25
Okay	0,3308	123	35
To find	0,3268	75	27
Wood	0,3125	45	20
Water	0,2964	72	24
Palm	0,2907	13	10
Hut	0,2905	63	22

As is shown by the output of the content analysis (Table 2), the discussion within the four groups with high level productivity was focused on the identification of critical objects for surviving on the island.
Another interesting analysis is the one related to the headword "thinking", which was produced only by the high and medium productivity groups (see table below).

Table 3. Thematic cluster: Headword "Thinking" and respective correlations

HEADWORD	CORR.	OCC.	ASS,
Survive	0,25	8	4
Enclosure	0,22	10	4
To excuse	0,19	13	4

It possible to observe that this headword is first related to "survive", which is a term strongly related to the goal of group. This could be interpreted as a clear focus of these groups on their specific task.
Medium productivity:
The most frequent headword produced by the medium productivity group is to search (47 occurrences).

Table 4. Thematic cluster: Headword "to search" and respective correlations

HEADWORD	CORR:	OCC.	ASS.
Go by	0,34	9	7
To find	0,322	46	15
To eat	0,275	34	11
Beautiful	0,273	14	7

As expected the most typed words are related to the goal of the task: finding objects useful to survive. Even more interesting to note is the thematic cluster related to the headword "to think" and its comparison with the previous group (Table 5):

Table 5. Thematic cluster: Headword "thinking" and respective correlations

HEADWORD	CORR.	OCC.	ASS,
To entertain	0,38	9	4
To die	0,27	10	3
Hut	0,23	24	4

The main difference between the two groups is the quality of the semantic association. In the high productivity group, it is evident that there is a greater connection between the word "thinking" and "survive", the main goal of the task, whilst in the medium productivity group a low quality connection to the first term (e.g. to think-to entertain) is evident.

This is an example that shows how the quality of production of the high performance group is different compared with the other levels.

Low productivity

The headwords most produced frequently by the low productivity groups are "to search" and "to eat". The fact that two verbs have the same occurrence is not relevant as much as their correlation to the headword "hello", which was not relevant to purpose of the task.

Table 6. Thematic cluster: Headword "to search" and respective correlation

HEADWORD	CORR.	OCC.	ASS.
Hello	0,4	10	8
Wood	0,3674	15	9
Hut	0,355	16	9
Building	0,3550	24	11
To eat	0,35	40	14

EXCLUSIVE WORD ANALYSIS

More unequivocal results come from the exclusive words analysis, which identifies singular words which belong just to a selected productivity group.

From this analysis it emerged that the high productivity group has the highest number of exclusive words. Those words are also more task related: weapon, cost, palm, safe, fire stones, starting, to tie, to stay, to cry, to use. In the medium productivity group, on the other hand, the exclusive words are only "jungle", "to entertain" and "to smoke". No exclusive words were produced by the low productivity group.

PERSONALITY ANALYSIS

Using the outcome of the Eysenck Personality Questionnaire-R, we identified a subgroup of extroversion subjects (19). These subjtects produced the same first ten most relevant words as the remaining subject (41). This datum suggests that the extroversion factor could influence the individual and group productivity.
To address this issue, we made a second thematic cluster analysis using T-lab.

Table 7. Thematic cluster: Headword "fire" and respective correlation

HEADWORD	CORR.	OCC.	ASS.
To switch on	0,41	15	12
Ok	0,3	43	15
Power on	0,293	10	7
Beach	0,289	17	9

Extroverted groups (19 subjects)
In the extroverted subjects, the most frequent headword is "FIRE" (57 occurrences).

As we can observe the most typed words are similar to the ones selected by the high productivity group; two things deserve attention: one that the number of people belonging to this category are 19 instead of 24 of the high performance; second, that the word ok, is quite relevant in term of occurrence (43). As we noted in the high performance group, the word ok stands for a confirmation of something said by a group member. Attention should focus on the fact that extrovert subjects seem more able than the non-extrovert to tune in to others contribution, thus reaching the group goal more easily.

Table 8. Thematic cluster: Headword "to search" and respective correlations

HEADWORD	CORR.	OCC.	ASS.
Fire	0,295	92	31
Switch on	0,2923	39	20
To find	0,292	100	32
Island	0,281	71	26

Non-extroverted group (41 subjects)
In this group the most frequent headword is to search (occurrence 120).
The correlation of this headword is shown in the follow table.

In this part of sample we can observe that the confirmation "okay" is not present. As expected, confirmation of other's ideas seems to be expressed more easily by extrovert subjects than by non-extroverted subjects. But if we identify the production of feedback as a positive influence on group production we could hypothesize that non-extroverts could have more difficult in tuning into each others contribution.

DISCUSSION

Results show some important trends on idea production in groups: the three different levels of productivity present some distinctions which are mainly based on types of correlation between the words and the semantic context from which they emerged. The task of the shipwreck has the purpose of making people work on ideas for survival; this excludes use of individual specific knowledge; for this reason the initial main ideas produced by the three groups are mainly the same. The difference emerges from the reciprocal correlation of these key ideas which allows a deeper conversation leading to a more complex concept.

We expected to find that the main ideas related to the original solutions of the shipwreck task would emerge from all the groups. The result shows that the same initial ideas mainly emerged from all three groups.

Because of this apparently analogy, judges, who identified numbers of ideas produced by each member, counted different levels of productivity among the ten groups. How can this variation be explained? In one of our hypothesis we expected to find different correlation among these same words corresponding to different levels of creativity. Results show that different group productivity corresponds to a different semantic association between high frequency words (the ones present in the tables below); this data suggests that beginning from the same basic words, different productivity could depend on how combining and interactive communication can influence successive and more complex ideas. We also found that the high-productivity group differentiated itself from the rest of the sample by a set of exclusive words that emerged from the interaction and from a task orientated production. These data suggest that there is a qualitative difference in production of those who have produced more non-redundant ideas: exclusive words are more task related and show deeper analysis of the problem then the other two level of performance.

Interesting data has also emerged from repeated measures of correlation in same words through different level of performances (e.g. the word thinking in high and medium performance). Even the same word in two different groups stimulated members in different ways so that in one case (high productivity) one member or more followed the train of thought of another, deepening that semantic category, while in the medium performance the word thinking dropped to a lower conceptual category (entertain) which is not significant to the task.

Finally, we explored a possible link between the personality factor "extroversion" and productivity. Results suggest that production of extroverts is quite similar to the production of the high productivity group. Moreover, the relevance of the word "okay" in the production of the extroverted subjects suggest that social feedback could be considered as a way to improve the general production of group.

In conclusion, given the emerging role of Internet, thinking about how people could be stimulated and supported over their creativity online should be an important field of research. From our exploratory study it has emerged that when members of a team interact more frequently, listen to each other and in particular give feedback, the global production increases significantly. This is in line with existing studies arguing that the process of social comparison and interaction are positive factors of group work.

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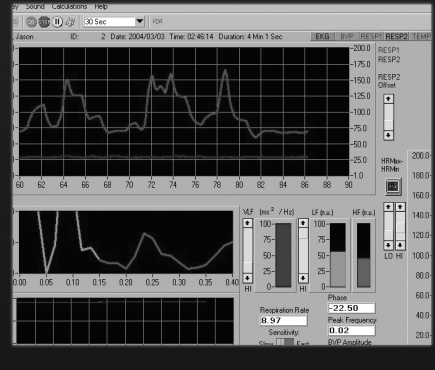

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New technologies are developing at a rapid pace. To help you stay abreast of the latest trends in advanced technologies and healthcare, this feature showcases upcoming 2009 events, which will provide you with the opportunity to connect with leading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

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Health Professions Education: Setting Standards for Best Practice in Simulation
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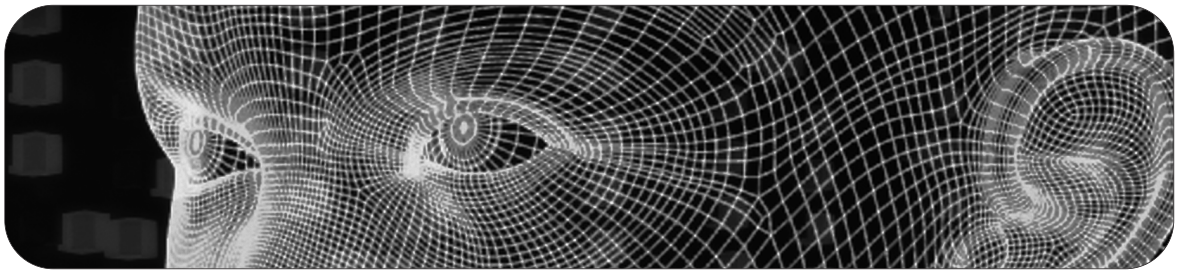

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