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INTERSTRESS

Interreality in the Management and Treatment of Stress-Related Disorders

INTERSTRESS is a European-funded project

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

Objectives:

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

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

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

These goals will be achieved through:

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

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

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EDITORIAL

"When you undervalue who you are, the world will undervalue what you do and vice versa," said financial guru Suze Orman. Is this true for small and medium sized enterprises (SMEs) that contribute to the attainment of information and communication technologies (ICT) goals in Europe? Read on, and judge for yourself.

According to UEAPME, the European association representing crafts and SMEs, 99.8% of Europe's 23 million enterprises are SMEs. The most recent survey of SMEs, ending February 2011, showed that 21% more SMEs showed declining vs. increasing profits. That same survey pointed to causes such as the increased cost of oil and commodities, resulting in a 69% increase in production inputs, and an improving European economy resulting in a 46% increase in labor costs. Among the most common economic challenges reported by SMEs are finding customers, obtaining financing, and competition. The European Commission (EC), recognizing that SMEs provide 67% of all jobs in Europe, is committed to collecting these data to ensure that SMEs have access to adequate financing.

Between 2002 and 2008, the SME job engine was churning, increasing by 1.9% annually vs. 0.8% for large companies. In 2008, the Small Business Act for Europe (COM[2008] 394 final) was launched, just before the economic slowdown brought this powerful job creation engine to a temporary halt.

So-called "micro" firms, employing an average of two people, are the mainstay of the European economy. The 2009 EC report found that "For micro enterprises, gross investment in tangible goods amounts to 24% of value added, compared to 19% for all firms … higher than could be expected on the basis of their profitability, underlining their importance for the EU-economy."

The value of SMEs to the EU is further underscored by the relative dearth of companies with revenue greater than €100 million. A 2008 article on ICT SMEs reported the number of large companies at 2,006 in the EU (for a population then numbering 310 million) vs. 3,176 large companies in the U.S. (for 291 million people). The EU ICT community has its own association of SMEs formed in 2007, PIN-SME (see http://pin-sme.eu/): It currently represents 50,000 ICT SMEs that provide approximately 200,000 jobs.

Another organization for SMEs, founded in 1996, is SME UNION (see http://sme-union.org/). It is the business organization of the European People's Party, representing a network of pro-business politicians and political organizations. "Its top priority is to reform the legal framework for SMEs all over Europe and to promote and support the interests of small and medium-sized enterprises which – due to their willingness to take risks and responsibility – are the engine of the European economy, thereby contributing to eradicating unemployment and promoting economic growth in Europe."

Efforts to promote economic parity made by the EC and organizations such as those mentioned above are essential to the economic security of SMEs. This is evidenced by the fact that although SMEs win 60% of public procurement contracts, the value of such contracts represents only 33% of market share. This EC study reported that the job-creating micro enterprises garnered just a 6% market share. Thus, SMEs are underrepresented by between 14-21% (based on 2006-2008 data) relative to their importance to the EU economy. This is not insubstantial when you consider that public procurement represents 19% of EU GDP.

As UEAPME Secretary General Andrea Benassi said in a recent statement, "The EU is not suffering from a shortage of entrepreneurship in ICT; but it is suffering from a shortage of ICT SMEs that are empowered to grow and innovate at international competitive levels." As an owner of an EU SME, my future may depend on my willingness to take an activist role to ensure that my company is not undervalued, and I urge my colleagues to do the same.

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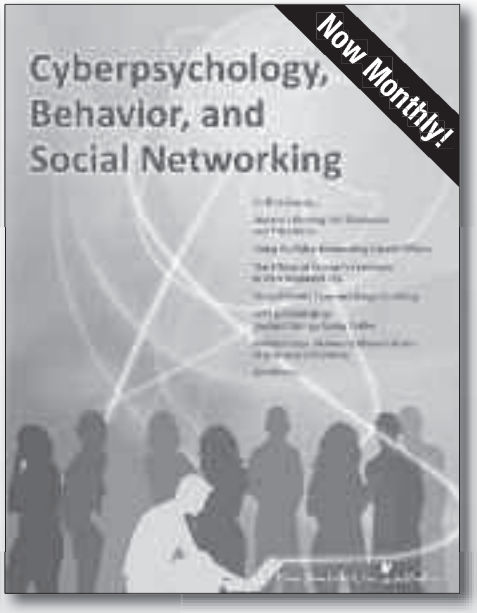

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TRAUMA TIPS: AN INTERNET-BASED INTERVENTION TO PREVENT POSTTRAUMATIC STRESS DISORDER IN INJURED TRAUMA PATIENTS

Joanne Mouthaan[1], Marit Sijbrandij[1,2], Johannes B. Reitsma[3], Jan S.K. Luitse[4], J. Carel Goslings[4] and Miranda Olff[1]

In the prevention of Posttraumatic Stress Disorder (PTSD) after severe traumatic injury, easily applicable, accessible, cost-efficient early interventions are needed that use well-established techniques for decreasing acute psychological stress reactions. Whereas most studies delivered cognitive behavioral techniques face-to-face or as a curative treatment, we incorporated them into a brief Internet-based early intervention program to reduce acute psychological distress and prevent long-term symptoms of PTSD in trauma victims. By means of interactive elements, visual and auditory materials, the intervention contains psychoeducation, modeling, in vivo exposure, stress management and social support. In this article, we describe the design of the program and the outcomes of an initial feasibility study among trauma patients (n = 5) and healthy controls (n = 5). The participants reviewed the program as useful and clear. Neither patients nor controls experienced adverse psychological reactions after completing the intervention. The results show that the intervention is well-received and feasible for implementation in severely injured trauma survivors.

Keywords: **Early Intervention, Internet Self-care, Posttraumatic Stress Disorder (PTSD), Prevention, Trauma**

Introduction

Following traumatic injury, many patients find themselves facing more than their physical recovery. Previous studies have shown that sizeable percentages of trauma patients develop psychiatric symptoms as a result of their traumatic experiences, such as Posttraumatic Stress Disorder (PTSD). One to six months post-injury, reported rates of PTSD vary from 17.5% to 42% (Ehlers, Mayou, & Bryant, 1998; Harvey & Bryant, 1998; Michaels et al., 1999; O'Donnell, Creamer, Pattison, & Atkin, 2004; Shalev et al., 1998; Yehuda, McFarlane, & Shalev, 1998). PTSD is a severe and disabling disorder associated with considerable personal suffering and psychobiological abnormalities due to a deregulated stress system, functional impairment, and a high economic impact (Walker et al., 2003).

To prevent the development of PTSD in trauma victims, several types of brief early interventions have been developed. The most frequently applied early psychological intervention after trauma, the single-session psychological debriefing, does not prevent the onset of PTSD and may even increase the risk for PTSD in some survivors (Rose, Bisson, & Wessely, 2003; Sijbrandij, Olff, Reitsma, Carlier, & Gersons, 2006; van Emmerik, Kamphuis, Hulsbosch, & Emmelkamp, 2002). It has been suggested that the emphasis on expressing emotions related to the trauma, which is a usual part of most acute interventions following psychological trauma, may exacerbate and sustain arousal, which may cause PTSD symptoms to escalate rather than to decrease (Sijbrandij et al., 2006). Therefore, recent guidelines advocate against the use of such trauma-

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focused early interventions for everyone involved in the traumatic event (National Institute for Clinical Excellence [NICE], 2005). To-date, no evidence-based alternatives exist to prevent PTSD in trauma-affected populations shortly after the traumatic event.

Instead, it has been suggested that future early interventions in trauma populations should focus on reducing hyperarousal and consist of "psychological first aid," such as psychoeducational materials about normal and abnormal reactions to trauma and about the various available care options (Gray & Litz, 2005). Lacking thorough research, psychological first aid still remains an evidence-informed, rather than an evidence-based, intervention. Stronger support has been found for the use of trauma-focused cognitive behavioral therapy (CBT) in the treatment of Acute Stress Disorder (ASD) and acute PTSD in injury populations (see Roberts, Kitchiner, Kenardy, & Bisson, 2009, for an overview). Cognitive behavioral techniques include psychoeducation about individual reactions to traumatic events, stress management techniques (i.e., relaxation exercises), exposure, and cognitive restructuring. Although trauma-focused CBT usually consists of four to five sessions, there is some evidence indicating that only one CBT session is useful in the treatment of PTSD in Turkish earthquake survivors (Basoglu, Salcioglu, & Livanou, 2007). In addition, a recent pilot feasibility study in which a single exposure therapy session was delivered to injury victims in the emergency department (ED) within 24 hours after experiencing trauma, showed that patients receiving this intervention were rated lower on clinician-rated global severity of symptoms than patients in the assessment-only condition (Rothbaum et al., 2008).

The Internet may provide a useful medium in delivering early interventions to recently trauma-exposed populations. E-Mental health interventions are considered a cost-effective variant of traditional interventions (Kaltenthaler et al., 2006). In addition, the accessibility of the Internet, its interactivity and low-threshold could be beneficial features in the delivery of care to injured trauma survivors. For the treatment of chronic posttraumatic stress symptoms, several Internet-based interventions have been developed, demonstrating feasibility (Litz, Williams, Wang, Bryant, & Engel, 2004) and efficacy (Hirai & Clum, 2005; Lange et al., 2003). However, few initiatives have yet been undertaken using the Internet as a medium for the prevention of PTSD. A pilot study of a preventive Internet-intervention that addresses mental health (among which PTSD was included) and substance abuse in disaster populations showed the program to be feasible (Ruggiero et al., 2006).

In the next section, we will describe the design and core elements of the Internet-based early psychological intervention "Trauma TIPS," which we developed for the prevention of PTSD in injured trauma survivors. The intervention is targeted at decreasing acute psychological stress reactions in traumatic injury patients within the first month following their injury. In addition, we will present the results of an initial feasibility study.

Design of the Trauma TIPS Early Intervention

The script for Trauma TIPS was written by the authors from the Center for Anxiety Disorders, Research group Psychotrauma of the Academic Medical Center in Amsterdam, the Netherlands. The intervention was produced by the University of Amsterdam's Audiovisual Center. The Trauma TIPS Internet-intervention is a roughly 30-minute Internet program with interactive elements and visual and auditory materials. Since patients use the Web program within the first month after experiencing a traumatic event, which may be one of the most hectic and stressful periods in their lives, we considered keeping the design and layout of the Web pages as simple and straightforward as possible. To achieve this, the toolbar of the program remained visible at the top of every page of the Web site. In addition, at the left and right hand bottoms of every Web page, the buttons "back" and "next," respectively, were present at all times, allowing patients to leave and enter sections at any time they wish. Trauma TIPS was accessed on a secure https://-Web site. Each patient was assigned a personal login name to log into the program. If a patient had forgotten his or her login name, he or she could click on a "forgot your login name?" button upon which the mail server automatically sent the login name to their preregistered E-mail address. With Active Server Pages (ASP) HTML codes were generated at the server, selecting the Web pages using the data generated by each patient. In a Microsoft Access database relevant information was filed, such as the responses to the online anxiety instrument we added to our program (see description of the program below), and the total amount of time patients spent interacting with the various elements of the program. The video and audio fragments in the intervention were put on a streaming media server to allow for immediate viewing after clicking on them, without prior downloading.

The Trauma TIPS intervention consisted of the following steps, corresponding to the buttons in the navigation bar at the top of each page (see Figure 1):

(1) Introduction: explanation of the goal of the intervention and operating instructions;

(2) Questions 1: a pre-test of state anxiety;

(3) Trauma: this module consists of three sections;

a. Trauma Unit: a video feature in which a brief overview of the procedures at the Trauma Unit was presented. In addition, the head of the Trauma Unit explained that stress reactions are very common after traumatic injury, but that the intensity may vary across individuals;

b. Experiences: three video features of Trauma Unit patients (re-enacted by actors) who briefly disclosed their experiences after the accident. Based on the distribution of sex, age and trauma mechanism in our hospital's trauma records, we presented three patients: a male survivor of an industrial accident ("Piet"; 51 years); a male survivor of a motor vehicle accident ("Mike"; 31 years); and a female survivor of an assault ("Esther"; 35 years);

c. Tips: a summary list of five tips for coping with common physical and psychological reactions after a traumatic event was presented. The tips corresponded to the suggestions of the actors during the three video features of the Trauma Unit patients;

(4) Exercises: two audio features of approximately seven minutes duration each with instructions for stress management techniques were presented. The stress management techniques were relaxation exercises based on breathing retraining and muscle relaxation, developed by external experts and staff members of the Amsterdam Academic Medical Center;

(5) Questions 2: a post-test of state anxiety;

(6) End of the program: information about other sources of available help was provided. Participants were given the opportunity to contact the main investigator of the project for additional support or information on professional help. Patients could also leave their remarks and suggestions about the program at a separate remarks section. The remarks were only visible to the project researchers.

Cognitive Behavioral Elements of the Intervention

The main cognitive behavioral elements of the intervention were: information/psychoeducation, modeling, in vivo exposure, social support, and stress management. Below, we will briefly outline the distinctive cognitive behavioral elements and we will discuss evidence to support their use in acutely injured trauma survivors.

Information and psychoeducation. First, information about the usual natural decline in symptoms of distress after experiencing a traumatic event was given in the video feature of the trauma unit professional (step 3a) and in the three video features of the patients (step 3b), who described their initial psychological reactions to the trauma, such as feeling tense, experiencing difficulties concentrating or sleeping, and feeling tired. All patients emphasized that they were moderately distressed at first, but that they improved as time went by. In addition, suggestions for coping strategies were provided in the patients' videos, such as seeking social support for emotional or practical reasons, seeking distraction, resuming normal daily activities (i.e., work, social events), and to self-expose to normal daily routines that may be feared or avoided, such as

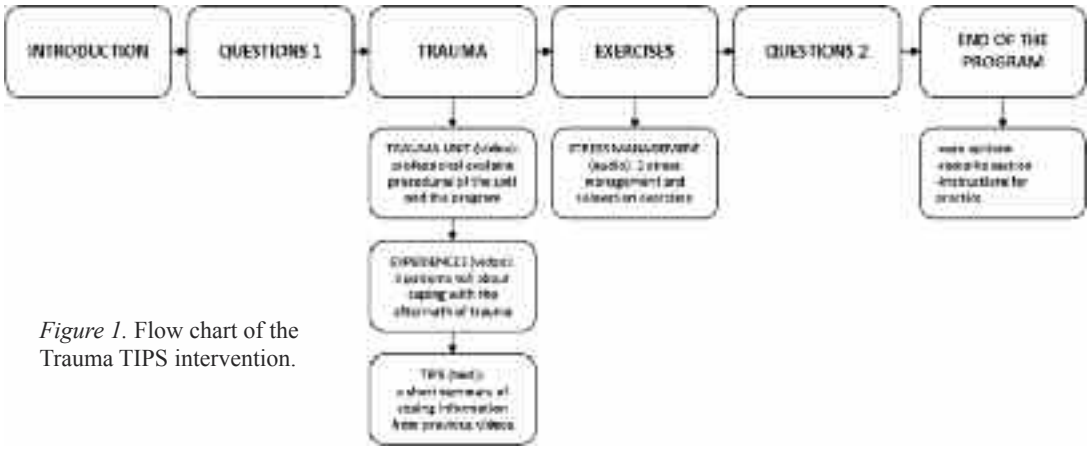

Figure 1. Flow chart of the Trauma TIPS intervention.

driving a car. Furthermore, the following five tips (step 3c) were provided: 1. Symptoms of distress, such as thinking back about what happened, not feeling up to much, and insomnia are common, but often spontaneously decline; 2. Seek support with other people, for emotional or practical help; 3. Seek distraction in activities; 4. Resume daily activities at one's own pace; 5. When many symptoms of distress are present, when a participant is worried or when symptoms do not decrease, participants were advised to contact a staff member of the Trauma TIPS team, or a staff member of the Trauma unit. Contact details were provided on the final page.

Note, however, that recent studies evaluating the use of psychoeducation in the immediate aftermath of severe injury, showed that psychoeducation does not contribute to reductions in symptoms of PTSD and may even worsen existing psychological symptoms (Ehlers et al., 2003; Scholes, Turpin, & Mason, 2007; Turpin, Downs, & Mason, 2005). One study in emergency room patients with panic attacks found that psychoeducation coupled with exposure instructions was more effective than psychoeducation alone in decreasing panic symptoms (Swinson, Soulios, Cox, & Kuch, 1992). In a recent systematic review on the efficacy of psychoeducation in the prevention of PTSD, Wessely et al. (2008) suggested that the type of psychoeducation provided so far may not have been optimal. Instead of sensitizing victims by summing up all possible stress reactions, the authors stated that psychoeducation should include constructive information to stimulate the expectancy of resilience, and promote help seeking, if necessary (Wessely et al., 2008). In our Trauma TIPS intervention, we adhered to these recommendations by not mentioning all possible stress symptoms patients may or may not develop, and by emphasizing return to normal routine.

Modeling, i.e., visually showing behavior with the intent to transfer knowledge on wanted behavior patterns, may facilitate behavior change (Bandura, 1969). It has been used previously in an early video-based intervention for rape victims (Resnick, Acierno, Holmes, Kilpatrick, & Jager, 1999). In Trauma TIPS, modeling was incorporated by showing three patients, enacted by actors, who briefly told their experiences after the accident. Even though the patients told their own story of how they have coped with the aftermath of trauma, the videos had several commonalities. Each patient conveyed information on how to cope with commonly occurring physical and psychological difficulties after traumatic injury. The videos also showed the patients successfully engaging in activities to reduce avoidance behaviors. For instance, one of the videos presented a trauma victim driving a car again after he initially had a fear of driving by himself.

In vivo exposure elements in the Trauma TIPS intervention were embedded within the three video clips of the patients. In these clips, the patients explained how they gradually encountered activities and situations that provoked anxiety. The purpose of the in vivo exposure tips was to stimulate patients to pick up their normal routine and to prevent avoidance behavior. As already mentioned earlier, of all the elements of the Trauma TIPS intervention, exposure was the element with the strongest empirical evidence.

Social support is strongly related to a more favorable PTSD symptom course (Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003). Recent commentaries indeed suggested that, as a part of early intervention, trauma victims should be stimulated to use their own social network (see Gray & Litz, 2005). In the Trauma TIPS intervention, social support was presented in the video clips of the patients as a successful coping strategy. We recommended patients to actively seek support from other people in the form of coping tips (see Information and psychoeducation).

Stress management was presented in the form of two audio clips of approximately seven minutes duration, each with instructions for stress management techniques. The first clip ("Muscle relaxation") focused on progressive muscle relaxation through breathing retraining. The second clip ("Safe place") was an exercise that focuses on decreasing stress or tension levels by imagining a safe and secure place while retraining breathing. The main purpose for the exercises was to decrease acute distress levels and help patients regain a sense of control. Relaxation therapy was not regarded as an effective stand-alone treatment for PTSD, but was usually provided as an effective anxiety-reducing tool within a larger framework of CBT treatments for early symptoms of PTSD and acute stress disorder, as well as chronic PTSD (Foa, Keane, Friedman, & Cohen, 2008).

Pilot Study for Feasibility and Acceptability of the Intervention

To evaluate the feasibility of the intervention and its effects on acute anxiety and early PTSD symptoms, we performed an initial pilot study of the intervention. We

hypothesized that the intervention was acceptable to the patients and feasible for implementation in the intended population. Second, we hypothesized that the specific parts of the intervention would not cause or aggravate adverse short-term psychological reactions (i.e., anxiety, posttraumatic stress symptoms).

Materials and Methods

Participants

In December 2006 and January 2007, five eligible consecutively admitted trauma patients (four males, one female; age in years: M = 34.4, SD = 19.5, Mdn = 23.0, range = 40; two patients had up to four years of highschool, three had five or more years of highschool) of the Level I Trauma Center of the Academic Medical Center in the Netherlands were included in the study. Four patients were admitted following a motor vehicle accident and one after a work-related accident. None of the patients endured severe physical injuries (Injury Severity Score: M = 4.6, SD = 4.3, Mdn = 6.0, range = 9) and all were released from hospital care immediately (n = 1) or after a few days (n = 4) (number of days in hospital care: M = 3.0; SD = 2.9; Mdn = 2.0, range = 7). Five healthy control subjects were included, who matched the patients in terms of gender (four males, one female), educational level (two up to four years highschool, three five or more years highschool), and age (M= 34.6, SD = 19.8, Mdn = 23.0, range = 41). Patients under the age of 18 years, with suicidal ideation, with psychotic, bipolar, or organic disorders, or depressive disorder with psychotic characteristics, with a Glasgow Coma Score < 13 at the time of the intervention, without access to the Internet, or who were physically unable to perform the intervention, were deemed ineligible for the study.

Measures

State anxiety. The State Trait Anxiety Inventory (STAI; Spielberger, 1983; Van der Ploeg, Defares, & Spielberger, 1980) was used to assess state anxiety online at pre- and post-intervention. The STAI is a well-established questionnaire containing 20 items on a 4-point Likert scale (1=very much to 4=not at all).

Posttraumatic stress symptoms. Patients completed the Impact of Events Scale-Revised (IES-R; Weiss & Marmar, 1997), a well-established questionnaire for assessing posttraumatic stress symptoms, at baseline assessment and at one month post-trauma. The IES-R consists of 22 items distributed over three subscales that represent the three symptom clusters of PTSD: Intrusion (eight items), Avoidance (eight items), and Hyperarousal (six items). The sum of all items represents a total score of PTSD symptoms. Scores on the items range from 0 (not at all) to 4 (very much). Because we were especially interested in the acute psychological reactions after trauma and post-intervention, patients completed an additional assessment of intrusive and hyperarousal symptoms at 24 hours post-intervention.

Feasibility and satisfaction. The feasibility and acceptability of the intervention was measured by assessing the participants' opinions on clarity and usefulness of all the individual parts of the intervention. Scores were rated on 4-point Likert scales ranging from 1 (not clear at all, not useful at all) to 4 (clear, useful). Participants could also indicate suggestions or improvements for the intervention. Furthermore, patient satisfaction was assessed on a 4-point Likert scale with scores ranging from 1 (very unsatisfied) to 4 (satisfied).

Procedure

After written and oral informed consent, patients completed a self-report assessment of PTSD symptoms. Next, personal login names for the Internet-based intervention were provided to all participants. State anxiety was assessed online immediately prior to and following the program. Within 24 hours of completing the intervention the participants were contacted face-to-face or by telephone by clinicians for an evaluation of feasibility of the intervention. Patients completed post-assessments of current PTSD symptoms at 24 hours after the program and again at one month post-trauma.

Statistical Analyses

Means and standard deviations of all questions on feasibility were computed. Means, medians and ranges of demographic characteristics and outcome variables are presented. To compare means between pre-intervention and post-intervention assessments of state anxiety and PTSD symptoms within patients and healthy control subjects, paired one sample t-tests were used. Level of significance was set at $p < .05$. Data were analyzed using SPSS (version 12.0.1).

Results

State Anxiety

Table 1 shows the individual and mean scores of the participants on the STAI at pre- and post-intervention. No significant differences were found between pre- and post-intervention assessments for both patients and controls. All mean scores were equal to norms of male and

Table 1
Individual and mean scores on state anxiety (STAI) at pre- and post-intervention of controls and patients, and on posttraumatic stress symptoms (IES-R) at baseline, 24 hrs post-intervention and one month post-trauma of patients

	Patients							**Controls**						
	1	**2**	**3**	**4**	**5**	**M (SD)**	**Mdn (range)**	**1**	**2**	**3**	**4**	**5**	**M (SD)**	**Mdn (range)**
State anxiety (STAI†)														
Pre-intervention	29	37	59	26	27	35.6 (13.8)	29.0 [33]	52	29	30	37	39	37.4 (9.2)	37.0 [23]
Post-intervention	30	36	61	24	27	37.4 (9.2)	37.0 [23]	39	31	31	35	48	35.6 (14.9)	30.0 [37]
PTSD symptoms (IES-R†)														
Baseline														
Intrusion	2	X	9	2	11	6.0 (4.7)	5.5 [9]							
Avoidance	0	X	1	0	1	.5 (.6)	.5 [1]							
Hyperarousal	2	X	4	1	6	3.3 (2.2)	3.0 [5]							
Total	4	X	14	3	18	9.8 (7.4)	9.0 [15]							
24 hrs post-intervention														
Intrusion	0	3	1	0	3	6.0 (4.7)	1.0 [3]							
Hyperarousal	1	5	11	0	1	1.8 (1.0)	1.0 [11]							
1 month post-trauma														
Intrusion	X	1	0	0	0	.3 (.5)	.0 [1]							
Avoidance	X	0	0	0	0	.0 (.0)	.0 [.0]							
Hyperarousal	X	0	8	0	0	2.0 (4.0)	.0 [8]							
Total	X	1	8	0	0	2.3 (3.9)	.5 [8]							

† STAI = State Trait Anxiety Inventory (Spielberger, 1983); IES-R = Impact of Events Scale-Revised (Weiss & Marmar, 1997)
Note. Paired sample t-tests results: *baseline-1 month*: total IES-R: mean difference = 9.0, 95% CI: -10.7 to 28.7, p = .19; intrusion: mean difference = 7.3, 95% CI: -4.4 to 19.1, p = .12; hyperarousal: mean difference = 1.0, 95% CI: -11.4 to 13.4, p = .76; avoidance: mean difference = .7, 95% CI: -.8 to 2.1, p = .18; *baseline-24 hrs post-intervention*: intrusion: mean difference = 0.0; hyperarousal: mean difference = 1.5, 95% CI: -1.3 to 4.3, p = .12; *24 hrs post-intervention-1 month*: intrusion: mean difference = 7.3, 95% CI: -4.4 to 19.1; hyperarousal: mean difference = -1.0, 95% CI: -14.1 to 12.1, p = .78.

female student populations, male army draftees, or ex-radiotherapy patients (van der Ploeg et al., 1980).

Posttraumatic Stress Symptoms

Table 1 also shows the individual and mean scores of the patients on posttraumatic stress symptoms. Although all mean scores of the patients decreased with time, no significant differences were found between any of the mean scores on posttraumatic stress symptoms.

Feasibility

Overall, the patients and the controls evaluated the intervention as clear and useful, although some sections were preferred above others. Most comments were focused on the sections containing the pre- and post-intervention assessments of state anxiety and the stress management exercises.

Regarding the assessments of state anxiety, the participants commented that they contained too much overlap between the questions (three patients and three controls) and too many questions (one patient, three controls).
Regarding the stress management and relaxation exercises, some participants (one patient, one control) had difficulty concentrating on the exercises enough to perform them seriously. Others (two patients, two controls) thought the exercises were very relaxing and would try them again. One control had difficulty listening to the voice and concentrating on the exercise.

Concerning the video of the trauma professional, the participants' comments were that the information was calming, soothing, clear and informative (four patients, five controls), helpful for themselves (two patients, two controls), or helpful for other patients (three patients, three controls).

The opinions of the participants about the videos of the patients were that they were interesting (two controls), soothing (one patient), diverse (one control), and easy to relate to (two controls). According to the participants, the video of the work-related accident provided helpful information about coping with the aftermath of injury both physically and psychologically (two patients, four controls) and on how to regain their normal routine after an accident (one patient and two controls). Three patients thought the information and the specific story of the video of the car accident was clear and insightful. The information in the video of the assault victim was easy to understand (two patients, two controls), interesting (one patient), and provided good tips for relaxation (two controls).

The tips summarized after the experiences of the patients were evaluated as calming and easy to understand and apply (three patients, five controls). Two patients and three controls felt the tips were helpful and worth trying themselves, and one patient and one control already applied them in their own situation. At the end of the program, the participants rated the possibility of providing remarks and the contact information as useful and necessary (three patients, three controls). Suggestions for improvement concerned resolving technical difficulties, such as automatically being logged out and having to log in again and re-answering all questions, and changing the questions of the pre- and post-intervention assessment.

Discussion

In this article, we described the Trauma TIPS intervention. Based on well-established cognitive behavioral techniques, we designed an Internet program for injured trauma victims with the aim of reducing acute hyperarousal and anxiety symptoms to prevent the development of long-term PTSD. In order to evaluate its feasibility for further study and implementation and to ensure that the elements of the intervention did not cause or aggravate adverse psychological reactions, we conducted an initial pilot study. The results show that the Internet-based intervention was feasible and acceptable and had no immediate adverse psychological reactions for the patients or the control subjects. The individual sections or steps in the program were generally evaluated as clear and useful. The participants showed satisfaction with the end product. The results also suggest some adjustments to the intervention that were implemented after the completion of the pilot study. For instance, most participants felt that the 20-item STAI, which we used to assess distress, was too long to complete twice immediately before and after the intervention. Therefore, we replaced the STAI as an online outcome measure with a more time-efficient instrument for assessing state anxiety, a single item Visual Analogue Scale (VAS), to place less demand on participants. With regard to the relaxation exercises, we chose another voice-over that was more neutral to listeners, as some of the participants criticized the original voice. Lastly, all technical difficulties were addressed and eliminated to minimize any inconvenience for future participants.

Since the current study was carried out as a pilot feasibility study, there are a few important limitations. First, we included a small number of participants. Thus, at present, no conclusions with respect to efficacy of the Trauma TIPS intervention may be drawn yet. In addition, we assessed symptoms of PTSD up to one month only after the

trauma. Further assessments at later points in time should be made to examine the long-term psychological effects of the intervention. Finally, the five trauma-exposed patients in this pilot exhibited low levels of anxiety and PTSD severity. The safety and efficacy of the Trauma TIPS in patients with higher levels of distress and arousal remains to be tested.

Currently, Trauma TIPS is under evaluation in a randomized controlled trial in 300 injured patients admitted to the Trauma Units of the Academic Medical Center and the Free University Medical Center in Amsterdam. In this trial, we compare the effectiveness of Trauma TIPS to usual care with respect to the prevention of (symptoms of) PTSD, anxiety and depression, and the reduction of healthcare costs. If the intervention indeed proves to be effective in preventing PTSD, it may be added to the standard care for trauma patients in Level I Trauma Centers and at emergency departments in peripheral hospitals. The e-Mental health approach is promising for acute psychological care for trauma victims due to its low-threshold nature, easy application, possibilities for wide distribution, and low burden on financial and personnel costs.

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POSTING INCOGNITO ... MALES WITH EATING PROBLEMS: ONLINE EMOTIONAL EXPRESSION AND SUPPORT

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Qualitative research in the area of eating disorders (EDs) has predominantly focused on females, whilst the experiences of males' remains poorly understood. Due to the secretive nature of eating problems/EDs it can be difficult to explore the experiences of males with these problems; however, online support groups/message boards, which are common and popular, provide a non-invasive forum for researchers to conduct research. This study analyzed naturally occurring discussions on an Internet message board dedicated to males and eating problems using content analysis. Two major overarching themes of emotional expression (sharing feelings of disturbed eating attitudes and emotions; being secretive) and support (informational and emotional) were identified. The message board provided a vital support system for this group, suggesting that online message boards may be an important avenue for health professionals to provide information, support, and advice.

Keywords: **Males, Eating Disorder, Online Support, Online Expression, Thematic Analysis**

Introduction

Males and Eating Problems

Eating Disorders (EDs) are mainly associated with females, however, it is recognized that males also suffer from eating problems (Dominé, Berchtold, Akré, Michaud, & Suris, 2009; Hudson, Hiripi, Pope, & Kessler, 2007; Muise, Stein, & Arbess, 2003; Neumark-Sztainer & Hannan, 2000), yet research is limited in this minority population and calls have been made for further research (Button, Aldridge, & Palmer, 2008; Lock, 2009). Furthermore, Greenberg and Schoen (2008) suggest that males with EDs have been "overlooked, understudied, and underreported" (p. 464). Research is evidently required in this poorly represented population and the Internet provides a viable way to conduct research with this minority population.

Online Support Groups

Increasingly, individuals with differing health issues turn to the Internet in the form of online support groups for advice and information (McGill & McVittie, 2007). Coulson (2008) reported a total of 136,000 "health and wellness" online support groups operating in July 2007, and the "health and wellness" section of Yahoo_Groups, had an estimated 25,000 online functioning support groups in April 2004 (Eysenbach, Powell, Englesakis, Rizo, & Stern, 2004).

Advantages of Online Support Groups for Individuals with EDs

Due to the secretive nature of EDs (Grunwald & Wesemann, 2006), many use online support groups for advice and help. These groups provide important information and support to those with eating problems (Walstrom, 2000); users can post questions and receive advice anonymously, therefore removing possible effects of stigmatization whilst gaining crucial social support from people who suffer from the same or similar symptoms (Campbell Eichorn, 2008). Online support is available 24 hours a day, seven days a week, and anyone can join

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(Coulson, 2008), therefore, users can post their messages when they need to (e.g., when they are feeling low, not just during regular office hours of healthcare specialists).

Some of the reasons that people utilize these online groups are the same reasons why it is notoriously hard to conduct research with males and females with eating problems (i.e., secretiveness, wanting to remain anonymous, stigmatization); however, males with eating problems have been proven to be more elusive and harder to conduct research with than females with eating problems.

Advantages of Conducting Research Using Online Support Groups

There are a number of advantages of employing online support groups for conducting research, for example, there are large quantities of naturally occurring data readily available; they provide a possibly unique opportunity of accessing those who are hard to reach (e.g., those affected by a stigmatized disease); and they offer a safe environment for those utilizing them, in turn allowing for a deeper expression of feelings and emotions that may not be possible face-to-face (Coulson, Malik, & Mo, 2007). Due to anonymity, users may give more honest opinions or approach more "taboo" areas than if there is face-to-face contact (Coulson, 2008), furthermore, higher levels of self-disclosure may take place as opposed to traditional methods, and these data are suggested to be more reliable than other methods (Coulson et al., 2007).

Previous Research Utilizing Online Support Groups for EDs

Studies have been conducted utilizing online support groups/message boards specifically for individuals who have EDs (large majority of participants were females): they have reported that online support groups offer innovative and low cost self-help services, similar to what a face-to-face support group may offer (McCormack & Coulson, 2009; Winzelberg, 1997) with the added benefit of helping to remove barriers associated with social standing (Winzelberg, 1997). They provide important information and support to those with eating problems (McCormack, 2010; McCormack & Coulson, 2009; Myers, Swan-Kremeier, Wonderlich, Lancaster, & Mitchell, 2004; Ransom, LaGuardia, Woody, & Boyd, 2010; Walstrom, 2000; Wesemann & Grunwald, 2008); and they are a popular form of support service delivery (Winzelberg, 1997). They are ideally placed to offer support and information to some people with EDs (Darcy & Dooley, 2007).

Online Support Groups for Males

Mo, Malik, and Coulson (2008) conducted an extensive literature review of studies examining gender differences in communication on online support groups that included both males and females and found that males engaged in largely practical task and information related communication, whereas females tended to prioritize emotion-focused issues. However, some researchers examined male only online support groups for males coping with infertility (Malik & Coulson, 2008) and fathers of children with spina bifida (Nicholas, McNeill, Montgomery, Stapleford, & McClure, 2003) and reported that these groups enabled their male users to express their emotions, experiences and concerns, in addition to the provision of informational, as well as emotional support. Mo et al. (2008) suggest that future research should examine online support groups for various health-related conditions to see if findings like this are replicated.

Purpose of This Study

No study has examined an online support group specifically for males with eating problems. These males tend to be secretive and suffer from stigmatization in society. Expressing their thoughts and concerns online may allow for them to break free from the traditional masculine role and ask for help (White & Dorman, 2000), hence online support groups may be of significant importance to their health and well-being. Given the reluctance of males to seek help (Galdas, Cheater, & Marshall, 2005), and more specifically, the reluctance of males with eating problems to seek help (Anderson, 1990), these boards provide an appropriate context to examine how males with eating problems feel and the possible support they may gain through online forums. Whilst previous research has included them in their analysis, they were analyzed with females and the number of males included in those analyses has been very small. Furthermore, the potential beneficial effects of online support that individuals with EDs perceive have yet to be described specifically for males. It is important that males with eating problems are not overlooked in research simply because of the difficulties of accessing this secretive, minority group. This study will extend the existing literature by focusing exclusively on males. It will analyze naturally occurring discussions from an online message board dedicated to males with eating problems.

Method

Recruitment and Procedure

An online message board dedicated to males with eating

problems (housed within the Web site of a leading UK charity for EDs) was selected for analysis. Participants were taking part in online discussions within this message board. There were 19 "threads" (i.e., there was an original post, usually a comment or question, which then had responses placed underneath this original post); there were up to 101 replies to these 19 threads. These messages together created a 40-page Microsoft word transcript. The data were posted during a six month time period; this was the maximum amount of time the researchers could allow for data collection due to time constraints.

Ethical Considerations

Informed consent can be waived if communication between members takes place in a public space, where those participating can expect to be observed (British Psychological Society, 2006; Coulson et al., 2007). This was a publicly occurring group, with identity protected and anonymity guaranteed, therefore no informed consent was sought as it was felt this may disrupt the flow of messages. Guidelines for Internet-mediated research (British Psychological Society, 2006; Childress & Assamen, 1998; Coulson et al., 2007) were consulted.

Participants

There were 15 male participants; no personal details were recorded to ensure anonymity.

Descriptive Qualitative Analysis

There was no research question due to the message board being a naturally occurring discussion group. Instead, passive messages were collected from the board and transformed into a transcript. Analysis was then undertaken using a content analysis approach (Morse & Field, 2002). The transcript was read and reread, highlighting segments of data which were then coded by identifying persistent themes, words or concepts (Morse & Field, 1995). Following this, data were grouped to allow for further identification of subgroups. Subsequently, data were categorized to reflect the overall sense of the data, with related categories being grouped into themes. Thinking theoretically and investigator reflexivity were strategies used to ensure rigor during the analysis process (Morse & Richards, 2002).

Results

The analysis of the 101 posted messages identified two main themes: emotional expression and support. Although these two themes are presented separately, they are interrelated as many of the users who openly expressed their feelings (and asked for advice) received advice and support from other users. Table 1 provides a short summary of the themes and subthemes.

Theme One: Emotional Expression

There were two subthemes that were quite evident

Table 1
Synopsis of themes

Theme	Brief description
1. Emotional expression	
Subthemes: 1a) Disturbed eating attitudes and linked emotions	Open expression of disturbed eating attitudes and patterns that were linked to negative emotions were described (e.g., feeling fat and miserable).
1b) Being secretive	New users tended to keep their eating problems a secret, suffering in silence; preferring to express their feelings anonymously.
2. Support	
Subthemes: 2a) Informational support	The detrimental effects of disturbed eating attitudes/behaviors were described and information on how to get help was supplied.
2b) Emotional support	Expressions of encouragement to keep trying to get better. There were many messages of good luck, compassion, and understanding, and users were very empathetic.

within this group – disturbed eating attitudes and linked emotions and being secretive.

Subtheme 1a: Disturbed Eating Attitudes and Linked Emotions

The majority of users openly expressed disturbed eating attitudes and patterns that were overtly linked to negative emotions. Some described feeling fat and miserable after eating so they binge (then having feelings of regret), not going to their GP as they feel they are not below "normal" weight, feelings of indifference when losing weight compared to feeling bad if their weight had gone up, and wanting to be thin. There were no comments about wanting to be muscular; it was particularly evident that the majority of the users of this message board desired to be thin. For many users of this message board issues with their weight were linked to negative thoughts about themselves. One user stated:

> "… if I eat, I feel so disappointed in myself, I feel miserable, fat, ugly and the list goes on … usually I end up binge eating, and I put back on the weight that I managed to lose. I feel SO awful when this happens."

There were a wide range of negative emotions expressed by the users of this board, from feeling disappointed, guilty, fat, ugly, miserable, desperate, lonely, and depressed, to feelings of worthlessness, unhappiness, shame and suicidal ideation. Some also expressed a fear of putting on weight, hatred for themselves, feelings of distress and unhappiness and feeling like they are living a fake life. They were very unhappy with their weight and tended to see it as a reflection of the type of person they are, negatively impacting on their psychological well-being; some did not appear to separate their feelings about their body from the type of person they are (e.g., I am fat therefore I am useless). There seemed to be a self-perpetuating cycle of feelings about their weight relating to feelings about themselves, making some users very distressed. For example, one user stated:

> "Have been feeling depressed … I also have been calling myself fat, ugly etc. and that I actually now can't stand to look in a mirror because I begin to cry … I want to do it (throw up) again more and more as I think it's my last chance and last hope of finally making myself thin."

Another stated:

> "Each time I look in the mirror I can't stand what I've become and hate myself for doing this to myself … It's such a disgrace. I don't even have the sense to purge."

There were no postings regarding the possible negative effects of media influence (e.g., pressure to be thin).

This subtheme particularly highlights the vulnerability of these male message board users, how their feelings about their eating problems and associated negative emotions seem to perpetuate the cycle of disordered eating. It also highlights that many are accessing this board in order to share how they are feeling, sometimes asking for advice and support from other users.

Subtheme 1b: Being Secretive

New users of this message board (i.e., users posting for the first and/or second time) tended to keep their eating problems a secret from their friends and/or family. They seemed to be suffering from these problems in silence, preferring to express their feelings anonymously on the message board. One user stated that after years of purging, he didn't want to tell his wife because he felt like it was a betrayal not to have told her before now. Others expressed fears of being laughed at or being told they are silly. Another user had a fear of being locked up in a psychiatric ward. It was evident that some of the users of this board had a fear of being "found out" and this secretiveness discouraged them from getting the help they needed. For example, one user stated that:

> "... fear that I will be laughed at, or told I am silly. I am scared of what others will think. It feels ok for me to talk over the net, because no one knows who I am, and so I do not feel as if I could be ridiculed, however I would not talk about it in person with anyone I knew, because of the stated fear."

Secretiveness seemed to be an inherent part of having an eating problem for the males using this board for the first or second time; however, this board provided a supportive forum to openly talk about how they were feeling whilst allowing users to remain anonymous and secretive.

> "… I really do not know what to do now and when I stumbled across this site I thought posting incognito may help me bring my issue out in the open for the first time."

> "... due to my job I can't risk this going on my medical records so I can't go to my GP. I'm desperate, please help if you can."

Initially, new users of the board posted messages because they could express their feelings whilst remaining anonymous, hence keeping their problems a secret. There were many reasons behind the need for anonymity, however, upon using the board for advice and support some seemed to be taking steps to seek help (please see theme two below).

The overall emotional expression theme highlights that users of this message board openly expressed their feelings and associated emotions about their eating problems, allowing for open, honest expression for those who wanted to remain anonymous. Subtheme 1a highlights that many users of this message board openly shared how they were feeling, whilst subtheme 1b highlights that some new users felt able to do this only because they were posting incognito and therefore felt safe to do so. However, when many of the new users familiarized themselves with posting on the board, the less strongly they felt about being secretive, and some considered seeking help, whilst others actively sought it.

Theme Two: Support

The users of this online board were extremely supportive of anyone who posted their messages. Once a user posted a message stating how they were feeling, other users were always quick to respond with advice, support, and encouragement, whether they requested it or not. It is of note that some male users of the message board actually found it after watching a TV program and whilst the media did not provide informational support within the message board, it had directed them to it and therefore supplied beneficial information to potential message board users. Many females provided support, however, their messages were not analyzed due to the study's aim to include male participants only. There were two subthemes evident within this group: informational support and emotional support.

Subtheme 2a: Informational Support

In order to highlight the possible detrimental effects disturbed eating attitudes/behaviors may have, some users described the physical/health effects they experienced as a result of their own eating problems. These ranged from reports of a hemorrhage in an eye, irregular heartbeat, palpitations, and chest pains, to low white blood cell count, malted hair, and one male even described suffering from a heart attack. These are serious problems that can result from an eating problem, and the sharing of this information seemed to help other users seek the help they needed.

Examples:

> "... You must not undertake purging behaviors. Unfortunately it doesn't seem to be spread on the news etc. about how dangerous purging is. You need to keep on a nutrition diet that is giving your body enough energy to at least maintain things. You are thin ice with your health ***, and I just feel a need to show you how worried I am. I have had a heart attack in the past, and know full well, the dangers of eating disorder behaviors."

> "The sad reality is that you will feel much more frustrated and depressed and low, the more you deprive your body of what it needs. The more you restrict; the lower you actually feel. You may feel a false sense of control, but at what cost? To stay focused and sharp, you need to not starve yourself."

When one user posted that they did not know how to approach their GP, another user actually posted some information for them to help them deal with the situation:

> "Hi *** I found this article for you. I hope you read it, as I am sure it can help."

This informational support helped encourage some males to seek help (not all, as some still remained secretive). One user asked for advice after posting that it had been eight weeks since he spoke to his GP but there was still no sign of a referral and he was getting anxious. He received the following response when he asked if he should pursue the appointment:

> "I agree that you should. Sadly a majority of people have to go seek help rather than be offered. It's a shame but you're going to have to nag the GP and maybe contact the clinic directly. Also a good thing would be to ask to be referred to your local mental health team who will be able to offer more help in terms of psychological and social if needed, best of luck."

Some users made appointments or went to see their GPs after receiving information and advice, stating:

> "Well the results weren't good I've got a very low white blood cell count I've been given a sick note for three weeks have to go back to the docs next week I'm feeling quite scared now."

> "I've just looked into the electrolyte deficiency and the symptoms look very familiar, I had blood tests twice recently and the docs don't seem to have picked it up but I hadn't realized it was so serious, so I've booked an appointment to see my GP and it's time to come clean though it won't be easy."

It was very clear that the message board users received information; this information appeared to help the new, more secretive users move toward the next step of getting help.

Subtheme 2b: Emotional Support

Emotional support was very evident on this message board; many users asked for help and other users responded to their requests with advice and words of encouragement. This emotional support included expressions of encouragement to keep trying to get better, messages of good luck, compassion, and understanding. For example:

> "I hope u get the help u need and I wish u all the best u will fight this just keep thinking of ur future and positive thoughts and u will beat this."

This support also took the form of empathy for how the user who posted the message was feeling, along with validation of feeling like that and expressions of other users feeling the same way, almost like a shared experience even though they did not know each other personally. For example:

> "I know how you feel."

> "Please keep strong and seek help mate."

> "Congratulations on coming forward. As you probably know, the first step of any problem is admitting it is a problem. So well done for reaching that stage. I have so much sorrow for you to hear you suffer the same feelings I experience, it's a hell like existence."

Users who did seek help after communication on the message board would come back and share the result (of speaking to a health professional/family member/friend) with other users who again responded positively, providing more words of encouragement and reassurance. For example, one user stated that:

> "I feel good about the referral I think I'm finally realizing how deep I am into my head now & need to do something about it, saying that some days I think I am normal & kind of like the way I do things as strange as that sounds."

More regular/familiar users of the board also supported each other – by getting to know each other online they provided regular encouragement and support to each other. For example:

> "Thank you. To know I have a *** family that is looking out for me really is touching and I'm truly honored to know each of you. You're all in my prayers and I think of you every day and of what you've done for me, and of what I can do for you all in return."

It was evident that emotional support was strong within this board. Whereas informational support was more beneficial to newer users, emotional support was of benefit to all users. The more regular users of the board seemed to be familiar with each other and "checked-in" quite often to see how the others were doing.

This overall support theme highlights that users of this message board both give and receive informational and emotional support; it provides a vital support system for its users. This support appeared to help some newer users seek the help they required, whilst also providing emotional support for both regular and new users.

Discussion

The aim of this study was to analyze naturally occurring discussions on an Internet message board dedicated to males with eating problems. Data were successfully extracted from the board and analyzed to produce findings of interest, supporting the use of this type of data for research. The study underscores the usefulness of utilizing this type of data for conducting research with those who are hard to reach (e.g., males with eating problems), a point highlighted by Coulson et al. (2007).

The main function of the online message board appeared to be the provision of a forum to express feelings and gain support; it was a helpful and supportive environment for the males with eating problems who used it. Analysis of the data revealed two main themes: emotional expression (disturbed eating attitudes and linked emotions and secrets); and support (informational and emotional).

Emotional expression involved users discussing feelings related to their eating problems and associated negative emotions. Some users seemed to experience a self-perpetuating cycle of being unhappy with their weight, seeing it as a reflection of the type of person they are, therefore negatively impacting on their psychological well-being (e.g., "I am fat therefore I am useless"). It was clear to see the negative impact eating problems had on the everyday lives of the users of this board. The majority were under no illusions about their problems; they realized that their eating patterns and behaviors were not healthy, but the negative emotions and feelings associated with their problems appeared to keep them in the cycle. Furthermore, the emotions and feelings described by these users are very similar to the way females with eating problems feel (Grilo, Wilfley, Brownell, & Rodin, 1994); the males using this board had a comparable emotional experience with their eating problems as females, similar to findings reported by Woodside et al. (2001).

The users reported a desire to be thin (there were no postings expressing a desire to be muscular) and this again is a similar finding to females with eating problems. However, these findings do not suggest that the treatment for males with eating problems should be similar to females; this study reports on the emotions and feelings described by the majority of the male users of the board and does not report on exactly how they came to feel that way. In fact, despite the similarities of these findings with findings from previous research with females with eating problems, Lock (2009) feels that researchers have tried to fit males with EDs into a framework that is mostly focused on young female's development.

Some of the newer users of the board were secretive about their eating problem, highlighting the fact that some males are reluctant to seek help (Anderson, 1990). However, many of the new users considered seeking help or even actively sought help after receiving support from the group. This suggests that the message board plays a vital role in the well-being and health/help seeking behavior of some of the males who utilized this message board. It appeared that the board provided a safe place to seek advice or simply talk about how the users felt. Posting incognito allowed for honesty and openness for the new users of the message board, underscoring this benefit of online support groups as highlighted by previous research (Coulson et al., 2007; Winzelberg, 1997).

Support from male users of this message board was very evident (support was also provided from females but not included in the analysis). An important point to note is that the media was mentioned in a positive light: it directed some of the users to the message board for help. Campbell Eichhorn (2008) reported that the negative effects of the media (i.e., pressure to be thin, etc.) were the least frequently mentioned theme in their analysis of an online message board for people with EDs and this may be because EDs are psychological and not manifested from the media. The results of this study tentatively support this idea because there were no postings from these message board users describing the negative effects of media pressure.

Users provided informational support by sharing their own experiences of eating problems, in addition to suggesting how to get help; this was encouraging for other users of the board, especially the newer ones. Emotional support was also very evident on this board, benefiting all users and many "checked-in" often to see how the others were doing.

The findings in the current study focused only on males, however, results were similar to previous research that analyzed mainly female online ED support groups (Braithwaite, Waldron, & Finn, 1999; Campbell Eichorn, 2008; McCormack & Coulson, 2009), that is, users of this board shared their experiences as both a way of emotional expression and as a way of soliciting help, informational and emotional support. It also supports Malik and Coulson's (2008), Nicholas et al.'s (2003), and McGill and McVittie's (2007) research on male only online support groups who found that males use these types of online support systems for emotional and informational support, not just informational support. The current study (alongside previous research) suggests that these online message

boards may be providing vital support systems for males that may not be found elsewhere.

Limitations

There was a limited number of participants in the study (i.e., 15 males) – smaller than the level of involvement in other studies examining online support groups for those with EDs (McCormack & Coulson, 2009) – however, this was because the study aimed to analyze messages posted by male participants only.

The study only takes into account what users chose to share with the group, therefore, it can be said that it does not provide a whole account of their experience with eating problems. Furthermore, messages from only one message board were analyzed, therefore, the themes highlighted reflect the experience of these users alone; the findings are only applicable to this particular group and cannot be generalized and applied to all males with eating problems. Moreover, it is imperative to remember that some accounts may not be entirely accurate as online forums may provide easy cover for deception; therefore, it is impossible to detect if the information represents the posters' characteristics accurately. Some users may choose to "downplay" their problems or even exaggerate them – in fact, some users may not even have the condition (e.g., "Munchausen by Internet:" MBI; Lamberg, 2003).

The clinical diagnosis of those using the board is unclear (if indeed they even have a clinical diagnosis); therefore, it can also be argued that the findings may not be generalized and applied to a clinical male population. However, Darcy and Dooley (2007) conducted a clinical profile of an online support group for those with EDs and reported that those who accessed the online groups had similar clinical profiles to traditional clinical samples.

Finally, the information supplied on the message board was from other users, not a professional moderator, therefore possible inaccurate or even dangerous medical information may be given (Coulson, 2008). However, Esquivel, Meric-Bernstam, and Bernstam (2006) examined the accuracy of 4,600 messages regarding online information on a breast cancer support group and found that only 0.22% of messages were false/misleading, and the participants were quick to point out inaccuracies. This message board did not have inaccurate or dangerous information posted on it by its users, however, there is still the possibility of an individual misinterpreting a message and this needs to be remembered when suggesting the benefits of online support groups for their users.

Conclusion

This study highlights the fact that users of this message board (from a secretive, minority population) expressed their negative emotions openly, subsequently, they received vital informational and emotional support. Emotional expression was evident, and remaining anonymous whilst receiving support and advice appeared to be one of the initial reasons new male users of this message board felt safe speaking about their eating problems, indicating that this crucial support and advice may not have been sought elsewhere. Upon receiving this advice and support many users did seek help, underscoring the important role this group played in the well-being of its users.

Implications for Practice

Using data that is conducted in "real world" settings yield imperative findings for practice (Swanson, Durham, & Albright, 1997). The findings from this study support previous suggestions that computer-mediated support groups provide a low cost self-help service for those with eating disorders/problems (McCormack & Coulson. 2009; Winzelberg, 1997), underscoring the "real world" benefits of the Internet in providing help and support to people who suffer from eating problems, in particular, males who are less likely to seek help.

Lock (2009) suggests that more targeted awareness and prevention efforts for males should be developed. This study raises awareness that the Internet may be a viable way to reach males with eating problems, for instance, interventions for males with eating problems could be conducted via online groups which have been proven successful with females (Heinicke, Paxton, McLean, & Wertheim, 2007). This study highlights the fact that the males who used the online message board benefited from sharing their negative emotions and gaining support.

Healthcare specialists should be sensitive to reasons why males with eating problems may find it hard to seek help and the findings from this study provide information on the types of support these males with eating problems seek out. The vital support that online message boards may provide to males with eating problems, or indeed any secretive, minority group, who use online support boards should be acknowledged. Moreover, the many benefits of utilizing these types of online message boards for offering professional help and advice should be considered by healthcare specialists.

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PREFERENCE FOR MODE OF DELIVERY OF COGNITIVE BEHAVIOR THERAPY IN SOCIAL ANXIETY

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Stated preference discrete choice modeling was used to examine the contribution of treatment effectiveness, cost, access, flexibility in scheduling and therapist contact to (a) forced-choice preference decisions; and (b) forced-choice decision to undertake preferred treatment if available. Socially fearful people were recruited from clinics (n=43) or the Internet (n=76). Participants preferred treatment that was lower cost and easier to access, characteristics associated with computer-assisted cognitive behavior therapy. More effective treatments and those that combined therapist engagement and self-directed delivery were also preferred. Decision to undertake therapy if available was significantly associated with ease of access and effectiveness, but not cost. Flexibility in scheduling therapeutic sessions was significantly associated with decision to seek treatment if available, and participants were more likely to say they would seek treatment that included therapist engagement, however minimal, compared to completely self-directed therapy. The findings have implications for improving access to therapy for people with social anxiety.

Keywords: **Cognitive-behavior Therapy, Social Anxiety, Treatment Preference, Stated Preference Discrete Choice Modeling, Treatment Access**

Social phobia is a common condition marked by early onset, significant impact on quality of life, and high levels of comorbidity (Grant et al., 2004; Kessler et al., 2005; Magee et al., 1996; Olfson et al., 2000; Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992; Zamorski & Ward, 2000). There is also evidence to suggest that in many cases of comorbidity, social phobia is temporally primary and may increase an individual's vulnerability for developing secondary psychological disorders (e.g., Kessler, Stang, Wittchen, Stein, & Walters 1999; Lampe, Slade, Issakidis, & Andrews, 2003; Merikangas et al., 1996; Nelson et al., 2000; Schneier et al., 1992). Epidemiological studies estimate that only 19%-33% of people with social phobia seek treatment (Canino et al., 2004; Grant et al., 2004; Kessler et al., 2005; Magee et al., 1996). Without treatment social phobia is likely to be enduring, and recovery rates are lower for those with comorbid conditions (Davidson, Hughes, George, & Blazer, 1993; DeWit, Ogborne, Offord, & Macdonald, 1999), further highlighting the need for effective, accessible treatments. While Cognitive Behavior Therapy (CBT) has been shown to be effective for the treatment of social phobia (Davidson et al., 2004; Manassis et al, 2002), fear of social and/or performance situations with unfamiliar people means that undertaking therapist-delivered therapy is challenging. The cost of treatment may present a further barrier, as social phobia is associated with low socioeconomic status (Kessler, Chiu, Demler, & Walters, 2005; Lampe et al., 2003; Magee et al., 1996; Olfson et al., 2000).

Computer-assisted CBT (CCBT) is an evidence-based self-help treatment modality that uses technology such as the Internet and computer programs to teach users psychological strategies that aim to improve mental health. CCBT provides advantages for people with social anxiety in terms of accessibility, cost and anonymity (Garcia-Palacios, Botella, Hoffman, & Fabregat, 2007; McCrone et al., 2004). Providing more accessible treatment options like CCBT may allow for early intervention, thus preventing deterioration in quality of life, and reduce the development of comorbid conditions. CCBT is shown to be effective for people with social phobia (Andersson, Bergstrom,

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Carlbring, & Lindfors., 2005; Carlbring et al., 2007) and the National Institute for Clinical Excellence (2005) recommended that examining user preferences for CCBT should be a research priority. To date this work has not been conducted.

Stated preference discrete choice modeling (SPDCM) instruments elicit consumer preferences and are used to predict service utilization (Phillips, Johnson, & Maddala, 2002). Previous approaches to predicting consumer behavior have relied mostly on questionnaires that require ratings of attitudes towards goods, services and interventions. Viney, Lancsar and Louviere (2002) commented that these methods are vulnerable to yea-saying bias and to contingent valuation, given that all attributes are measured simultaneously. Not all attributes are able to be included in SPDCM questionnaires and based on literature, key service attributes (e.g., cost, effectiveness) are identified to reflect important dimensions of differences between options. SPDCM provides data on consumer preference for individual attributes of treatment as well as for the treatment as a whole (Johnson et al., 2007). Pairs of scenarios are presented and respondents choose the scenario they prefer. Labeling scenarios, in this case CCBT and therapist-delivered CBT, increases the likelihood of responses being more reflective of actual choices they would make in real life when labels are known to consumers and thus do influence decisions (Bryan, Buxton, Sheldon, & Grant, 1998). SPDCM is an innovative, sound approach to understanding consumer behavior. It has recently been used to examine treatment preferences and treatment adherence among people with psychological disorders (e.g., Dwight-Johnson, Lagomasino, Aisenberg, & Hay, 2004; Johnson, Ozdemir, Manjunath, Hauber, Burch, & Thompson, 2007).

This study used a SPDCM questionnaire to identify the characteristics of people with social anxiety who express a preference for CCBT attributes compared to therapist-delivered CBT attributes. The study aimed to identify the extent to which the treatment attributes of setting, effectiveness, cost, scheduling flexibility and amount of therapist contact determined (a) stated preference and (b) willingness to undertake treatment. The extent to which these factors may be sensitive to symptom severity, age, income, and Internet use/familiarity was also considered. Based on previous research, it was expected that attributes associated with CCBT would be attractive for people with social phobia who: were relatively young, as this sector of the community includes the highest number of users of the Internet in Australia (ABS, 2007); had lower incomes, due to the relative affordability of CCBT compared to therapist-delivered therapy (Lampe, et al., 2003; Magee, et al., 1996); were experiencing more severe symptoms of social phobia (Olfson, et al., 2000); and who may experience greater comfort accessing resources that are anonymous (Erwin, Turka, Heimberg, Frescoa, & Hantulab, 2004).

Method

Participants

People were recruited from free community clinics in Sydney and through the Internet. Inclusion criteria for both samples were minimum age of 16 years, presence of social anxiety, and sufficient English reading skills to complete the questionnaire. Participation was voluntary.

The Clinic sample (n = 43) was recruited from five adolescent and adult mental health clinics and met DSM-IV criteria for social phobia. Exclusion criteria were: presence of organic disorder, substance use disorder, or psychosis; and guardianship through a government agency. The response rate was 91%, with less than 1% missing data.

Subjects making up the Internet sample (n = 76) were recruited through search engines and links from Australian mental health Web sites. The purpose of recruiting participants from the Internet was to ensure that people with concerns about social situations who were familiar with using the Internet environment to acquire information about treatment, but who may not be currently presenting for treatment, were included. Thirteen percent of those who commenced the survey through the Internet did not complete it, and completed surveys included 6% missing data.

The total sample was comprised of 119 people (54 female) aged between 16 and 59 years (M = 28; SD = 10.7). Approximately half were aged 16 to 24 years (n = 60) and the remainder were aged 25 to 59 years. The Internet sample self-selected for social anxiety concerns.

Materials

Demographic Information, Experience with Computers and Experience with Therapy for Social Anxiety

This section included 21 questions that concerned: (1) demographic characteristics; (2) access to computers and the number of hours per week spent online; and (3) current or previous treatment experience.

Fear of Negative Evaluation (FNE)

The FNE (Watson & Friend, 1969) contains 30 true or false items and has demonstrated validity and reliability in samples with social anxiety (Friend & Gilbert, 1973; Smith & Sarason, 1975; Watson & Friend, 1969). It is frequently used in studies of social phobia (Rodebaugh, et al., 2004), and scores are significantly correlated with scores on the Social Phobia Scale and Social Interaction Scale (Heimberg, Mueller, Holt, Hope, & Leibowitz, 1992). FNE scores ≥20 are consistent with international norms for social phobia (Stopa & Clark, 2001).

Depression Anxiety and Stress Scale 21 (DASS-21)

The DASS-21 (Lovibond & Lovibond, 1995) has 21 items rated on a four-point scale to assess emotional states over the past seven days. The DASS-21 comprises three subscales (DASS-Depression, DASS-Anxiety and DASS-Stress) and has good psychometric properties among clinical and non-clinical samples (Lovibond & Lovibond, 1995).

Illness Intrusiveness Rating Scale (IIRS)

The IIRS (Devins, 1994) is a 13-item scale to assess interference in valued activities using a seven-point rating scale. The IIRS has strong psychometric properties, with high internal consistency, reliability, and validity, and is a useful tool for people with social phobia (Antony, 1997; Devins et al., 2001). The mean IIRS score for a clinical sample with social phobia (n = 49) was 54 (Antony, Roth, Swinson, Huta, & Devins, 1998). To focus participants on interference due to social anxiety the IIRS was entitled "Social Anxiety Intrusiveness Rating Scale."

Stated Preference Discrete Choice Modeling Questionnaire (SPDCMQ)

The SPDCM design was selected based on the optimal design strategy recommended by Street, Burgess and Louviere (2005) using the software package SAS. The SPDCM design used the minimal number of comparisons and permitted estimation of main effects and two-factor interactions (Street et al., 2005). The SPDCMQ included 16 scenarios to measure treatment preferences and attributes following a description of techniques used in CBT and an example scenario with responses.

Five treatment attributes each with four levels (0,1,2,3) were included to reflect important differences between CCBT and therapist delivered CBT as follows:

1. Distance to treatment setting (distance 0, 5, 15 or 30 kms);

2. Treatment effectiveness (symptoms reduce by 55%, 65%, 75% or 85%);

3. Total treatment cost (free, $300, $800 or $1500);

4. Treatment flexibility (control of frequency and duration of therapy very limited, limited, high, very high);

5. Degree of therapist contact (none, minimal, equal therapist contact and self-directed, all provided by therapist).

The questionnaire presented scenario pairs under the heading "therapist directed" and "computer-assisted." Participants were required to select one treatment option. The second part of the question asked participants to indicate whether they would undertake the preferred treatment if it were available or not seek treatment.

Procedure

Data were collected between August 2007 and August 2008. The clinic sample completed the questionnaire in paper-and-pencil format and the Internet sample completed the questionnaire online.

Results

Characteristics of the Sample

Scores of >20 on the FNE are consistent with international norms for social phobia (Stopa & Clark, 1993). Of the total sample, 77.5% had FNE scores >20. Almost two-thirds (62.3%) of the sample had DASS-21 Depression subscale scores at or above the 95th percentile, and 72.8% had DASS-21 Anxiety subscale scores at or above the 95th percentile based on published norms (Henry & Crawford, 2005). The average IIRS score (M = 50.4) is broadly consistent with clinical samples with social phobia (M = 54.6); (Antony et al., 1998; see Table 1).

There was no significant difference between the Clinic and Internet samples in FNE ($t(114) = .82$, $p > .05$); DASS-Depression ($t(112) = 1.95$, $p > .05$); DASS-Anxiety ($t(112) = .73$, $p > .05$); or IIRS scores ($t(111) = -1.74$, $p > .05$; see Table 1). More than half (54.3%) reported that they had not previously received treatment for social anxiety and there was no significant difference between the Clinic and the Internet sample in the proportion who reported that they had received any treatment previously ($\chi 2(1, N = 116) = .06$, $p > .05$; see Table 1). Site of recruitment was not significantly associated with whether people reported having tried (a) individual

Table 1
Characteristics of the Sample (n = 119)

	Clinic sample (n = 43)	Internet sample (n = 76)	Total sample (N = 119)
Mean age in years (SD)	24 (8.2)	30 (11.4)*	28 (10.7)
Number of males (%)	15 (34.9)	50 (66.7)*	65 (55.1)
Mean FNE (SD)	23.7 (5.3)	22.6 (7.5)	23 (6.8)
Mean DASS-Depression (SD)	20.69 (10.6)	16.22 (12.4)	17.91 (12)
Mean DASS-Anxiety (SD)	16.18 (11.1)	14.7 (9.3)	15.29 (10)
Mean IIRS (SD)	47 (17.6)	52.4 (15)	50.4 (16.2)
Mean age of onset (SD)	12.10 (6.7)	11.44 (5.8)	11.68 (6.1)
Previous Treatment^			
Individual or Group Therapy (n; %)	17 (58.6)	31 (44.9)	48 (40.3)
Medical Practitioner/Medication (n; %)	9 (31)	31 (44.9)	40 (33.6)
Self-Help (n; %)	7 (24.1)	29 (42)	36 (30.3)
No Previous Treatment	24 (55.8)	39 (53.4)	63 (54.3)
Number in income category (%) Parent support <$30000 $30001-$60000 >$60001	 12 (28.6) 24 (57.1) 3 (7.1) 3 (7.1)	 10 (15.2) 30 (45.5) 17 (25.8) 9 (13.6)*	 22 (20.4) 54 (50.0) 20 (18.52) 12 (11.1)
Frequency of Educational Qualification (%) School Certificate or below Higher School Certificate Post-School education	 19 (44.2) 12 (27.9) 12 (27.9)	 9 (15.3) 11 (18.6) 39 (66.1)*	 28 (27.5) 23 (22.5) 51 (50.0)
Number with home computer (%)	34 (87.2)	75 (98.7)	109 (94.8)
Number with home Internet (%)	29 (74.4)	58 (76.3)	87 (75.7)
Mean Internet use hrs/wk (SD)	16.62 (24)	14.3 (16.3)	15.2 (19.4)

FNE: Fear of Negative Evaluation; DASS: Depression Anxiety and Stress Scale; IIRS: Illness Intrusiveness Rating Scale
* p< .05
^ People could report more than one previous treatment

or group therapy; (b) consultation with a medical practitioner or being prescribed medication; and (c) self-help (all p's>.05).

The average age of the sample was 28 years old (SD = 10.7). The Internet sample was significantly older than the Clinic sample ($t(117) = -3.10$, $p = .002$; see Table 1). The total sample was divided into two age groups (16-24 years [n = 59]; 25-59 years [n = 59]), and there were no significant differences between the groups in FNE ($t(113) = -.25$, $p > .05$); DASS-Depression ($t(111) = .01$, $p > .05$); DASS-Anxiety ($t(111) = 1.75$, $p > .05$); or IIRS ($t(110) = -1.68$, $p > .05$) scores.

Males comprised 55.1% of the sample. There was a significant association between the site of recruitment and sex, with males comprising about two-thirds of the Internet sample and females about two-thirds of the Clinic sample ($\chi2(1, N = 118) = 11.16$, $p = .001$; see Table 1). However, males and females did not differ in FNE ($t(113) =-1.80$, $p > .05$); DASS-Depression ($t(111) = -.18$, $p > .05$); DASS-Anxiety ($t(111) = -1.26$, $p > .05$); or IIRS ($t(110) = -.62$, $p > .05$) scores.

Age of onset did not differ significantly between the Clinic and the Internet sample ($t(111) = 0.54$, $p>.05$) or between age groups ($t(110) = -1.91$, $p>.05$). Age of onset was not correlated with scores on the FNE ($r=.11$), DASS-Depression ($r=.01$), DASS-Anxiety ($r= .02$), DASS-Stress ($r=.09$) or IIRS ($r =.13$).

About 20% of the sample reported relying on parents for financial support and about 50% reported earning <$30,000 per annum. There was a significant association between site of recruitment and income ($\chi2(3,N = 108) = 8.75$, $p = .03$; see Table 1), where those in the Internet sample were more likely to be in higher income categories consistent with the higher average age and proportion of males in the Internet sample. About half the number of participants had completed post-school qualifications. Again, there was a significant association between recruitment site and education. The Internet sample was more likely to have completed post school qualifications ($\chi2(2, N = 102) = 15.79$, $p < .001$; see Table 1) consistent with higher average age.

Almost 95% of participants had access to a home computer and 75.7% had access to the Internet in their homes (see Table 1). Participants reported spending an average of 15.2 hours per week on the Internet, and there was no significant difference between the Clinic sample and the Internet sample in time spent on the Internet each week ($t(116) = .61$, $p > .05$) or presence of Internet access in the home ($\chi2 (1, N = 118) = .05$, $p > .05$; see Table 1).

Stated Preference Discrete Choice Modeling

Two random effects probit regression analyses were conducted to identify preference attributes and to identify characteristics associated with treatment modality preference. The dependent variable was treatment preference in the first analysis and decision to go ahead with treatment if it were available in the second analysis. The independent variables were attribute levels. The regression estimate provided the coefficient for each independent variable and a probability value for each coefficient. A probit regression model was used to estimate main effects and to obtain parameter estimates, with normally distributed errors assumed.

Effects coding was used for categorical variables flexibility and therapist contact where service attributes could be accurately assigned and contrasted between specific treatment modalities (CCBT or therapist-delivered therapy). Effects coding compared each of three levels of flexibility and therapist contact to the baseline of very limited flexibility or no therapist contact. The numerical variables (distance to treatment setting, percent symptom reduction, and cost) were coded as values. The predicted probability of CCBT utilization for groups of participants who shared characteristics such as age, site of recruitment, and symptom severity was estimated.

Preference for CCBT or Therapist-delivered CBT

The results of the random effects probit regression model for treatment modality preference showed that preference was significantly associated with lower cost of therapy, shorter distance to travel and greater symptom reduction (see Table 2). Using effects coding for flexibility and degree of therapist contact, the only significant effect was preference for equal self-directed and therapist-directed contact compared to no contact. Preference was not associated with degree of flexibility or control over the frequency, duration and times that therapy was accessed (see Table 2).

Scores on the FNE were strongly associated with treatment modality preference, where people with higher scores were more likely to prefer low cost of therapy, shorter distance to travel, and greater symptom reduction. Age and site of recruitment were not significantly associated with treatment preference (see Table 2).

Table 2
Random Effects Probit Model for Stated Preference for Treatment Modality

Variable	Z	p	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)
Setting	2.32	.02	0.36	4.28
Symptom reduction	-5.11	< .005	-7.07	-3.05
Cost	18.19	< .005	16.24	20.16
Flexibility				
Limited	1.05	.29	-.92	3.01
High	-.95	.34	-.2.91	1.01
Very High	.99	.32	-.97	2.95
Contact with therapist				
Mostly self directed	-1.21	.23	-.3.17	.75
Equally self directed	-2.95	< .005	-4.91	.99
Completely therapist directed	.27	.78	-1.68	2.23
Age category (16-24; 25-59)	-1.07	.29	-3.03	.89
Fear of Negative Evaluation (FNE)	-.3.05	< .005	-5.01	-1.09
Site of recruitment	.24	.81	-1.72	2.20
Constant	2.37	.02	.41	4.33
Number of observations	1,566			
Log likelihood	-812.08			
Chi square	381.38	< .005		

Decision to Undertake Treatment if Available

The second question asked participants to indicate whether they believed they would undertake the selected treatment if it were available. Shorter distance to travel and greater symptom reduction were significantly associated with decision to undertake treatment, but cost was not. Effects coding indicated that "high" and "very high" flexibility, and therapist contact that was mostly self directed, equally self and therapist directed and completely therapist directed were significantly associated with decision to undertake treatment (see Table 3). Decision to undertake treatment was strongly associated with FNE scores and people with higher scores were more likely to prefer shorter travel, greater symptom reduction, high and very high flexibility and therapy with at least some therapist contact. Neither age nor site of recruitment was significantly associated with decision to undertake treatment (see Table 3). As the two samples differed in age and method of recruitment these variables were included in the analysis to examine the effect of these differences on the findings, and neither age nor site of recruitment was a significant predictor in either analysis. In addition, when the analyses were conducted for the two samples separately (leaving out the variables age and site of recruitment) the pattern of results for the two samples was the same.

Table 3
Random Effects Probit Model for Decision to Seek Treatment

Variable	Z	p	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)
Setting	6.42	< .005	4.46	8.38
Symptom reduction	-9.54	< .005	-.11.50	-.7.58
Cost	1.48	.14	-0.48	3.44
Flexibility				
Limited	-1.81	.07	-3.77	0.15
High	8.42	< .005	6.46	10.38
Very High	-7.28	< .005	-9.24	-5.32
Contact with therapist				
Mostly self directed	6.24	< .005	4.28	8.20
Equally self directed	-4.93	< .005	-6.89	-2.97
Completely therapist directed	3.43	< .005	1.47	5.39
Age category (16-24; 25-59)	-.13	.90	-.2.09	1.83
Fear of Negative Evaluation (FNE)	2.32	.02	.36	4.28
Site of recruitment	.41	.68	-1.55	2.37
Constant	-1.91	.06	-3.87	.05
Number of observations	1,574			
Log likelihood	-747.37			
Chi square	182.69			

Discussion

This study sought to identify the factors that determined treatment preference decisions under conditions of forced choice. About half of the sample reported earning <$30,000 per year and a further 20% reported being supported by their parents. In 2007-2008 the median gross household annual income in Australia was $66,820 (ABS, 2007). In contrast to reports that social anxiety is associated with lower levels of education, the participants in this study reported educational attainment in line with the general Australian population (ABS 2006; 2007). These data suggest that people with social anxiety living in Australia have very good access to computers (94.8%) and the Internet (75.7%), as in 2007 only 73% of Australian households had a home computer and 60% had access to the Internet at home (ABS, 2007). The average number of hours per week reportedly spent on the Internet by participants in this sample (15.2) was comparable to the Australian average of 13.7 hours per week (Nielson, 2008).

Less distance to travel, increased symptom reduction, and therapist contact were important for both forced choice treatment preference decisions and decision to undertake treatment. Importantly, while cost was important for forced choice preference it was not significantly related to the decision to actually undertake treatment. These findings may help to explain apparently contradictory reports that cost is a barrier to treatment for people with social

anxiety (Olfson et al., 2000), but that free specialist services have low rates of treatment commencement for those with social anxiety (Coles, Turk, Jindra, & Heimberg, 2004). Increased level of flexibility in scheduling was associated with decision to undertake treatment but not with forced choice preference, implying that people only consider flexibility in scheduling when they are deciding to engage with treatment.

Consistent with the suggestion that people with social anxiety wish to play a role in managing their own health (Griffiths & Christensen, 2006), respondents were more likely to prefer treatments that combined therapist contact and self-directed components to self-directed delivery alone, and this preference was more pronounced for those with higher scores on the FNE. CCBT with increased therapist contact has been shown to reduce attrition and to improve effectiveness of treatments for social anxiety compared to CCBT alone (Andersson et al, 2005; Carlbring et al, 2007).

There was no significant association between age and either treatment preference or decision to undertake treatment in the present sample. As well, there was no significant difference between younger and older people in hours spent using the Internet each week. Taken together, the findings suggest that CCBT may be a highly accessible medium for people of all ages in Australia.

Respondents were more likely to prefer treatments that combined therapist contact and self-directed components to self-directed delivery alone, and this preference was more pronounced for those with higher scores on the FNE. This is consistent with the work of Parslow and Jorm (2000) who found that increased utilization of mental health services was associated with increased psychological distress. Consistent with Olfson and colleagues (2000) it was predicted that people with more severe social anxiety may prefer treatment modalities that required less therapist contact, however, other work has shown that people with social anxiety who reported a preference for in-vivo exposure felt exposure to real social situations was necessary to overcome their fear (Garcia-Palacios et al., 2007). These findings have implications for other self-directed modes of delivery, and suggest that self-directed therapy may be most likely to engage people with social anxiety when used in conjunction with some therapist contact.

Arguably, the site of recruitment may have affected preference for therapy that could be provided in a flexible mode of delivery, as the Internet sample was recruited while using a computer to seek information about social anxiety and the Clinic sample while undertaking therapist-delivered intervention. However, there was no significant effect of recruitment site on either forced choice preference or decision to undertake treatment for the combined sample, no significant difference between the Clinic and Internet samples in the number of hours per week spent on the Internet, and no difference in the pattern of results for the two samples when they were analyzed separately. A higher number of respondents to the survey were recruited through the Internet (n = 76) compared to metropolitan clinics (n = 43). As noted above, many people with social anxiety do not seek specialized treatment and even fewer attend clinics (Magee et al., 1996; Coles et al., 2004), and the lower sample size for the Clinic sample is consistent with this. However, while samples recruited through clinics and the Internet differed significantly in age and sex, they did not differ in symptom severity. This suggests that the Internet-based recruitment was effective in providing access to the responses of people with social anxiety. Consistent with previous research (Grant et al., 2004; Kessler et al. 2005; Magee et al., 1996), more than half of subjects in the Clinic and Internet samples had not sought treatment. High response rates are important for minimizing response bias (Minichiello, Sullivan, Greenwood, & Axford, 1999) and the response rate for the Clinic sample was high. Response rates for the Internet sample cannot be precisely known, but the Internet sample had a relatively high rate of non-completion of the online questionnaire.

The present study is the first to use stated preference discrete choice modeling to examine factors associated with preference for modality of delivery of treatments for social anxiety. While it must be acknowledged that subjects in the Internet sample were not diagnosed with social phobia and cannot be regarded as a patient sample, the recruitment method produced a relatively large and heterogeneous sample where symptom severity assessed by the self-report instruments included in the study was similar between sites of recruitment. Distance to travel for treatment, expected symptom reduction, cost, contact with a therapist and flexibility were important for people with social anxiety in making choices about treatment modalities and in making decisions to undertake treatment. Importantly, participants preferred therapy that included some therapist contact, suggesting that a combination of CCBT with therapist contact may be an attractive treatment modality for those with social anxiety who characteristi-

cally delay seeking treatment. This pattern of preference was stronger for those with more severe social anxiety and did not appear to depend on age or site of recruitment. The results have implications for delivering effective therapy to those experiencing social anxiety.

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TECHNICAL ASPECTS AND TESTING OF A PROGRAM TO ASSESS DEFICITS IN FACIAL EXPRESSION RECOGNITION IN CHILDHOOD CANCER SURVIVORS

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The research presented here focuses on the ease of use of an instrument's interface for a target pediatric population, where participants were asked to interpret virtual character facial expressions. Forty-one children, both pediatric cancer survivors and healthy recruits, took part in six tasks that had them describe or express their confidence in descriptions of different facial expressions, portrayed either overtly or subtly and dynamically or statically by eight virtual characters. In this test of usability and feasibility, childhood cancer survivors performed comparably to healthy participants, suggesting that this instrument is feasible for use with cancer patients.

Keywords: **Facial Expression Recognition, Pediatric Cancer Survivors, Usability, Virtual Characters**

Background and Significance

Dramatically increased cure rates for childhood cancer survivors have led to favorable prognosis for long-term survival (American Cancer Society, 2009). While these patients are at high risk for physiologic effects of cancer therapy (Oeffinger & Hudson, 2004; Oeffinger et al., 2004), children who receive therapies that impact the central nervous system are at even higher risk for cognitive, social, and psychological disorders (Mulhern & Palmer, 2003). The repercussions of these deficits can be lasting and costly, with many childhood cancer survivors never achieving the normal milestones of adulthood, such as living independently, marrying, and procuring stable employment (Gurney et al., 2009). As a result, there is some need for better assessment of critical psychosocial variables.

Unfortunately, assessment of psychosocial functioning of childhood cancer survivors is difficult. For instance, the gold standard with healthy children includes sociometric procedures involving peer nominations and ratings often done by researchers in a classroom, and a few studies have followed this approach (Noll et al., 1992; Vannatta et al., 1998). However, the incidence of childhood cancer in a school district, much less a school or classroom, is low, making these kinds of procedures impractical and inefficient, and possibly unethical due to singling out the cancer survivor. An alternative assessment involves standardized proxy reports by teachers or parents (Patenaude & Kupst, 2005). However, these measures were developed to be sensitive to specific components of social functioning, such as aggression or social anxiety, hence, tending to focus on maladaptive behavioral outcomes (e.g., getting teased, threatening or bullying others) rather than the social pragmatics (Duke & Nowicki, 2005) underlying successful peer relations (e.g., keeping appropriate physical boundaries, maintaining reciprocal conversations).

Effective social interaction requires attention to and interpretation of complex nonverbal social cues including facial expressions, body language, and tone of voice (Knapp, 1972). In particular, facial expressions are a rich source of social information (Blair, 2003). Theories

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of emotion posit that individuals use others' facial expressions to gain important information about their social goals and to evaluate their responses to the individuals' own behavior (Fridlund, 1994; Lazarus, 1991). Errors in facial expression recognition, then, would have potentially negative repercussions for social interactions, such as misunderstanding turn-taking during conversation, misinterpreting a smile of polite attention as one of genuine interest or, more gravely, misinterpreting an irritated expression as one of hostile intent. Given that childhood cancer survivors often have nonverbal deficits (Bonner et al., 2009; Buono et al., 1998; Carey et al., 2001), it is reasonable to assume that they may make more of these types of social errors.

Recent technological and methodological advances suggest a novel means to assess children's processing of facial expressions as a first step toward assessing their social competency (Hubal, Fishbein, et al., 2008). These advances rely on dynamic virtual characters, sometimes called "embodied conversational agents" (Poggi & Pelachaud, 2000), that can be easily tailored for use with different populations or for different applications. For instance, a study of the effects of maltreatment on children's ability to perceive anger (Pollak & Sinha, 2002) used a computerized method that presented an image starting with an undifferentiated face that gradually gained organization and resolution to form a coherent facial expression. Those researchers found that children with a history of maltreatment recognized anger expressions with less visible information than other children, suggesting that they are sensitized and vigilant to threat cues. Similarly, Coupland et al. (2004) describe a task where participants needed to respond to expressions morphed from a neutral state to a full expression. However, none of the previously used instruments enable the systematic manipulation of carefully-specified facial expressions, nor for tailoring the age, ethnicity, and gender of the virtual character to the participating child. To this end, Hubal, Evens, et al. (2008) developed a facial expression recognition instrument that employs a well-known systematic facial expression coding system to systematically manipulate facial expressions. The research presented here focuses on the ease of use of the instrument's interface for the target pediatric population while participants interpreted virtual character facial expressions.

There were two hypotheses. First, it was hypothesized that all participants (pediatric cancer survivors and healthy controls) would find the instrument usable, and that the former group in particular would not have difficulty with manipulation of facial expression, even though there is some evidence of physical impairment in survivors (Dolgin et al., 1999; Mulhern et al., 1989). For this reason a number of different tasks, described below, were tested. Second, it was hypothesized that all participants would be able to distinguish the different facial expressions, but that both emotion expressed and subtlety or overtness of expression would influence their recognition.

Methods

Participants

Participants were 41 children ages 9-16. Of these participants, 15 were childhood cancer survivors and 26 were healthy recruits. Of the cancer survivors, six were female (all but one Caucasian, who was Hispanic) and nine were male (all Caucasian). Of the healthy recruits, half were female (two African American, seven Caucasian, four of mixed ethnicity) and half male (two African American, eight Caucasian, three of mixed ethnicity).

Procedures

All testing occurred during one 90-minute session. After consent from parents and assent from the participants, the participants completed a brief assessment of their ability to use the mouse to navigate through task-related procedures (e.g., using a slider bar, clicking on multiple-choice responses) and received additional assistance when needed. Participants' general response time was measured by presenting a series of faces similar to those that followed, but they were asked to identify the gender of each face, not the expression, as quickly as possible without making mistakes. Additionally, a brief visual acuity task was administered to verify that the participants did not have visual impairments that may have prevented them from clearly seeing the depicted faces. After the testing was completed, participants were given a gift certificate to a local shopping mall and parents were reimbursed for their time and transportation.

Stimuli

Stimuli are discussed in more detail in Hubal, Evens, et al. (2008), who systematically developed facial expressions by referring to Facial Action Coding System (FACS; Ekman, Friesen, & Hager, 2002) criteria. FACS uses the movement of facial action units (AUs) to sig-

nify facial expression, but FACS training stimuli are solely images of actors' facial expressions. To generate dynamic, flexible, and modifiable facial expressions, Hubal, Evens, et al. used virtual characters (Hubal & Frank, 2001; Poggi & Pelachaud, 2000), defining AUs using a variety of mesh deformation techniques, rendered as a series of animation keyframes. For each AU, a corresponding vertex selection set (i.e., subset of the mesh) was identified (for certain AUs representing incongruent muscle groups multiple selection sets were aggregated). With the rest mesh at frame zero, animation keyframes were captured, each representing the extreme position of one AU. These deformations were applied to a control mesh, allowing multiple faces to be exported without having to recreate the AUs for each.

Eight faces were used, one female and one male representing African American, Asian, Caucasian, and Hispanic ethnicities (see Figure 1). A subset of AUs was chosen to be implemented, specifically, those that are most often implicated in facial expressions for six "universal" expressions of anger, disgust, fear, happiness, sadness, and surprise, as described in the FACS manual and other sources (Ekman, 1989; Kohler et al., 2004; Ryan et al., 2009). For each expression, a subtle version and an overt version was generated, portraying minimum and extreme representations of the expression, respectively, as assessed by two FACS-trained coders working collaboratively. The order of stimuli (the gender, ethnicity, and expressions portrayed) was predetermined and the same for all participants, except for those stimuli used to match the participants' gender and ethnicity (Tasks 2b, 3b, & 4), for which the order of expressions was predetermined.

Figure 1. Virtual characters.

Tasks

To gauge the usability of the virtual character expressions and their acceptance, participants were involved in six tasks:

1. In Task 1 participants were presented 24 faces, either subtle or overt expressions, ranging across ethnicity, gender, and facial expression. In this task, the expressions were static. The participants' job was simply to press the spacebar when they decided on the expression portrayed, then specify their decision. The primary measure for Task 1 was time needed by the participants to decide on an expression.

2. In Task 2a participants were presented six faces, all overt expressions, spread across ethnicity, gender, and facial expression. In this task, the expressions were dynamic. The participants' job was again simply to press the spacebar when they decided on the expression portrayed, then specify their decision. The difference from Task 1 was that these faces began at a neutral state then morphed at a steady (pretested) pace toward the maximum of each facial expression. Instead of time, the primary measure for Task 2a was what percentage of morph was needed by the participants to decide on an expression.

3. In Task 2b participants were presented a single face, matched to each participant's gender and ethnicity, with six different overt facial expressions. As in Task 2a, in this task the expressions were dynamic, starting from neutral, and the participants' job was to press the spacebar when they decided on the expression portrayed.

4. In Task 3a, as in Task 2a, participants were presented six faces, all overt expressions, spread across ethnicity, gender, and facial expression. In this task, too, the expressions were dynamic. The participants' job was to advance a slider bar from a neutral state (on approximately one-quarter of trials the slider bar started not on the left but on the right, and the participants' job was to decrement the slider bar, but still beginning at a neutral state) until they decided on the expression portrayed, then specify their decision. The primary measure for Task 3a was again what percentage of morph was needed by the participants to decide on an expression.

5. In Task 3b, as in Task 2b, participants were presented a single face, matched to each participant's gender and

ethnicity, with six different overt facial expressions. As in Task 3a, in this task the expressions were dynamic, starting from neutral, and the participants' job was to press the spacebar or backspace (to advance or decrement the slider bar) until they decided on the expression portrayed.

6. Participants were presented with the same 24 faces as in Task 1, plus another six of a single face matched to each participant's gender and ethnicity, with six different facial expressions, either subtle or overt. In this task, as in Task 1, the expressions were static. The participants' job was simply to press a button on the side of the screen indicating which of six labels (anger, disgust, fear, happiness, sadness, surprise) they decided the expression portrayed, then specify their confidence in their decision. The primary measure for Task 4 was the confidence of the participants underlying what they decided as the expression.

One reason for engaging participants in all of these tasks was to explore usability. There was uncertainty whether or not the target population – pre-adolescents and adolescents and in particular pediatric cancer survivors, who might exhibit physical functional deficits – could adequately perform all of the tasks. For instance, it was unclear whether or not all participants could adequately manipulate a slider bar or the spacebar. Another reason for these tasks is it was unknown if static faces were sufficient to elicit the desired recognition of expressions or if dynamic faces were needed.

Results

Performance across the tasks indicated that the facial expression recognition system is highly usable for all participants, with only slight differences in how different groups of participants interacted with the system. Further, reactions to the expressions – both static and dynamic – showed consistent and interpretable patterns.

Task 1

On the measure of time needed to decide on an expression, health status (either a cancer survivor or a healthy recruit) just failed to reach significance ($F(1,39)=3.06$, $p<0.09$). The trend, though, was of interest; healthy participants required one additional second (2.91s vs. 3.99s), on average, to decide. Further, this trend held for the individual facial expressions; cancer survivors responded more quickly for each emotion.

The decision times for the expressions were then subjected to a repeated measures analysis. There was no interaction between expression and health status ($F(5,195)<1$), but a highly significant effect of expression itself ($F(5,195)=9.20$, $p<<0.01$). Individual contrasts showed that the response to happiness significantly differed (was faster) from all other facial expressions; that the response to fear, surprise, anger, and sadness all took essentially the same time; and that the response to disgust significantly differed (was slower) from all other facial expressions.

Regarding ethnicity and gender, a significantly slower response was found when ethnicity between the participant and virtual character matched than when ethnicity mismatched ($F(1,40)=5.62$, $p<0.02$), but no effect of gender match or mismatch ($F(1,40)<1$). These results were unchanged when health status was included, and the matches/mismatches did not interact with health status.

Task 2a & 2b

For Task 2a, on the measure of percentage morph needed to decide on an expression, health status had no effect ($F(1,35)<1$), all participants requiring about two-thirds of the morph (that is, two-thirds of the way from a neutral state to the extreme positions for all the AUs making up the expression) before deciding on a facial expression. Ethnicity again showed significance ($F(1,29)=4.98$, $p<0.03$), where the percentage morph needed was greater for matched ethnicity than mismatched. Gender match or mismatch again did not show significance ($F(1,29)<1$). These results were unchanged when health status was included, and the matches/mismatches did not interact with health status.

For Task 2b, as with Task 2a, health status had no effect on percentage of morph needed to decide on the expression ($F(1,38)<1$). Given that the same face was presented six times, a repeated measures analysis was run that showed a highly significant effect of expression itself ($F(5,40)=6.44$, $p<<0.01$). Individual contrasts showed that the response to happiness marginally differed (required a lower percentage morph to determine the expression) from sadness; and both happiness and surprise significantly differed from fear, anger, and disgust.

Task 3a & 3b

For Task 3a, on the measure of percentage morph needed to decide on an expression, health status had no effect ($F(1,38)<1$), all participants requiring about

three-fifths of the morph before deciding on a facial expression. Ethnicity match or mismatch in this case did not show significance ($F(1,39)<1$). Gender in this case showed significance ($F(1,39)=4.97$, $p<0.03$), where the percentage morph needed was greater for mismatched gender than matched. These results were unchanged when health status was included, and the matches/mismatches did not interact with health status.

For Task 3b, as with Task 3a, health status had no effect on percentage of morph needed to decide on the expression ($F(1,38)<1$). Given that the same face was presented six times, a repeated measures analysis was run that showed a highly significant effect of expression itself ($F(5,180)=4.91$, $p<<0.01$). Individual contrasts showed that the response to happiness significantly differed (required a lower percentage morph to determine the expression) from sadness, disgust, and fear; and both anger and surprise significantly differed from disgust and fear.

Task 4

On the measure of confidence underlying the decision about an expression, health status had no effect ($F(1,39)<1$), all participants expressing high confidence in their deciding on a facial expression.

The expressions were then subjected to a repeated measures analysis. There was no interaction between expression and health status ($F(5,195)<1$), but a highly significant effect of expression itself ($F(5,195)=16.81$, $p<<0.01$). Individual contrasts showed that the confidence in response to happiness significantly differed (was greater) from all other facial expressions; that the confidence in response to fear, sadness, and surprise all were essentially the same; and that the confidence in response to disgust significantly differed (was lesser) from all other facial expressions.

Looking to ethnicity and gender, no effect of ethnicity match or mismatch ($F(1,40)<1$) was found and no effect of gender match or mismatch ($F(1,40)<1$). These results were unchanged when health status was included, and the matches/mismatches did not interact with health status.

Discussion

In this test of usability and feasibility, childhood cancer survivors performed comparably to healthy participants. Any differences between participants groups did not appear to stem from any ability to employ the instrument or understand its instructions. Though there have not been many studies looking at different children's interaction with virtual characters (Cassell & Tartaro, 2007; López-Mencía et al., 2010), there appear to be affordances of virtual characters that engage children. Though overt ease of use ratings were not collected from the participants, their equal ability to manipulate the instrument's controls and their undifferentiated timing and confidence ratings lend support to a hypothesis that cancer survivors can use the instrument as easily as healthy participants, and that the task is neither too difficult nor too easy for children to complete. Additional studies with pediatric cancer survivors, especially given the relatively small number of participants tested, will continue to address this hypothesis.

The results also showed similar patterns in how all participants distinguished among facial expressions, both in the emotions they portrayed and in their subtlety. The obvious next question is whether or not this instrument has value, that is, whether or not the accuracy of responses (e.g., was the subtle expression just presented a happy face) across gender and ethnicity differed between cancer patients and healthy participants. The research team is currently investigating this question and preliminary results suggest important differences between health statuses. If these results bear out, then the additional control afforded by this instrument – the control over gender and ethnicity presented, the ability to portray overt or subtle expressions, the basis of expressions on FACS AUs validated by FACS-trained analysts – over existing instruments such as DANVA2-CF (Nowicki & Duke, 2001) represents an important advance in the assessment of one component of social skills of pediatric cancer survivors. Clinicians could use the instrument to tailor intervention to specific facial expression recognition deficits. Further, the research team is planning additional studies using not just facial expression but also virtual vignettes involving emotional content, similar to parallel research done with adolescents (Hubal, Fishbein, et al., 2008), so that clinicians could tailor interventions to carefully assessed social deficits exhibited by the patients.

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E-HEALTH INTERVENTIONS FOR DEPRESSION, ANXIETY DISORDER, DEMENTIA, AND OTHER DISORDERS IN OLDER ADULTS: A REVIEW

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E-health interventions targeting older adults seem to be a promising approach in domains including depression, anxiety disorder, and dementia – three of the most prevalent mental disorders in old age. Further, these technical innovations (e.g., ambient-assisted living and smart homes, game-based applications and training programs) may have the potential to compensate for or prevent health-related changes or to foster active aging. As highlighted by this literature review, however, research in this area is still at an early stage. The methodological quality of the studies and projects differs, and there is a lack of randomized controlled trials and robust research designs (much research to date has been limited to pilot and short-term studies). Advantages and challenges of using information and communication technology (ICT) applications in the above-mentioned domains are discussed, as are user characteristics.

Keywords: **E-health, Older Adults, Depression, Anxiety Disorder, Dementia**

Introduction

E-health research focusing on the second half of the lifespan is still scarce. However, there is growing interest in the field and initial results are promising. A particular point of interest is whether older adults are familiar with information and communication technology (ICT) facilities such as computers and the Internet, and are thus able to benefit from health services provided through these media. A further question is whether these new media meet the needs of elderly people and have the potential to foster active and healthy aging. Kryspin-Exner and colleagues (Kryspin-Exner, Oppenauer, Preschl, & Maercker, 2009) have discussed e-health applications targeting older users and their caregivers, including assistive technology, tele-medicine, tele-monitoring, psycho-education, and support via the Internet. Further, older people are sometimes included in the adult samples of studies evaluating Internet-based therapeutic interventions, and increasing numbers of projects in this domain focus specifically on older adults. Against this background, this paper reviews research on e-health interventions involving older adults and their caregivers. We identified relevant articles, abstracts, and conference proceedings published in German or English by searching the appropriate databases (MEDLINE, Premedline, PsycCritiques, PsycINFO, PSYNDEXplus, PubMed/Medline, and Web of Science) and the Internet (using Google and Google scholar), and by screening reference lists and the archives of the journal Gerontechnology. We searched for terms such as e-health, e-mental health, Internet, online, technology, intervention, therapy, old age, older people, caregivers, significant others, family members, gerontechnology, depression, anxiety, dementia, mobility, ambient-assisted living, monitoring, and healthy aging (in various combinations). Because the number of completed high-quality studies in the field is limited, we also included reports on ongoing projects. Information on all of the articles included in the review is provided in Table 1.

A necessary condition for any technical device being used in old age is that the technology meets the needs of older adults and is accepted by this target group. Charness and Boot (2009) discussed research on atti-

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tudes toward technology in old age, as well as age-related changes in the perceptual, cognitive, and motor abilities that influence successful technology use. The authors concluded that age-related differences in technology use may decline over time, but will not disappear in future generations for two reasons. First, older people will continue to experience changes in their perceptual, cognitive, and motor abilities; second, technological development will continue to advance rapidly. It may be possible to decrease age-related differences further if product designers consider psychological guidelines (see Oppenauer, Preschl, Kalteis, & Kryspin-Exner, 2007, for a review of technology use in old age from a psychological perspective). Technology that considers and meets the needs of individuals across the lifespan is labeled gerontechnology: "[…] It helps support 'successful aging' […]. It focuses on the total human lifespan […] and the encompassing of all domains of human activity. An enhanced quality of life in older adults is the ultimate goal of gerontechnology" (Bronswijk et al., 2009, p. 3).

Areas of E-Health Applications in Old Age

The Berlin Aging Study (BASE; Wernicke, Linden, Gilberg, & Helmchen, 2000) found depression, anxiety disorder, and dementia to be some of the most frequent mental disorders in old age. Many older people suffer from mild or subsyndromal depression and show symptoms that do not reach the threshold criteria for Major Depressive Disorder (Forstmeier & Maercker, 2008; Maercker et al., 2008). Frequency of subsyndromal depression is related to age, polypathia, functional limitation, and need for help. In the following, we discuss the available research on e-health interventions for (1) depression, anxiety, and Posttraumatic Stress Disorder (PTSD), and (2) dementia. As mentioned above, details of all studies described are presented in Table 1.

E-Health Applications for Depression, Anxiety, and PTSD

Samples in randomized controlled trial (RCT) studies of Internet-based therapeutic interventions for depression, anxiety, and PTSD often include older adults. Although these studies do not focus specifically on the second half of the lifespan or on age differences, their findings indicate that both older and younger individuals benefit from these interventions.

To our knowledge, findings from only one completed RCT study on e-health and depression in old age have been published to date. Focusing on older adults (aged 50–75 years, N = 301), Spek and colleagues (Spek, Cuijpers, et al., 2007) demonstrated that an Internet-based cognitive behavioral self-help intervention was effective in older people with subthreshold depression (BDI-II score below 20; Beck, Steer, & Brown, 2006). Relative to a waiting list control condition, the authors found a moderate effect size (0.55) for the Internet-based intervention – similar to the effects reported for an offline group cognitive behavior therapy intervention. Results from a one-year follow-up showed that these effects persisted over time (Spek et al., 2008).

An example of research on PTSD (secondary outcomes: depression, anxiety, etc.) in old age is a study currently being conducted by Knaevelsrud, Böttche, and Kuwert (2009, 2010) with adults aged 65 years and above (see www.lebenstagebuch.de). The sample currently is comprised of 74 patients who experienced traumatic situations as children, during or shortly after the end of World War II. These patients participated in standardized, Internet-based cognitive behavioral writing therapy (Integrative Testimonial Therapy). Over six weeks, the patients wrote eleven texts and received feedback from a therapist. Results from 74 participants showed (among others) a decrease in PTSD symptoms (PDS, Foa, Cashman, Jaycox, & Perry, 1997) and depression (BSI, Derogatis, 1992).

Recently, Gamito and colleagues (2010) presented results from a pilot study (N = 10 war veterans, mean age: 63 years) on Virtual Reality exposure therapy (VRET). Participants were assigned to the VRET group (exposure to a virtual war scenario in 12 sessions), to a control group (exposure in their imagination), or to a waiting list. First results from this study showed a reduction in PTSD (CAPS, Blake, Weathers, Nagy et al., 1992) and psychopathological symptoms (SCL-90-R, Derogatis, 1994) in the VRET group.

The Butler system provides several depression and anxiety modules for older users (Botella et al., 2009). The system contains two therapeutic modules based on life review and autobiographical memory: the *therapeutic book of life* and positive mood induction modules for depression and anxiety. The latter are *Virtual Environments (VE)* in which the user learns techniques to reduce negative moods and to recall positive autobiographical memories. The *book of life* is a 3-D adaptation of a book containing several chapters that

can be customized by users (to include text, pictures, and Mp3 music files). Besides therapeutic modules, the Butler system offers diagnostic (depression and anxiety) and "playful"/social interaction modules. All applications are guided by a personalized icon, the so-called "butler." Results from a pilot study (N = 4, pre-post comparison) showed an increase in positive emotions and a decrease in negative emotions in older users (visual analogue scales; Botella et al., 2009). In addition, the participants reported high levels of satisfaction and experienced little difficulty in using the system.

We are currently using the depression modules of the German version of the Butler system as supplements to a face-to-face setting in an intervention study with older adults aged 65-75 years old who show mild to moderate depression (Preschl, Wagner, Forstmeier, & Maercker, 2010). The treatment is based on recent advances in the context of life review interventions (Bohlmeijer, Smit, & Cuijpers, 2003; Haight & Haight, 2007; Maercker, 2002; Maercker & Zöllner, 2002; Serrano, Latorre, Gratz, & Montanes, 2004) and computerized mood induction (Banos et al., 2004; Banos et al., 2005; Riva et al., 2007) in old age. Both parts of the intervention focus on inducing positive memories and positive mood. Results from a pilot study (N = 3) show a decline in depressive symptoms (BDI-II, Beck, Steer, & Brown, 2006) and increase in quality of life (WHO-5, WHO 1998), as well as good participant acceptance of the computer modules (exploratory data). Further, the participants reported improvements in meaning of life (LAP-R, Mehnert, Müller, & Koch, 2007) and reminiscence strategies (RQ, Mayer, Filipp, & Ferring, 1996). We are currently conducting an RCT study (waiting list control condition) focusing on these outcome variables.

Rosenberg and colleagues (2010) recently presented results from a pilot study of a game-based intervention for older adults with subsyndromal depression. Nineteen older adults aged 63–94 years old participated in a 12-week physical activity program based on Nintendo's Wii ® sports (five games: tennis, bowling, baseball, golf, and boxing). Results showed improvements in depression (QUIDS, Rush, et al., 2003), mental health-related quality of life (SF-36, Ware & Sherbourne, 1992), and cognitive performance (RBANS, Randolph, Tierney, Mohr, & Chase, 1998).

E-Health Applications for Dementia Patients and Their Caregivers or Significant Others

We identified three RCT studies and several ongoing projects, as well as work to develop and evaluate various prototypes. The REACH project (Resources for Enhancing Alzheimer's Caregiver Help) is an initiative for caregivers of people with (mild to moderate) Alzheimer's disease (Schulz et al., 2003). This six-site project in the U.S. investigated a variety of interventions (e.g., monitoring of caregiver stress, computerized telephone support). Between 100 and 257 caregivers (mean age: 61.1–68.5 years) participated in RCT intervention studies at each site. Caregivers showed reduced stress and higher skill acquisition after the intervention (main outcome measure: CES-D, Radloff, 1977).

Results from an RCT study (N = 66) of an Internet video-conferencing group intervention program for family caregivers of older adults with Alzheimer's disease, stroke-related dementia, or Parkinson's disease showed a decline in stress (3-point scale measuring severity of experienced stress and RMBPC, Teri, et al., 1992) among the participants after 10 weeks (Marziali & Donahue, 2006). Note that the caregivers were older adults themselves, with an average age of 67.8 years old.

Mahoney, Tarlow, and Jones (2002) evaluated a preventive multimedia program (CD-ROM) providing psychoeducation about symptoms of Alzheimer's disease and "normal" memory loss. Their RCT study involved 113 older adults (mean age: 72 years). Beside promising results on the usability of the program, the authors reported highly significant differences between the intervention and the control (no program) groups, with individuals in the intervention group displaying significantly more knowledge concerning memory loss (KMLT, Mahoney, Tarlow, & Jones, 2002).

Pot and Blom (2009) are currently conducting a Web-based intervention program (online counseling) for family caregivers of people with dementia. To date, 60 individuals have started the intervention program, which involves eight sessions plus a booster session one month later. The aim of the intervention, called mastery over dementia, is to reduce depressive symptoms and caregiver burden and to improve coping strategies.

Riikonen, Mäkelä, and Perälä (2010) have evaluated 29 technologies for dementia patients (age range: 54 to 90

years), including risk-prevention technology (e.g., cooker/door alarm, monitoring system), assistive technology (e.g., electronic medication dispenser), and emergency technology (e.g., safety alarm telephone, monitoring system). Results obtained from 25 individuals with dementia and their family caregivers show that these devices have the potential to prolong independent living and to reduce caregivers' stress (NPI, Cummings et al., 1994).

Recently, Alm and colleagues (2009) presented positive (essentially qualitative) results for three technological approaches focusing on the provision of enjoyable activities for people with dementia (N = 5–40 depending on the prototype). An interactive system provides entertainment, facilitates communication, and fosters creativity in this target group. In a 3-D environment, users have various options to explore and enjoy virtual surroundings (a hothouse in a botanic garden, a museum, and an old-fashioned pub), play games, be creative (e.g., paint a virtual pot or compose a piece of music), or enter into conversation via a system called CIRCA. The idea of CIRCA is to facilitate communication between people with dementia and their caregivers using individual reminiscence (video, music, and photographs) and to overcome the barriers of short-term memory loss that often obstruct communication.

Libin and Cohen-Mansfield (2004) have investigated the use of therapeutic robotic pets (two cats) for patients with dementia in a setting similar to traditional pet therapy. As dementia patients may no longer be able to care for a real pet, a robotic pet could function as an alternative. Results of a pilot study showed decreased agitation and increased pleasure and interest after engaging with the robotic pets. Another robotic pet for dementia patients is AIBO (Yonemitsu, Higashi, Fujimoto, & Tamura, 2002). In a case study (N = 4), AIBO was found to enhance communication with the robotic pet as well as among patients. Further, Odetti and colleagues (2007) have presented positive results on acceptance of the system (N = 23, mean age of participants: 76.6 years).

An example of ongoing research in the field of dementia is the COGKNOW project. Dröes and colleagues (2009) have recently developed a prototype electronic assistant providing older people with mild dementia with support in the domains of memory, social contact, daily activities, and psychological distress (N = 90 older adults and caregivers were involved in the design process). Another ongoing project is the development of the ALADDIN platform aiming to support patients and their caregivers in terms of disease self-management (Haritou, 2009). The system will monitor patients' health parameters and assess cognitive and behavioral functions as well as activities of daily living. Further, ALADDIN will provide risk assessment, security features, and social network utilities. Another system that may be more relevant at an advanced stage of dementia, when patients are at increased risk of getting lost, is the Global Positioning System (GPS) currently being developed by Willemse, Horjus, and Pot (2009). It has been suggested that this system will help people with dementia to live independently in familiar surroundings for as long as possible.

The ENABLE project (http://www.enableproject.org/index.html) also merits consideration. The general aim of this project was to develop and evaluate technical devices for people with dementia: devices to support memory (e.g., medication reminder), to provide pleasure and comfort (e.g., a picture gramophone), and to facilitate communication (e.g., a pre-programmable telephone). Results showed that the products tested could help people with dementia, but the successful use of a device was related to its operational reliability. Technology for this target group needs to be comfortable, secure, and safe.

More Complex Age-Appropriate Approaches

Individuals in the second half of the lifespan face challenges in a variety of domains: decline in sensory, motor, and cognitive abilities; multi-morbidity and chronic disease; difficulty performing Activities of Daily Living (ADL) and instrumental Activities of Daily Living (IADL) (bathing, dressing, preparing meals, shopping, leisure activities, etc.); and changes in social relationships (Forstmeier & Maercker, 2008). Interventions are thus needed to facilitate active participation in social life as well as physical and mental well-being across the lifespan – that is, to foster active aging: "Active Aging is the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (WHO, 2002, p. 12). Key components of this concept are autonomy, independence, quality of life, and a healthy life expectancy. In the following, we present findings from studies of ICT interventions designed to foster active aging and to compensate for or prevent common health-related changes in old age.

Ambient-Assisted Living (AAL) and Smart Homes

Ambient-assisted living (AAL) and smart homes are technologies designed to enhance older people's quality of life and to help them remain independent (i.e., in their own homes) for as long as possible (Chan, Campo, Esteve, & Fourniols, 2009; Demiris, 2008; Huch, 2009). These devices are developed to compensate for age-related changes in domains such as mobility/safety and sensory, memory, or social skills, and to provide help with ADLs or to monitor health parameters in case of chronic disease. The common ground of these initiatives is that they foster in-home self-care, as opposed to hospital/institutional care (Chan et al., 2009; Huch, 2009), thus prolonging independent living and helping to combat the increasing costs of health care systems in aging societies. Chan and colleagues (2009) have identified ethical and legal issues and individual needs that have to be considered in this context, especially with regard to monitoring devices. For example, it is significant whether or not users are able to make an informed choice and give informed consent. Further, the privacy concerns of monitored users have to be considered (Chan et al., 2009; Charness & Boot, 2009). Privacy can be increased by using less invasive technology, such as monitoring systems that do not allow the user's face to be clearly identified (Caine, Fisk, & Rogers, 2006). In the following, we provide some examples of smart home and AAL solutions in the above-mentioned domains. To our knowledge, no RCT studies have yet been conducted in this field; research in this area is still at a very early stage.

The COGKNOW project (Dröes et al., 2009) is an example of a smart technology solution providing memory and social support. For example, the system can remind the user to telephone a significant other or to close the front door. If the user wants to phone a family member or friend, the system automatically connects to that person. Assistive social robots are another kind of smart solution facilitating social contact. In their review of research in this area, Broekens, Heerink, and Rosendal (2009) drew attention to the lack of RCTs and robust research designs (much of the research to date has been limited to pilot and short-term studies). The reason for these deficits may be that research in this domain – as in other e-health domains in old age (Chan et al., 2009) – is in its early stages (no studies about assistive social robots were published before 2000). Beyond these concerns, the existing research on assistive social robots has provided limited qualitative and quantitative evidence for positive effects of these technological solutions on health and psychological well-being in old age.

GEROHOME is an example of an automatic monitoring system of ADLs such as preparing a meal (Anfosso & Bourdeau, 2009). Preliminary results from two case studies (with participants aged 64 and 85 years old) indicate that the system is able to detect different ADL levels. Franco and colleagues (Franco, Gallay, Berenguer, Mourrain, & Couturier, 2008) presented similar results, showing that another monitoring system (N = 13, mean age: 83) was able to differentiate daily and nocturnal ADL levels. The idea behind automatic monitoring of ADLs is to gain further insights into physical and mental health conditions and to identify problems, thus informing the development and targeted implementation of preventive and support measures. There are two main monitoring approaches (Anfosso & Bourdeau, 2009). One is to measure bio-signals such as blood pressure or body temperature in people with chronic disease by means of wearable devices (Bestente et al., 2008; Lee et al., 2008). These data are sent to and recorded at a local base station and provide caregivers with information about the health status of the older person, allowing them to initiate (emergency) assistance where necessary. The other main monitoring approach is to use sensors embedded in the house (e.g., to warn the resident that the oven is on). Recently, Reder, Ambler, Philipose, and Hedrick (2010) conducted a pilot study (N = 12, age 55+ years) involving remote monitoring of four domains (meal preparation, physical activity, vitamin use, and personal care) with older adults and their caregivers over a three-month period. Results from qualitative interviews indicated satisfaction with the system and positive outcomes on various psychological variables (perceived safety, well-being, peace of mind, and independence). However, the subjects identified privacy concerns and technical problems as barriers.

In a short overview, Huch (2009) introduced the Ambient-Assisted Living for Europe initiative, including a variety of ongoing international projects (listed in Huch, 2009, p. 114). The VITALIshoe project (Hlauschek, 2009) is an example of a technological device designed to promote mobility/safety. This instrumented shoe was developed to prevent falls by monitoring motion patterns and training balance, thus enhancing the long-term activity levels of older adults. In the sensory domain, the Hear Me Feel Me project (http://www.hearmefeelme.org) uses mobile phone technology to compen-

sate for visual impairment. In this approach, a mobile phone provides speech synthesis and audio input and output as well as the possibility to connect to the Internet. The user can thus access several services: medication and medicine-related information and services, health monitoring, and diet information.

Game-Based Applications and Training Programs to Foster Active Aging

Fozard, Bouma, Franco, and Bronswijk (2009) have discussed the use of technology to address the needs of this target group beyond health-related challenges – specifically, the use of leisure technology to help older adults have fun and to enjoy life. Although the authors concluded that little is known about the application of these technologies in this context, some research in this field is available. Gamberini and colleagues (Gamberini et al., 2008) reviewed game-based applications for older people, finding them to have positive affects on cognitive abilities as well as on social and emotional variables. The ElderGames project is an example of a game-based technology that allows older users to play and interact together while improving their training problem-solving strategies, psychomotor abilities, etc. (Gamberini et al., 2006; Gamberini et al., 2008). The authors report good results in terms of usability (N = 4, mean age: 68 years), acceptance (N = 107) and monitoring of cognitive abilities (N = 59) (Gamberini et al., 2009). Further, Basak, Boot, Voss, and Kramer (2008) showed that playing a strategy video game enhanced cognitive functioning in older adults. After participating in a game tutorial, the participants (20 in a training group, 20 in a control group) spent a total of 23.5 hours over four to five weeks playing the game. Another program focusing on physical and social interaction is Age Invaders (Khoo, Merritt, & Cheok, 2009). In this game, various family members (children, parents, and grandparents) play together via the Internet (e.g., avoiding laser beams). The system was tested with seven older players aged 64–78 years old; findings on its usability were encouraging. Finally, Charness and Boot (2009) discussed the effects of games on cognitive and perceptual abilities and well-being. The authors found positive results in this field to be limited (e.g., self-reported functioning). Further research should focus on more objective outcome measures and on the transfer of the trained functions to real life.

Further, there is some literature on game-based and rehabilitation programs for motor skills and other abilities. Erren-Wolters and colleagues (Erren-Wolters, van Dijk, de Kort, Ijzerman, & Jannink, 2007) reviewed the literature on Virtual Reality (VR) applications designed to train the mobility of younger and older people. The authors found the methodological quality of the studies to range from poor to fair. Again, these findings testify to the novelty of the field, with research still being in its early stages. Nevertheless, first results seem to indicate the potential of VR applications to train mobility and thus foster the real-life use of mobility devices. For example, Giotakis, Tsirgogianni, and Tarnanas (2007) presented findings from a rehabilitation training program based on VR exposure therapy (VRET). During the intervention, 68 older adults (mean age: 76.8) completed several tasks (e.g., walking on virtual slippery streets). Results show reduced fear of falling (FES-I, Yardley et al., 2005) and increased balance confidence (ABC, Powell, & Myers, 1995). TheraGame is another example of a VR training program in which the user learns to navigate around virtual objects (Kizony, Weiss, Shahar, & Rand, 2006). Results from 12 healthy older adults and four patients with neurological deficits aged 65-76 showed that enjoyment and usability of the system were high. Likewise, Rand, Kizony, and Weiss (2008) found a VR system (Sony PlayStation II Eyetoy) designed to train patients after stroke to have good usability. Ten healthy older adults and 12 stroke patients aged 50-80 participated in the usability studies. Participants trained their motor function in a game-based VE (e.g., playing Kung-Fu).

Conclusion

This literature review of e-health interventions targeting three of the most frequent mental disorders in old age – depression, anxiety disorders, and dementia – has identified a variety of studies and ongoing projects, the initial results of which are promising. We considered ICT solutions such as Ambient-Assisted Living (AAL) and Smart Home technologies designed to compensate for or prevent health-related changes or to foster active aging in old age, as well as game-based applications and training programs. Our literature review included peer reviewed papers and RCTs as well as conference proceedings (i.e., ongoing projects) and papers reporting the results of pilot studies. Overall, the studies reviewed involved a total of 965 participants aged 65 years old and above. There is a growing interest in this field and the idea of fostering active and healthy aging unites a variety of research fields and professions. Beyond the

Table 1
Articles Included in the Review

Authors (name of project)	Area of interest	Format	*N*	Age of participants (in years)	Research design	Source	Selected findings
	Depression/ anxiety			**60-94**			
Botella et al. (2009) (Butler/Mayordomo)	Depression/ anxiety	E-Health platform, prototype	4	66-74	Pre-post comparison (pilot study)	Peer reviewed journal	Increase in positive and decrease in negative emotions (visual analogue scale)
Gamito et al. (2010)	PTSD	Virtual Reality (VRET)	10	Mean age: 63	Pilot study, waiting list control group and other treatment	Peer reviewed journal	Reduction of PTSD (CAPS) and psychopathological symptoms (SCL-90-R)
Knaevelsrud et al. (2009; 2010)	PTSD, further depression/ anxiety	Internet-based therapeutic intervention	74 (ongoing)	65+	RCT, waiting list control group	Conference proceedings	Improvement in PTSD (PDS) and depression (BSI)
Preschl et al. (2010) (Butler)	Depression	E-health supplement to face-to-face setting	3	65-75	Pre-post comparison (pilot study); authors are currently conducting an RCT study (waiting list)	Conference proceedings	Improvement in depression (BDI-II), quality of life (WHO-5), meaning of life (LAP-R), reminiscence strategies (RQ)
Rosenberg et al. (2010) (Nintendo's Wii sports)	Depression	Game	19	63-94	Pre-post comparison	Peer reviewed journal	Improvement in depression (QUIDS), mental health-related quality of life (SF-36), cognitive performance (RBANS)
Spek et al. (2008); Spek, Nyklicek, et al. (2007) (follow-up)	Depression	Internet-based therapeutic intervention	301	50-75	RCT, waiting list control group	Peer reviewed journal	Improvement in depression (BDI)
	Depression/ anxiety			**18-75**			
Cavanagh et al. (2006) (Beating the Blues)	Anxiety/ depression	Computerized therapy package	219	19-70	Pre-post and follow-up comparisons	Peer reviewed journal	Improvement in self-reported anxiety and depression (single-item 9-point scale)
Kessler et al. (2009)	Depression	Internet-based therapeutic intervention	297	18-75	RCT, waiting list control group	Peer reviewed journal	Recovery from depression (BDI)
Knaevelsrud & Maercker (2007)	PTSD, further anxiety and depression	Internet-based therapeutic intervention	96	18-68	RCT, waiting list control group	Peer reviewed journal	Improvement in PTSD (IES), anxiety, and depression (SCL-90)
Proudfoot et al. (2004) (Beating the Blues)	Anxiety/ depression	Computerized therapy package	274	18-75	RCT, control: treatment as usual	Peer reviewed journal	Improvement in depression (BDI)
Wagner, Knaevelsrud, & Maercker (2006)	Complicated grief, further anxiety and depression	Internet-based therapeutic intervention	55	18-68	RCT, waiting list control group	Peer reviewed journal	Improvement in PTSD (IES), anxiety and depression (SCL-90)

Wright et al. (2005)	Depression	Computer-assisted intervention (therapist contact and computer sessions)	45	18-65	RCT, waiting list control and face-to-face intervention group	Peer reviewed journal	Improvement in depression (HAMD and BDI)
	Dementia			**54-90**			
Alm et al. (2009) (CIRCA)	Dementia	Multimedia leisure system (prototypes)	5-40 (depending on prototype and phase of the design process)	Not specified (dementia patients and their carers)	Development and evaluation of prototypes	Peer reviewed journal	Positive experience with the prototypes (essentially qualitative results)
Dröes et al. (2009) (COGKNOW)	Dementia, memory, social support	Electronic assistant	90 (45 dementia patients; 45 carers)	Not specified (dementia patients and their carers)	Development and evaluation of a prototype	Conference proceedings	Development of system providing personalized support
Haritou (2009) (ALADDIN)	Dementia	Platform for assisted living	Not specified	Not specified (dementia patients and their carers)	Development and evaluation of a prototype	Conference proceedings	Not specified (onging)
Libin & Cohen-Mansfield (2004)	Dementia	Robotic pet	9	83-98	Experiment, direct observation	Peer reviewed journal	Decreased agitation; increased pleasure and interest (main outcome measure: ABMI)
Mahoney et al. (2002)	Dementia, memory loss	Preventive multimedia program (CD-ROM)	113	Mean age: 72	RCT (use vs. non-use of program)	Peer reviewed journal	More knowledge about memory loss in the IG (KMLT)
Marziali & Donahue (2006) (Caring for Others)	Dementia and other mental disorders	Video-conferencing group intervention	66	Mean age: 67.8	RCT, control: treatment as usual	Peer reviewed journal	Decrease in caregiver stress (3-point severity scale, RMBPC)
Odetti et al. (2007) (AIBO)	Dementia	Robotic pet	24	Mean age: 76.6	Experiment on acceptability (observation and single-item questions)	Conference proceedings	System was accepted
Pot & Blom (2009)	Dementia	Online counseling	60 (started, ongoing)	Not specified (caregivers of dementia patients)	Pre-post and follow-up comparisons (ongoing)	Conference proceedings	Not specified (ongoing)
Riikonen et al. (2010)	Dementia	Home-care: risk preventive, assistive and emergency technology	25	54-90	Explorative evaluation of various technical devices	Peer reviewed journal	Devices fostered independent living and decline in caregiver stress (NPI) in some cases
Schulz et al. (2003) (REACH)	Dementia	Various interventions for caregivers in 6 US sites (monitoring of stress and computerized telephone support)	100-257 caregivers (dependent on site)	Mean age: 61.1-68.5 (dependent on site)	RCTs, control: minimal support group or usual care	Peer reviewed journal	Improved coping; reduced stress and depression (dependent on site), main outcome measure: CES-D

Yonemitsu et al. (2002) (AIBO)	Dementia	Robotic pet	4	Not specified (older adults with dementia)	Direct observation	Peer reviewed journal	Increased communication
	Dementia			**54-90**			
Anfosso & Bourdeau (2009) (GEROHOME)	ADLs	Monitoring	2	64-85	Explorative test of system	Peer reviewed journal	System able to detect ADL levels
Basak et al. (2008)	Cognitive functioning	Game	40	Mean age: 68.88-70.05	Pre-post comparisons	Peer reviewed journal	Improvement in cognitive functions (APM and others)
Bestente et al. (2008)	Chronic disease	Monitoring	25	Not specified (older adults)	Development and test of a prototype	Peer reviewed journal	Not specified (system successfully tested)
Franco et al. (2008)	ADLs	Monitoring	13	Mean age: 83	Explorative test of system	Peer reviewed journal	System able to differentiate daily and nocturnal ADL levels
Gamberini et al. (2009)	Cognitive functioning and social interaction	Game	4 (usability evaluation) 107 (acceptance) 59 (monitoring cognitive abilities)	Mean age: 68	Usability studies and acceptance evaluation of prototype; pre-post comparisons	Conference proceedings	System user friendly and accepted, able to monitor cognitive abilities (fit with WASI)
Giotakos et al. (2007)	Mobility, rehabilitation	Virtual Reality (VRET)	68	Mean age: 76.8	Pre-post and follow-up comparisons	Peer reviewed journal	Reduced fear of falling (FES-I) and increased balance confidence (ABC)
Hlauschek (2009) (VITALIshoe)	Mobility/ safety: fall prevention	Instrumented shoe	Not specified (onging)	Not specified (older adults)	Development and evaluation of a prototype	Conference proceedings	Not specified (onging)
Huch (2009), (Hear Me Feel Me)	Sensory challenges	Mobile phone (NFC) technology, connected to Internet	Not specified (onging)	Not specified (older adults)	Development and evaluation of a prototype	Conference proceedings	Not specified (onging)
Khoo et al. (2009) (Age Invaders)	Physical and social interaction	Game	7	64-78	Development and usability studies of a prototype	Peer reviewed journal	Development of a system that fits the user's needs
Kizony et al. (2006) (TheraGame)	Rehabilitation	Virtual Reality	16	65-76	Usability studies of the prototype, pre-post comparisons	Conference proceedings	Moderate to high levels of enjoyment (SFQ) and usability (SUS)
Rand et al. (2008) (Sony Playstation II EyeToy)	Rehabilitation	Virtual Reality	22	50-80	Usability studies of the prototype, pre-post comparisons	Peer reviewed journal	System feasible for older adults and stroke patients (SFQ and SUS)

Reder et al. (2010)	ADLs	Monitoring	12	55+	Pre-post comparison (pilot study)	Peer reviewed journal	Satisfaction with the system; increase in perceived safety, well-being, peace of mind and independence; qualitative interviews

Note: CAPS = clinician-administered PTSD scale; SCL 90 = Symptoms Checklist; RCT = Randomised Controlled Trial; PDS = Posttraumatic Stress Diagnostic Scale; BSI = Brief Symptom Inventory; BDI = Beck Depression Inventory; WHO-5 = WHO-Five Well-being Index; LAP-R = Life Attitude Profile–Revised; RQ = Reminiscence Questionnaire; QUIDS = Quick Inventory of Depressive Symptoms; SF36 = MOS 36-item Short-Form Health Survey; RBANS = Repeatable Battery for Assessment of Neurocognitive Status; HAMD = Hamilton Depression Scale; ABMI = Agitated Behaviours Mapping Instrument; KMLT = Knowledge about Memory Loss Test; RMBPC = Revised Memory and Behavior Problems Checklist; NPI = Neuropsychiatric Inventory; CES-D = Center for Epidemiologic Studies – Depression Score; ADLs = Activities of Daily Living; APM = Raven's Advanced Progressive Matrices; WASI = Wechsler Abbreviated Scale of Intelligence; VRET = Virtual Reality Exposure Therapy; FES-I = Falls Efficacy Scale – International; ABC = Activity-Specific Balance Confidence; SFQ = Short Feedback Questionnaire; SUS = System Usability Scale.

areas described in this literature review there are also new research areas developing. For example, Second Life has been used to entertain older people and overcome social isolation and loneliness (Boulos, Hetherington & Wheeler, 2007) and Robot Suit HAL (Hybrid Assistive Limb) has been shown to be a helpful device in the assistance of the user's limbs (e.g., the support of movement of arms and legs of older or disabled individuals; Sankai, 2006).

Our findings underline that research in the field of e-health for older individuals is still in its early stages. As previously reported (Broekens et al., 2009; Chan et al., 2009; Charness & Boot, 2009; Erren-Wolters et al., 2007), methodological quality varies, and there is a lack of RCTs and robust research designs (much research to date has been limited to pilot and short-term studies). To our knowledge, findings from only one completed RCT study on e-health and depression in old age (Spek et al., 2008; Spek, Nyklicek, et al., 2007) and three completed RCT studies on e-health and dementia in old age (Mahoney et al., 2002; Marziali & Donahue, 2006; Schulz et al., 2003) have yet been published.

Further, it remains to be seen whether investigated prototypes will reach the final phase of implementation and can be placed on the market. In addition, ethical and legal issues and individual needs warrant particular consideration in this context, especially where monitoring devices are concerned (Chan et al., 2009; Charness & Boot, 2009). Beyond these challenges, we identified some high-quality research and a variety of innovative ongoing research and pilot studies in the field. The promising results of these studies indicate that ICT may be able to make a significant contribution to active and healthy aging in the future.

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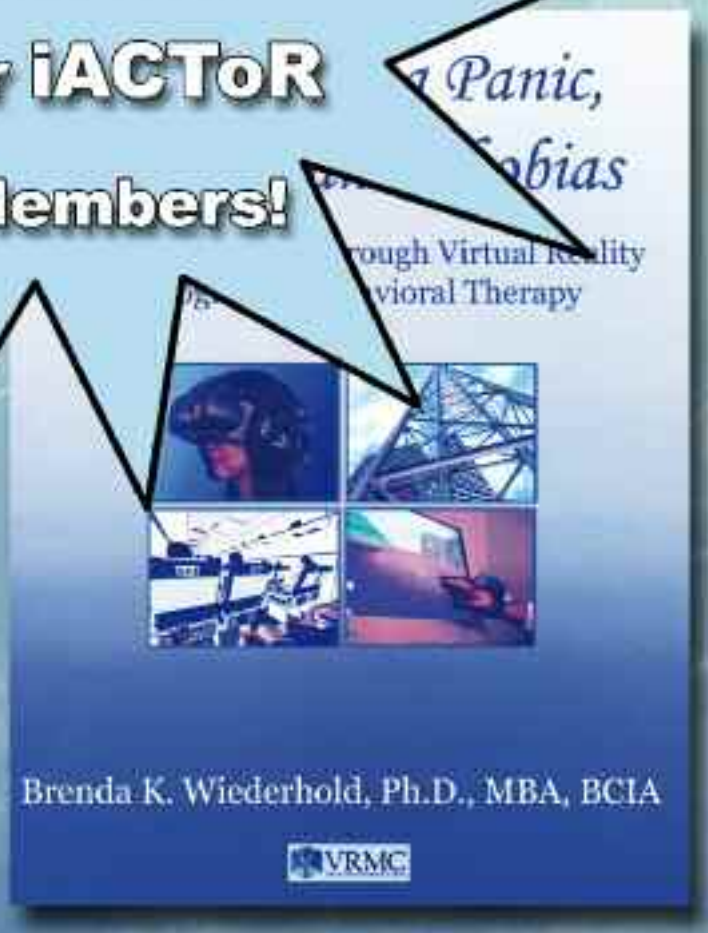

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USING ARTIFICIAL INTELLIGENCE TO CONTROL AND ADAPT LEVEL OF DIFFICULTY IN COMPUTER-BASED COGNITIVE THERAPY – AN EXPLORATIVE STUDY

Inge Wilms[1, 2]

Within the field of cognitive rehabilitation after brain injury, rehabilitation training is constantly adjusted to match the skills and progress of the individual patients. As no two patients are alike in functional injury and recovery, it is a challenge to provide the right amount of training at the right level of difficulty at any given time.

This study investigates whether a modified version of the artificial intelligence (AI) reinforcement method called the "actor-critic method" is able to detect response time patterns and subsequently control the level of difficulty in a computer-based, cognitive training program. The efficacy of the AI logic was tested under the actual training conditions of a brain-injured patient.

The results showed that the AI controlled training system was able to learn and adjust fast enough to control and adapt the level of difficulty of the training to match the changes in the patient's abilities over a three-week period.

Keywords: **Reinforcement Learning, Cognitive Rehabilitation, Adaptive Therapy, Actor-critic, Adaptive Progression**

Introduction

Over the past decade an increasing amount of evidence supports the notion that cognitive functions injured from trauma may recover, at least partially, through training and therapy that target different aspects of brain plasticity (Kleim & Jones, 2008; Friedemann Pulvermüller & Berthier, 2008). As with healthy brains, certain elements such as the intensity of the training, the type of feedback provided and the progression of the level of difficulty seem to be important, general aspects of the more recent type of therapy used experimentally in the rehabilitation of cognitive deficits (Frassinetti, Angeli, Meneghello, Avanzi, & Ladavas, 2002; Friedemann Pulvermüller & Berthier, 2008).

In methods like cognitive Constraint Induced Aphasia Therapy, one of the key elements is the personalized intensive training which challenges the patient gradually with progressively harder tasks (Friedemann; Pulvermüller, et al., 2001). However, to advance the training at the right pace and to the right level of difficulty is perhaps one of the hardest challenges for the therapists to do correctly, as performance of patients may fluctuate from day to day. First of all, no two brain-injured patients are alike even when diagnosed with similar afflictions. This means that training-progress may vary substantially from patient to patient. Even slight differences in impairment may impact the way training will affect progress and amelioration making it extremely difficult to determine how fast to advance with the training (e.g., Wilson, Gracey, Evans, & Bateman, 2009). Secondly, even with the same category of affliction, what is considered to be hard or difficult may vary from patient to patient (Wilson, 1998). Thus, the combination

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of parameters that determine the level of difficulty may very well differ substantially from patient to patient.

It therefore seems advantageous to study systems that may monitor the activity of the patient and be able to adjust parameters intelligently to match individual progress and deficits. However, this poses considerable challenges to the training system itself. First, it has to be able to monitor and detect consistent progress during training under realistic training conditions where progress may not be linear or constant and where measurements may be influenced by factors not under immediate control, such as the current condition of the patient. Secondly, the system has to be able to assess the ability of the patient quickly and consistently in order to select a correct set of parameters controlling difficulty level at any given time during training. In essence, the system must be able to adjust its behavior according to the individual effect of parameters, some of which may be known, some of which may not be.

Some computer-based cognitive training systems do offer automated progression in level of difficulty, most of them through a "staircase" progression whereby the program increases the general level of difficulty from one level to the next when the patient masters a certain percentage of the tasks at one level (Sturm, Willmes, Orgass, & Hartje, 1997; Wertz & Katz, 2004). In other cases the training progress is administered by the therapist, who is then required to monitor the progress and offer increasingly harder challenges (Pedersen, Vinter, & Olsen, 2001).

To some extent, challenges and requirements to intensive computer-based therapy for cognitive rehabilitation match those of computer game-play. Artificial intelligence (AI) has been used successfully in games to solve similar challenges of adjusting computer-controlled adversaries to match the skills of the game player at any given time (Bourg & Seemann, 2004; Spronck, Sprinkhuizen-Kuyper, & Postma, 2004). The research in this field has proven that certain machines learning AI algorithms are fast and efficient enough to learn and subsequently adjust game-play in real time to the constantly evolving skills of the player (Ponsen, Spronck, Munoz-Avila, & Aha, 2007; Spronck, et al., 2004).

Purpose

The purpose of this study was to explore whether an AI engine, based on the actor-critic machine-learning logic, would be able to control the multidimensional progression of level of difficulty (LOD) as defined by three different parameters in a computer-based, cognitive training program for patients with acquired reading difficulty after brain injury known as pure alexia. In particular, the question was whether the engine would be fast and adaptive enough to compensate for fluctuations in the performance of the patients over time and be able to detect the subtle differences in the effect on difficulty provided by each parameter. This article specifically deals with the technical aspects and results of the study. The rehabilitation aspects and results from this study will be presented elsewhere.

Considerations Regarding the Artificial Intelligence Agent

Learning Agent

The term "learning agent" refers to AI agents or programs that are able to learn about the environment in which they operate. This knowledge is in turn used to improve the agent's ability to make appropriate choices of action. Learning can be achieved in several ways through different types of feedback. Usually, the way AI learning is achieved is categorized in three groups: supervised learning, unsupervised learning and reinforcement learning (Russell & Norvig, 2003). The difference being that in supervised learning the agent is initially taught correct behavior from samples of input and corresponding output. The outcome of this supervised teaching is a performance function which may then act as an expert system capable of solving problems of a similar kind. In unsupervised learning, the agent is searching for patterns in input and establishing rules based on those. Decision trees are examples of results of unsupervised learning (Russell & Norvig, 2003).

Reinforcement learning (RL) originates from psychology research, where reinforcement learning is thought to be one of the fundamental ways living beings learn from interacting with the environment. Similar to living beings, computer programs can learn through trial and error (Sutton & Barto, 1998). The RL agent learns about the appropriateness of selected actions through rewards and punishments after execution of behavior without prior knowledge of the environment (Russell & Norvig, 2003; Sutton & Barto, 1998).

The Choice of AI Method

In this study, the principal requirement for the AI algorithm was that it was learning quickly, was flexible and did not unduly impact the computer as the training program needed to respond rapidly and appropriately to the

actions of the test subject. The so-called actor-critic method from the RL category was chosen as it had previously been proven able to learn and optimize selection of actions quickly and easily in the research field of computer games with similar challenges (Spronck, Ponsen, Sprinkhuizen-Kuyper, & Postma, 2006; Spronck, et al., 2004; Spronck & van den Herik, 2005).

In research the term "Game AI" often refers to the appearance of intelligent behavior of computer-controlled game characters (Spronck & van den Herik, 2005). A large portion of game AI is often either fixed state machines or scripted logic due to the complexity in using and adapting the computational logic into usable, programmable entities (Bourg & Seemann, 2004; Galway, Charles, & Black, 2008). Recent research, however, has tried to establish usable solutions to game AI based on reinforcement learning techniques (Spronck, et al., 2006; Spronck & van den Herik, 2005).

Spronck et al. (2004) had successfully implemented and evaluated a solution based on a combination of dynamic scripting and a slightly modified version of the temporal difference (TD) learning methods named actor-critic methods. Using these methods they had optimized the selection of available actions for computer-controlled non-player characters (NPCs) in a role-playing game to set a level of difficulty that would challenge the player's skills appropriately. By matching NPC strength to the strength of the player at a given time the player would stay motivated for gaming.

Since Spronck's team (2005, 2006) had already tested the actor-critic logic against other RL techniques such as the Monte Carlo methods and Q-learning, and found it most suitable with regards to speed and impact, it seemed prudent in this study to build upon their actor-critic findings given the fundamental similarities in the requirements to the AI logic.

The Actor-critic Method

The actor-critic methods differ from other TD-learning methods in that the policy is independently represented by a structure known as the "Actor." The estimated value function is known as the "Critic." The Critic must learn and adjust the value of actions selected by the Actor through the sensory information from the environment. Since learning takes place in real time, the critic must learn and criticize any current action followed by the actor; this is also know as on-policy learning (Sutton & Barto, 1998).

The AI Engine in This Study

The Main Logic

The actor-critic method used in this study consisted of three parts: (i) an actor that selected the appropriate parameter settings from three databases, (ii) a fitness function that converted the results from the actions to a numeric representation which were then passed to the third part, and (iii) the critic, that adjusted weight values for each action chosen thus raising or lowering the probability of the action to be reselected. Figure 1 shows the architecture of the agent.

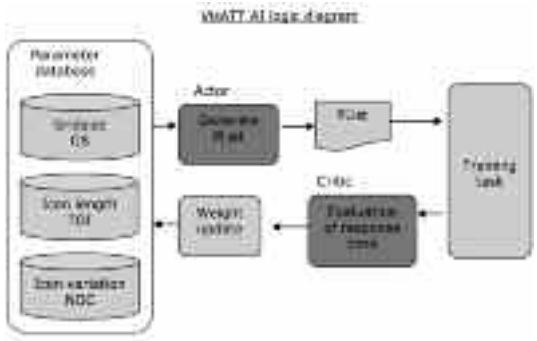

Figure 1. The architecture of the AI engine used in the VisATT training program.

The AI engine had no pre-established knowledge of the environment. The engine learned the appropriateness of a given set of parameters during actual training by examining sensory input in the form of response times achieved at any given time and continuously adjusted the choice of parameter settings.

Before each trial, the actor of the AI engine selected one setting from each of the three parameter databases based on the following algorithm:

Algorithm 1: Action selection (ACTOR)

```
1: Clear Plist();
2: k = 0;
3: for each parameterDB do
4:     sumWeights = 0;
5:     for i=0 to parameterDBSize-1 do
6:         sumWeights = sumWeights+parmDB[i].weight;
7:     end for
8:     fraction = Math.random()*sumWeights;
```

```
9:      sum = 0; j = 0;
10:     selected = false;
11:     while (not selected) do
12:          sum = sum+parameterDB[j].weights;
13:          if (sum>fraction) then
14:               selected = true;
15:               Plist[k] = parameterDB[j];
16:               k = k+1;
17:          else
18:               j = j+1;
19:          end if
20:     end while
21: end for
```

The probability that a specific setting for a parameter was chosen was influenced by the weight value attached to each setting. The sum of all weights defined the selection space. The size of each weight made each setting more or less visible within this selection space. Using a randomly generated selection criterion, it was possible to ensure a certain amount of exploration, since even large weights did not guarantee 100% selection each time. Initially, all weights were set to the same value of 100.

The critic of the AI engine receives the response time from the trial and determines the fate of the selected parameter settings:

Algorithm 2: Action evaluation (CRITIC)

```
1: medianRT = dampenInput(responseTime);
2: fitvar = AIFitness(medianRT);
3:
4: for i = 0 to Plist.length-1 do
5:      Plist[i].ParameterDB.weight =  Plist[i].Parame-
terDB.weight * fitvar;
6:
7:      // Ensure exploitation across the range
8:      if  Plist[i].ParameterDB.weight < atMin then
9:        Plist[i].ParameterDB.weight = atMin;
10:     end if
11:     if  Plist[i].ParameterDB.weight > atMax then
12:       Plist[i].ParameterDB.weight = atMax;
13:     end if
14:     i = i+1;
15: end for
```

The AI Engine Fitness Function

The criterion for success for the AI engine was determined by measuring the time from the target icon was presented in the middle of the panel until the time the correct button was pressed (the response time). Two criteria set the lower and upper limit for an acceptable response time (see Figure 2). If the subject's time fell within these criteria, the LOD was acceptable. If response time fell beneath the low threshold (tooEasy), LOD was deemed too easy and the weights for the parameters selected would be reduced making those parameters less eligible for selection. Similarly, if the response time fell above the upper threshold (tooHard), LOD was deemed too hard and the weight of the parameters involved was reduced.

Figure 2. The tooEasy/tooHard range which determines fitness of chosen actions.

A bottom limit value of 20 as the lowest and 600 as the highest weight setting ensured that all parameters would remain eligible for selection allowing the difficulty to be reduced if necessary. This logic would ensure that as response times to a certain parameter setting would improve, the parameter would eventually drop below the tooEasy/tooHard threshold causing a new setting to be favored and selected.

Algorithm 3: The fitness function (AIFitness)

```
1: if responseTime < tooEasy then // Check if this was
too easy
2:    return 0.9;
3: else
4:    if responseTime >tooHard then    // Check if it
was too hard
5:        return 0.95;
6:    else
7:        return 1.05;                 // Just right
8:    end if
9: end if
```

The setting of the Easy/Hard range in this study was calculated by testing a range of settings and measuring

which settings had an effect. A rule of thumb from all the completed tests seemed to suggest that 35% of all response times during a random 200-task session must be within the Easy/Hard settings. Using this rule of thumb, the subject's ideal setting proved to be 1000/1800 ms as opposed to normal controls, which estimated the setting to be 1000/1500.

Method

The AI engine was developed in Java and incorporated into a computer-based cognitive training program for visual attention (VisATT). As described above, the purpose of the engine was to monitor subject performance during training and constantly try to adapt the LOD of the training to challenge the subject's abilities. The adaptation in this case was done by adjusting the weights of three parameters according to a fitness criterion. The weights assigned to each parameter made the parameters more or less likely to be selected, resulting in an individualized increase or decrease of LOD as defined by the combination of the three parameters.

The testing of the engine was done as part of a real training program to place a maximum stress on the AI engine. It would have to perform rapidly and flawlessly under "noisy" conditions, where patient performance would potentially be influenced by a number of known, as well as unknown, factors. Quantitative data was recorded for each trial.

Test Subject

The subject was a right-handed male who, in 2005 at the age of 47, suffered a cerebral hemorrhage following thrombolysis treatment of a pulmonary embolism. As a result, the subject was left with an upper right quadrantanopia and subsequently diagnosed with pure alexia (letter-by-letter reading). Reaction times in single word reading were measured by a voice-key test administered by a trained neuropsychologist three months post injury. This showed a word length effect of 380 msec per letter ($r^2 = .130$, $F(1, 50) = 7.5$, $p < .01$) for words of three to nine characters and a mean response time of 1,973 msec. In winter 2005/2006 the subject attended a rehabilitation program at the Center for Rehabilitation of Brain Injury (CRBI), of which the last two months were dedicated to daily intensive training aimed at improving reading abilities. Neuropsychological tests conducted in March 2006 at CRBI showed that the subject's performance was within the normal range compared to Danish norms, except for three scores on tests that involved psychomotor speed and alphanumerical material. In April 2007, two months before this study, the subject was retested on the reading test mentioned above. The results showed a word length effect of 270 msec per letter ($r^2 = .351$, $F(1, 70) = 37.8$, $p < .001$) and a mean response time of 1,717 msec. Further comprehensive investigation and assessment of this patient's injury, reading skills and neuropsychological profile may be found in (Starrfelt, Habekost, & Gerlach, 2010).

Training Schedule

The total amount of training consisted of one uninterrupted 30-minute session per day, seven days a week, for three weeks, totalling approximately 13,500 trial tasks – a trial constituting the task of pressing a button with a target icon as fast as possible. After each training session, data on the current status of the parameters was saved in order to allow training to recommence at that level the following day. Prior to the initiation of the training period, the test subject trained for three days to become acquainted with the functions of the system. The data from these tests was excluded from the measurements presented here.

All training took place at the subject's home once a day. The subject was free to choose the time of day to maintain motivation and to avoid interference with other unrelated activities planned during the three weeks of training.

Equipment

The subject trained on a laptop PC running Windows XP and Java 1.5. The primary input device was a 17-inch LG 1730SF TFT finger touch monitor placed horizontally on a table with the touch-screen facing upwards to reduce fatigue during training. Screen resolution was 1280x1024 pixels.

Software

The training software consisted of two components: the AI engine and the training program for visual attention (VisATT), which was controlled by the AI engine. Both components were designed and programmed by the author especially for this study to ensure proper and timely interaction between the components and the logging of relevant data that could be used later on in simulations of activity.

Data Collection

The primary internal data collection was done automati-

cally by the training system which recorded trial event data during training sessions directly onto a disk to prevent loss in case of unscheduled interruptions. The secondary internal logging happened at the end of the session, when the "x" at the top right corner of the training screen was pressed. This signaled the end-of-session and the current AI settings (weights and values) and the last-played date would be saved for subsequent resumption.

The Training Program - VisATT

The training program was developed specifically to train letter span and object detection speed. The design and implementation of the training were done in collaboration with the neuropsychologist who had previously worked with the test subject.

For each trial, the subject was presented with a target icon in the middle of the screen surrounded by a set of selection buttons (see Figure 3). One and only one of the surrounding selection buttons would match the target icon in the middle. The rest of the buttons, the distractors, would have icons of a similar type and length. For each trial, the subject had to search the surrounding buttons for the button matching the target icon, and then press the one matching button as quickly as possible. The number of buttons, the length of the word on the icon and the variety of distractor words were determined by the values of three parameters. The buttons would be distributed evenly on the screen in predetermined patterns, ensuring an approximately equal distance from the center.

Figure 3. The basic training panel layout. The target icon in the middle of the screen is "A" and the button choices are "D," "B," "B," "D," "C", "A." The person training must find and press the "A" button to the left as quickly as possible.

The test subject was told to press the "PAUSE" button if he needed a break for some reason during training. This would cause the response time data from this trial to be discarded in the internal calculations. A special log record was created to identify this situation.

The VisATT Parameters

The LOD is often closely linked to the task being trained. To define what makes a task more or less difficult is in some cases obvious, for example, when juggling balls in the air, adding a ball will increase difficulty. However, in rehabilitation it may not always be equally obvious what will be difficult for a patient and what will not. It most likely depends on the type and location of the injury, previous abilities, motivation and future goals of the patient (Wilson, 1998). For this reason, the training program was designed specifically for a patient with pure alexia. Pure alexia is most often characterized by a decrease in reading speed corresponding to the word length as well as degraded processing of visual objects (Leff, 2004; Starrfelt, Habekost, & Leff, 2009). The following parameters were chosen to be the most appropriate to represent elements that would be expected to increase or decrease LOD by, in various ways, increasing or decreasing visual the complexity of the visual stimuli presented:

1. Grid size – the number of buttons shown on the screen. Only one button will contain an icon matching the center icon, and the other buttons act as distractors. The LOD is increased as the number of buttons increases by adding visual elements to be searched through and ignored. There are eight settings (2, 4, 6, 8, 10, 12, 14, 16) for this parameter corresponding to the number of buttons displayed.

2. The icon length (TOI) – the word length. There are four settings (1, 2, 3, 4 letters) for this parameter indicating the length of the icon word.

3. The icon variation factor (NOC) – the variety pool size. As only one button, the target button, may contain the center icon, the rest of the buttons, the distractors, are displayed with similar types of icons selected from a pool. The NOC parameter determines the variety pool size. The setting range of this parameter is 2-28 with two-step increases.

Results

During testing, the logs revealed that the AI logic did not initially work as intended. The correlations between raw

response time and parameters were not significant enough for the AI engine to detect changes in the performance of the test subject, due to the fluctuations in response time. This is a fairly common problem in psychophysical experimental psychology when using raw response time data to analyze correlations in tasks which require a high degree of concentration and quick responses (Howitt & Cramer, 2005). Dampening the influence of noise in the data was therefore done using a small, rolling, temporal median table of response times for each parameter setting. Thus, the median value calculation required a set of raw response times for each setting of the parameters, but not the combinations of settings. A fair amount of trial and error showed that the median response time calculated on the basis of a small rolling history of the five most recent response times for each setting was sufficient to dampen noise and at the same time maintain the responsiveness to changes in the subject's ability. This result was passed to the AI engine instead of the raw response time.

The AI Controlled Level of Difficulty

The selection results were compiled from the daily event log files. Training tasks with wrong buttons activated were removed from the results as were the records made due to pressing the PAUSE button. The reason for this was that these records were considered exceptions and typically the cause of extreme outliers. Analysis showed that erroneous button presses constituted less than 1% of the total number of button presses and they were therefore determined by the author to be insignificant indications of performance in this case study.

Figure 4 shows the changes over time in the preferred setting of the GS parameter controlling number of buttons. Initially, a setting of 2 is weighted highest and selected most often, but already after six days of training two buttons (GS=2) begins to be too easy and four buttons (GS=4) becomes the preferred setting. Towards the end of the training period six buttons (GS=6) begin to be chosen more and more often. The subject did not reach a plateau during the three weeks of training.

The same pattern was seen for the second parameter, the word length parameter (TOI). Figure 5 shows that towards the end of the training period the settings 1 and 2 were favored above 3 and 4.

The last parameter, the NOC parameter, showed no correlation between median response time and setting causing the AI engine to select settings totally at random (see Figure 6).

Discussion

The Use of AI for Adaptive Control in a Cognitive Training System

The research question in this project was whether or not the chosen AI algorithm was suitable for controlling and adapting LOD in a cognitive training program under real-life conditions. A reinforcement learning al-

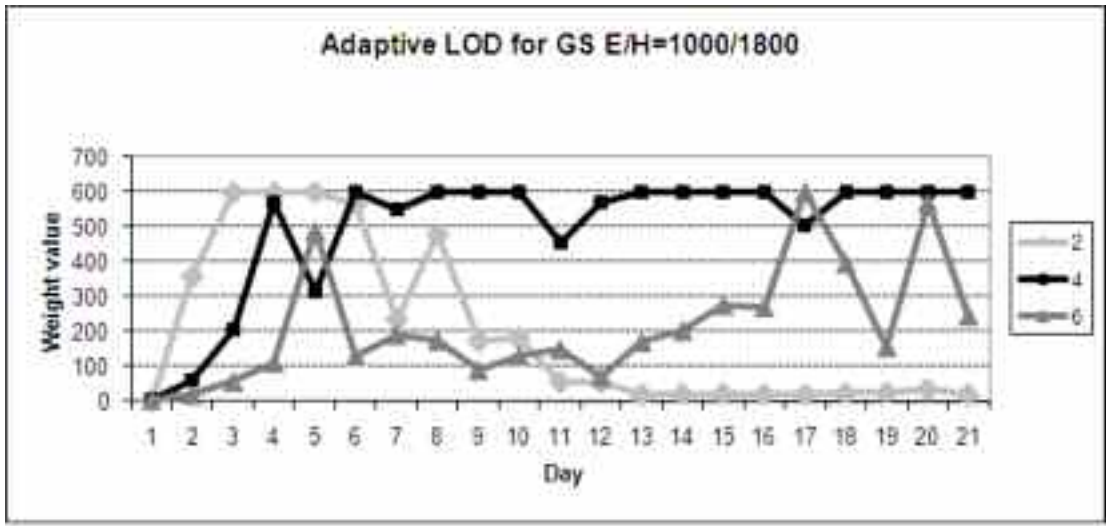

Figure 4. The weight assignment of the eight settings of the GS parameter (no. of buttons) during the three weeks of training.

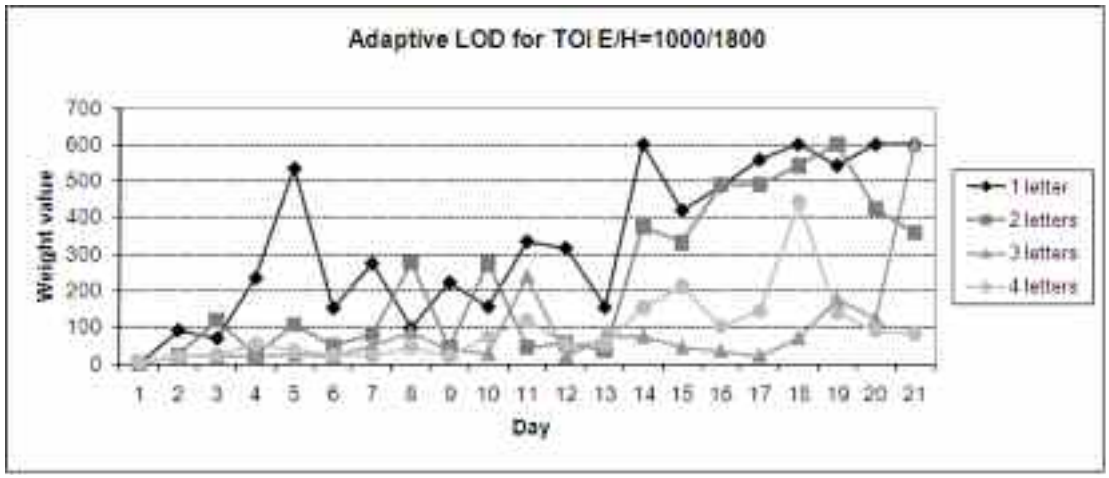

Figure 5. The weight assignment of the four settings of the TOI parameter over the three weeks of training.

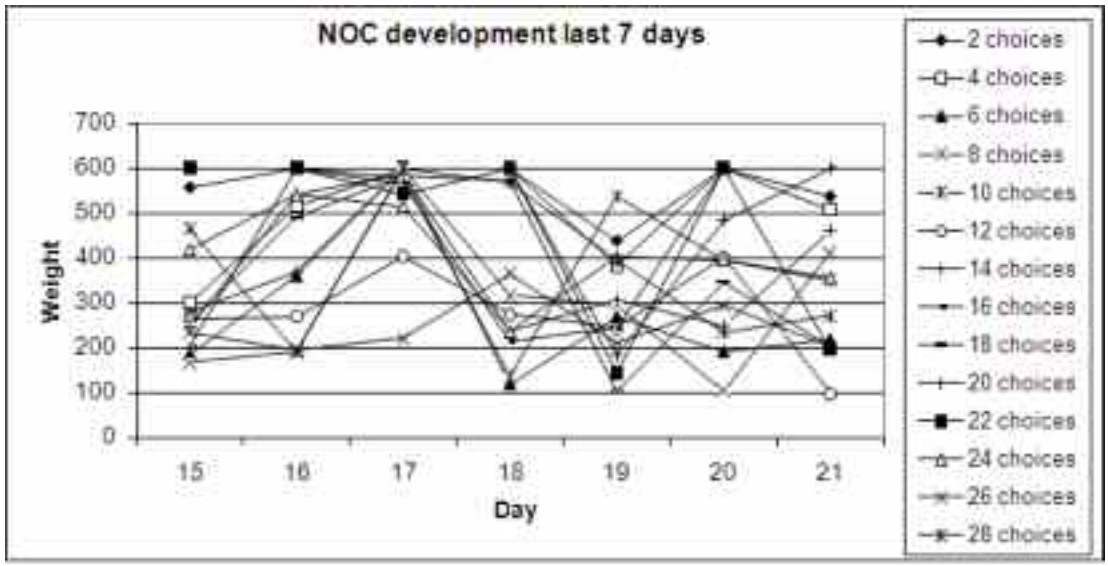

Figure 6. The weight assignment of the 14 settings of the NOC parameter over the last week of training.

gorithm was chosen as the AI method for two reasons, its ability to learn in an unknown environment and its fast learning rate. As the weight distribution for the parameter settings in Figures 4 and 5 showed, the AI engine and logic managed to distinguish a group of settings as being an appropriate LOD as opposed to others that were either too hard or too easy. It also showed that the selected settings changed as values changed from day to day depending on the effects measured by the system through response times. Figure 6 shows the results from the third parameter, the NOC, which controlled the variety of icons within the remaining distracters. This parameter never seemed to stabilize at any preferring setting.

When considering the conditions of the environment in which the AI engine managed to work, the use of AI technology in cognitive training looks promising. The AI engine itself was a simple implementation offering many opportunities for improvements of the algorithms

used to control weights and determine fitness. In this implementation the free assignment of weight values worked to isolate optimum settings, but there may very well be further possible improvements in using some of the culling and clipping techniques that Spronck et al. (2005) suggest in their research.

The Easy/Hard Setting – the Success Criterion

The success of the AI engine in this study depends on the measure of success used to rate the selected actions. If these measures are not distinct, the agent has no way of learning or change actions.

In this study the measure of success was determined by the predefined Easy/Hard range against which the response time was compared and selections subsequently rated. However, the Easy/Hard setting turned out to be difficult to estimate. If the Easy/Hard range was too wide, it was too insensitive to changes in performance related to individual parameter changes causing assignment of the same fitness value to too many adjacent settings of the parameters. This resulted in too much variation in the selection of parameter settings. If on the other hand, the Easy/Hard settings were too narrow, all settings were judged to be either too easy or too hard causing a leveling out of the influence of the weights which resulted in random selection rather than selection by appropriateness. As no established model for determining the settings existed, a set of guidelines was developed, which was based on observed results from testing the programs on volunteering fellow students and friends.

The heuristic nature of the guidelines, however, does not ensure optimal settings, so this is definitely an area that requires further investigation and automation.

Another subject for future research will be to investigate whether the AI engine in fact needs an independent measure of success for each parameter controlled. The TOI parameter did not seem to converge around one or two settings as the GS parameter did. One explanation could be that the optimum Easy/Hard range for one parameter differed from the optimum Easy/Hard range of another. Another explanation could be that three out of four settings did in fact provide equal levels of difficulty. It will require further tests and analysis to determine whether this is in fact the case.

From another perspective, the Easy/Hard range could be viewed as the primary parameter of LOD which needs to be estimated, at least initially, in order to match a certain level of ability. With further research it might be possible to automate the estimation and initial settings of the Easy/Hard range using the same AI engine, but by turning the logic around so the Easy/Hard range becomes the parameter to be estimated from a fixed task set of one or more parameters in the parameter database. Another possibility would be to let the therapist set the range, but that would require some kind of assistive tool for the therapist to be able to judge what would be suitable.

Parameter Selection

The decision to let the AI engine control three parameters was in part based on the fact that in Spronck's research (2004, 2005, 2006) the AI solution was able to handle this, and in part based on the fact that this would reflect the conditions of challenging cognitive training. However, the relationship between success criteria and parameters in Spronck's game were, in retrospect, much simpler than those met in this study. In the case of Spronck, his success was determined by a Boolean variable (win or lose), whereas mine was determined by the Easy/Hard range of response times which was directly influenced by the parameters and indirectly by other factors outside my control. Also, the potential difference in impact of the several parameters in combination was not an issue in Spronck's solution.

Although the use of three parameters did make the study more demanding and raised new questions, it did show that the AI engine was able to detect correlations between response time and two of the parameters. In an actual training environment there may be other parameters exerting influence on the response time during a session. Secondary factors such as fatigue, motivation, concentration and the visuo-motor movements involved in pressing buttons, may directly or indirectly influence the performance of the test subject. In theory however, the influence from these factors presumably affect the parameters in equal measures like background noise.

This study faced some of the same difficulties facing therapists when trying to translate the difficulties introduced by impairment into trainable parameters controlling level of difficulty. As opposed to the modified fitness function of Spronck's design (Spronck, et al., 2006; Spronck, et al., 2004; Spronck & van den Herik, 2005),

the algorithms in this study had no way of ascertaining the effect is of the individual parameters. This is definitely an area for further investigation and improvement of the AI engine.

Trying to define a programmable logic for the engine has made me even more convinced that technology can play an important role in assisting therapists in planning, designing and executing training.

Limitations in the Study

Due to the investigative nature of this study, there were several areas that would require more appropriate control in future studies. In particular, the noise created by the physical arm movements of the subject. To create a realistic training environment, the buttons on the screen were not laid out at the same physical distance from the center of the target icon. The reason for this was that the subject was allowed free movement of the arm and was not required to reposition the arm after each pointing trail, so it was deemed less essential in the initial study. In future studies, this is an area which could be improved upon. However, the fact that the AI algorithm managed to adjust, despite this, does suggest that the algorithm is fairly resilient to noise.

Conclusion

The results from this project demonstrate some of the conditions to be met if training is to be controlled by the AI actor-critic reinforcement logic (Sutton & Barto, 1998). In terms of controlling level of difficulty it means that:

• The response time must be influenced by task difficulty. The harder the task, the longer the response time. This must be verified with patient data.

• Task difficulty must be expressible through a number of parameters.

• The criterion for a challenging level of difficulty must be defined as a response time range with an upper and lower level within which the patient must operate in order to progress.

• Each parameter must indicate a range of settings from low to high LOD.

When considering the conditions of the environment in which the AI engine managed to work, the use of AI technology in cognitive training looks promising.

This study was explorative and intended to develop and test AI controlled training to determine whether this type of advanced computer technology could, in fact, be used under the conditions of cognitive training. The conclusions from this study were:

• That it was possible to develop an AI engine able to measure and adjust LOD using reinforcement learning methods.

• That it was possible for the AI engine to work under the very difficult conditions of the real-life cognitive training of a patient suffering from alexia. By introducing the temporal median filter to dampen the noise in the raw input, the AI engine did manage to control all three parameters and show clear indications of being able to adjust LOD as the patient's skills improved. The weights controlling the AI parameter selection converged to an optimum for the two parameters controlling number of buttons and length of word that had a clear correlation between measured median response time and LOD setting. The third parameter controlling variety of words on the distractor buttons that had no correlation showed an even distribution of weights across settings.

The next research step will be to test the AI engine under different training conditions and with different training programs. The hope is that this type of intelligent training tool will assist in the wider study of the effects of intensive, adaptive cognitive training of patients with cognitive impairments after brain injury.

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Wounds of War IV: Pain Syndromes: From Recruitment to Returning Troops

EDITED BY:
Professor Dr. Brenda K. Wiederhold, Ph.D., MBA, BCIA

WOUNDS OF WAR IV: PAIN SYNDROMES – FROM RECRUITMENT TO RETURNING TROOPS

On September 30-October 2, 2011 the NATO Advanced Research "Wounds of War IV: Pain Syndromes – From Recruitment to Returning Troops" will draw over 25 eminent experts from 11 countries to discuss the topic of increased Pain Syndromes in our service men and women.

To be held in Südkärnten, Austria at the Hotel Amerika-Holzer, discussion topics will include increased Pain Syndromes as a result of missions, as well as how Pain Syndromes may be prevented. Research has shown that those who have served in both combat missions and peacekeeping operations are at an increased risk for Pain Syndromes. The ultimate aim of the workshop will be critical assessment of existing knowledge and identification of directions for future actions. The co-organizers of the workshop alongside Professor Brenda K. Wiederhold include Professor Kresimir Cosic, Professor Mark D. Wiederhold and Colonel Carl Castro.

Full papers will be published with IOS Press
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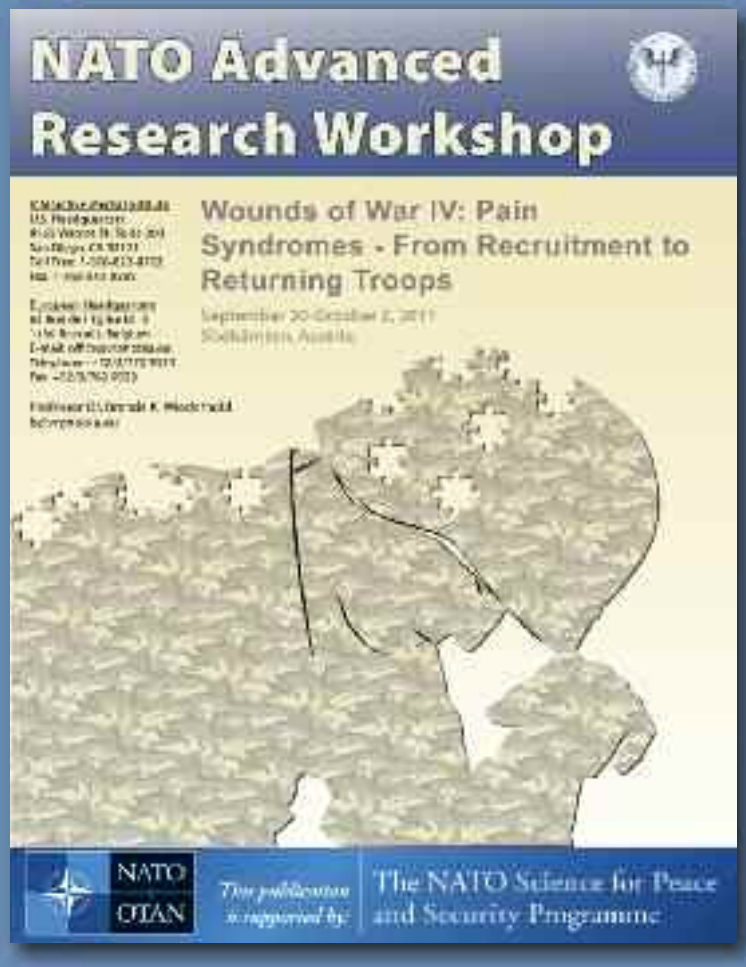

The post-conference book will reflect the key topics discussed in the four sections at the workshop:

First Session
Vulnerability to Pain Syndromes
Second Session
Diagnosis and Assessment of Pain Syndromes
Third Session
Treatment of Pain Syndromes
Fourth Session
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SHORT REPORTS

EXERGAMING: INTERACTIVE BALANCE TRAINING IN HEALTHY COMMUNITY-DWELLING OLDER ADULTS

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Exergaming is a term used for videogame exercise. The aim of this study was to examine the training effect of an exergame that relies on the movements of a dynamic balance board. Nine healthy elderly subjects participated in a six-week intervention in which they played balance games three times a week. Before, after and during the intervention phase balance was assessed with the figure-of-eight test, the Berg Balance Scale (BBS), and the tandem and one-leg stance, both performed with eyes open and closed. Intervention effects were examined using multilevel modeling statistics. Predominantly, the dynamic balance performance, measured by the figure-of-eight and the BBS, improved ($p < 0.05$). Balance improvement was dependent on level of performance at the start of training; participants with initially low balance scores improved more across time than the highest scoring participants.

Keywords: **Postural Control, Aged, Videogames, Sensory Feedback, Exercise Therapy, Recovery of Function**

Introduction

Balance disorders are common in older adults. Impairments may be the result of a specific pathology affecting a particular component of the sensory, motor and central processing systems, or the general progressive loss of sensorimotor function due to normal aging (Ganz, et al., 2007; Lamoth, et al., 2011; Sturnieks, St George, & Lord, 2008). Impaired balance is an important predictor of falls within the older adult population. Falls often lead to injury and loss of independence, and are associated with illness and early death (Ganz, et al., 2007; Howe, et al., 2007). Therefore, improving and maintaining functional abilities and balance is essential for older adults.

While there are many health and social benefits from different exercise regimens, balance training, in particular, significantly results in functional improvement in older adults (Rochat, et al., 2008; Sihvonen, et al., 2004b). Balance training not only improves postural stability, but also the confidence of elderly patients. Accordingly, elderly people with better balance will be more likely to maintain healthy levels of physical activity, which in turn will help to enhance their balance control and prevent fall incidents. Physical therapists commonly use balance and coordination exercises, using, for instance, a wobble board to train balance. However, due to the repetitive nature of the exercises, motivation and attention span might be difficult to sustain, particularly so in the case of prevention programs where there is no direct need for rehabilitation. This can impair the potential effectiveness of the therapeutic exercise (Betker, et al., 2006; Fitzgerald, et al., 2010). New technology-based techniques, such as exergaming (a term used for videogames that are also a form of exercise), can act as an aid by providing a motivational factor to encourage longer engagement in the exercises than would normally be seen. Moreover, by playing a balance game people do not pay attention to the physical exercise and their own movements (i.e., an internal

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focus of attention) but on the outcome of their movements in the projected environment (i.e., an external focus of attention). This environmental focus might facilitate the learning process (Wulf & Prinz, 2001). In addition, research indicated the importance of adapting the exercise interventions to the performance level of the older adults in order to provide individualized training. Exergames offer an advantage because the task difficulty can be adapted easily to the performance level of an individual user (Lamoth, et al., 2009; Sihvonen, et al., 2004b). This indicates that there is potential for the use of exergame applications for physical training in the healthy elderly population.

In general, regulation of balance involves the integration of information from the visual, vestibular, and somatosensory systems, all providing information regarding the orientation of the body relative to its surroundings. With increasing age, individuals seem to rely more on exteroceptive information and prioritize the use of vision for controlling balance (Hatzitaki, et al., 2009). To provide visualization of the center of pressure as measured by a force platform on a display or by means of acceleration sensors attached to a moveable platform, real-time visual feedback is provided regarding balance performance and game scenarios can be created that challenge a person's postural control. Feedback on the augmentation of center of pressure by means of visual information has been shown to increase postural stability in healthy young controls during quiet stance (Dault, et al., 2003).

Recently, the use of computer games as a form of balance training (e.g., Nintendo Wii Balance Board) has gained increasing attention in the gaming industry and media. Although there is some evidence that older adults benefit from interactive dynamic balance training using biofeedback and Virtual Reality (VR) (Bisson, et al., 2007; Fraser, Soiza, & Steward, 2009), evidence for its beneficial effect on postural control is still scarce. Therefore, the aim of the present study is to examine the effects of a six-week balance-training program involving an exergame that requires postural control on a moveable platform with acceleration sensors in a group of elderly community-dwelling persons. By subtly shifting weight on the balance board the person virtually tilts a maze to guide a ball to a target. The ability to react to self-induced balance perturbations is trained, because while standing on the unstable platform, every small movement of the participant will displace the platform and perturb the movement of the ball on the screen. The perturbation-based balance training with feedback may help elderly users learn how to restore balance when their center of gravity or their stance is displaced.

Method

Participants

Nine healthy elderly subjects (five women; mean age 77 ± 5.0 years) participated in this study. The participants were recruited from senior apartments, through the use of a recruitment letter. To qualify, individuals had to be healthy older adults aged above 65 years old who were able to walk without aids, had the ability to use a keypad using their hand, understand verbal instructions and had the visual ability to perceive the information presented on the screen of the balance board. Criteria for exclusion were elderly people with orthopedic or neurological disorders which prevent them from walking without aids or pressing the buttons on the interface, with visual deficiencies that prevent them from perceiving information on the screen, or with cognitive impairments that prevent them from understanding the instructions. The local Medical Ethics Committee approved the study, and all subjects signed an informed consent form.

Instruments

A balance-training device was used which integrates video gaming with balance control on a moveable platform (SensBalance Fitness Board; Sensamove®, the Netherlands). The SensBalance Fitness Board consists of a moveable platform, a touch screen, a computer and a safety rack around the platform to hold on. The touch screen (19-inch) is located at a height of 135 cm on a platform with a 54 cm horizontal distance from the middle and is tilted at an angle of 30 degrees. The platform (60 cm diameter) has a standard height of 20 cm and can turn over 20 degrees in all directions. The computer is built in at the front of the apparatus under the cap, and is activated with an on/off button. The safety rack contains two bulwarks with a silicone grip at a height of 115 cm and 100 cm. Sensors measure the acceleration of the moveable platform; this signal is used to interact with a video game and provides real-time feedback showing balance performance on a screen in front of the participant in the form of a labyrinth or maze game. While standing on the unstable platform, every small movement of the participant will displace the platform and perturb the balance system. When the platform is perfectly balanced the maze is horizontal and the ball lies still. By subtly shifting weight on the balance board peo-

ple can tilt the maze presented on the screen and a virtual ball can be moved through the maze to a target hole. The sample frequency of the feedback display is 25 Hz.

Procedures and Intervention

To examine the effect of the balance exercise intervention subject data were analyzed with an interrupted A1BA2 time series design. A baseline phase (A1) was followed by an intervention phase (B), and followed again by a period of no intervention (delayed phase; A2). This single subject design makes the participant serve as his or her own control, since the performance prior to the intervention is compared to the performance during and after the intervention. The baseline phase and the delayed phase lasted three weeks and each week two assessment sessions took place in which a balance test was administered. The intervention phase included a six-week exergaming training program on the Sens-Balance Fitness Board, consisting of a 20-minute training session three times a week. In addition, during the intervention phase one assessment session per week was performed before a training session in which the balance tests were administered.

The training was performed individually in the meeting room of a nursing home under the supervision of a researcher who did not provide any additional feedback. During the first intervention session the basic level (training games) was used. In the following sessions, similarly to regular computer games, the program was adjusted to the participant's level by increasing the difficulty of the gaming level (Figure 1). These individual training adjustments ensured that the training was challenging for all individual participants during the whole program. In the easiest training level the game only required movements on the board in one direction: forward, backward or lateral displacement. With increasing difficulty, the game required postural movements in all directions, making the control more complex. A game was successfully completed when the ball fell in the hole. After completing all three levels, further challenges were made through increasing the gain of the apparatus, requiring that the participant made smaller and more precise movements to generate the same outcome on the screen as with the lower gain.

Balance performance was quantified using the figure-of-eight test, the Berg Balance Scale (BBS) and the tandem and one-leg stance, both performed with eyes open and closed. The figure-of-eight consists of two sets of

Figure 1. Examples of games with different levels of difficulty. By shifting their weight on the balance board the participant had to move the ball throughout the maze.

two circles, the inner with a diameter of 1.50 m, the outer with a diameter of 1.65 m. The participant was told to walk in the space between these circles without touching them. The time, measured in seconds, needed to walk twice through the eight at a comfortable speed without stopping was recorded (Hess, et al., 2010).

The BBS is based on 14 items common to daily life activities to evaluate functional balance (Berg, et al., 1992). The maximum score that can be achieved is 56. A short version of the FICSIT-4 was used that assessed the ability to maintain balance (in seconds) for a maximum of sixty seconds in (1) tandem stance with eyes open, (2) tandem stance with eyes closed, (3) one-legged stance with eyes open, and (4) one-legged stance with eyes closed (Rossiter-Fornoff et al., 1995). All tests were administered according to a standardized protocol.

Statistical Analysis

Changes in balance performance were investigated using multilevel modeling (MLwiN-package), which is an extension of multiple regressions. For longitudinal data, multilevel modeling is a strong statistical analysis capable of explaining different sources of variance in the data. In general, the coefficients in multi-level models are calculated by means of computational estimation procedures, such as Iterated Generalized Least Squares (IGLS) (Goldstein, Browne, & Rasbash, 2002).

In the present study a two-level hierarchical structure was made with the participants' individual measurements defined as level 1 (L1) nested within the individual participants, who represent level 2 (L2). Multilevel models consist of a fixed part which describes the average curve (the underlying population trend on the balance tests), and a random part which models the variation around the mean of the balance tests due to the time of measurement and due to individual differences. First, the effect of the grand mean that underlies all observation of the balance test is determined (the empty model). The intercept refers to the initial level of the dependent variable. Subsequently, the parameters for in-

dividual participants are randomly set, and the new regression model encloses the estimates of the differences between the means of the participants, with different intercepts for the participants while the slope stays the same in this model. The statistical significance of the model is judged by the change in the consistency of the model to the data measured by the change in the model's log likelihood ratio from the previously (empty) model. The likelihood ratio test statistic is computed as -2 log L1 – (-2 log L2) which under the null hypothesis follows a chi-squared distribution with the difference in the number of parameters between the two models as degrees of freedom. By comparing the deviance of the model with that of the empty model, the model fit is evaluated, then the effect of the intervention on balance performance is analyzed. Measurements of the baseline phase are compared with those of the intervention and delayed phase. The intervention variable is added as an exploratory variable to the model; if the model is significantly improved, the intervention has influence on the balance performance. Finally, the estimates are completed with the variance and co-variance between the participants for the different phases. The model now has an intercept and slope that is different for the baseline, intervention and delayed phase, but stays the same for all participants. To further improve the model the intercept and slope for the intervention and the delayed phase can be set randomly, and for both steps the model has to be controlled for a significant improvement. This last model has different intercepts and slopes for the phases and participants. By comparing the deviance of the final model and the empty model, the model fit is evaluated. Level of significance was set at $p<0.05$.

Results

Tables 1 and 2 show the model variables for the multilevel models made for the figure-of-eight, the BBS and the tandem and one-leg stance.

First, the intercept could be included in the random model, because the participants differed from each other at the start of the program. By including the phases as a category variable the model significantly improved for both the figure-of-eight and the BBS, implying an overall significant effect of phase on the balance tests. The time necessary to complete the figure-of-eight test decreased during the program, and the score on the BBS increased. Next, the model improved significantly by making the slope random for the intervention, and the delayed phase in the figure-of-eight and the BBS. The models revealed that participants had a different intercept and slope, meaning that they started at a different level and improved at a different rate.

The relationship between the baseline phase and the two other phases, represented by the covariance, revealed that participants with the worst scores – high intercept for the figure-of-eight and low for the BBS at the start of the program – had a steeper slope during the exercise program, and negative for the figure-of-eight and positive for the BBS. The lowest scoring participants at the start of the program improved more across time than the highest scoring participants at the start of the program (see Figure 2).

The models of the other balance tests, i.e., tandem and one-leg stance with eyes open and closed, significantly improved when the intercept was randomly set (Table 2).

The participants had a different mean score for the tandem and one-leg stance tests. The models did not significantly improve when the intervention was added to the models, implying no significant intervention effect on these test scores. However, for the tandem stance with eyes open and closed the models improved by adding the intervention and setting the delayed phase to random for the participants. There was a small improvement during the program and in the delayed phase, particularly, the participants scored better on the tandem stance with eyes open and closed.

Discussion

The aim of the present study was to examine the effect of playing an exergame that requires postural control on a moveable platform to improve balance in community-dwelling healthy elderly population. After completing a six-week training program, older adults improved, in particular, on the balance tests with a more dynamic component such as the figure-of-eight and the BBS. Standing balance, quantified by the tandem and one-leg stance with eyes open and eyes closed, was improved, but not significantly, after the exergaming intervention.

Despite the recently increased amount of attention in the gaming industry and media directed at computer games as a form of exercise, evidence for a beneficial effect of exergaming on postural control is still scarce. The present work demonstrates that healthy elderly subjects were able to benefit from a short, intensive exergaming balance program taking individual performance into account.

Table 1
Multilevel models for the figure of eight test (figure-of-eight) and the Berg Balance Scale (BBS). For the fixed effects of the model the coefficients (Coeff) are given, for the random effects the variance are given (SE = standard error).

	Model figure-of-eight		Model BBS	
Fixed effects	**Coeff**	**SE**	**Coeff**	**SE**
Baseline	21.90**	3.32	54.20**	0.73
Intervention effect	-2.27**	0.87	0.56**	0.16
Delayed effect	-3.01**	1.07	0.91**	0.28
	Variance	**SE**	**Variance**	**SE**
Random between subject effects				
Variance around the intercept	98.60*	46.80	4.68*	2.23
Intervention effect	5.66*	3.25		
Delayed effect	8.96*	4.82	0.48	0.31
Relationship baseline level and intervention effect	-24.40*	12.10		
Relationship baseline level and delayed effect	-27.90*	15.50	-1.57*	0.80
Relationship intervention and delayed effect	7.17*	3.81		
Random within subject effects				
Within participants	3.62**	0.45	0.68**	0.08
Deviance statistics				
Empty model	1,117		685	
Final model	696		420	

* $p<0.05$, ** $p<0.01$

Balance improvement was demonstrated by a decrease in performance time for the figure-of-eight and an increased score on the BBS in the healthy elderly subjects who participated in the exergaming training. The figure-of-eight and the BBS evaluate the ability to maintain postural stability while performing challenging activities with a dynamic component. An improvement in the performance on these tests indicates that participants have more confident postural control while testing the limits of their stability, and presumably improved their functional abilities as well.

We did not observe a significant improvement in the outcome variables that describe performance in the more static standing balance tests. Only a small effect was seen in the tandem stance with eyes open and closed. The lack of significant effects on the tandem stance and one-leg stance in this study might be related to the relatively short duration of the exergaming training (Hackney & Earhart, 2008). However, the smaller positive effect of our exergaming training seen in standing balance tests, compared with dynamic tests, may be indicative of the specificity of the training effect, in that exergaming training particularly improved balance control the most. These results are in line with those reported in an earlier study where elderly subjects completed a 10-week training program consisting of two 30-minute sessions per week, with augmented visual feedback on the movements of the center of pressure on a stable force platform while performing exercises. The older adults predominantly improved their balance in activities

Table 2
Multilevel models for the tandem and one-leg stance with eyes open (EO) and eyes closed (EC). For the fixed effects of the model the coefficients (Coeff) are given, for the random effects the variance are given (SE = standard error).

	Model tandem EO		Model tandem EC		Model One-leg stance EO		Model One-leg stance EC	
Fixed effects	**Coeff**	**SE**	**Coeff**	**SE**	**Coeff**	**SE**	**Coeff**	**SE**
Baseline	48.50**	4.27	14.60**	2.61	33.20**	7.66	4.32**	0.753
Intervention effect	4.04*	2.42	1.24	2.68				
Delayed effect	4.54	3.46	3.36	4.75				
	Variance	**SE**	**Variance**	**SE**	**Variance**	**SE**	**Variance**	**SE**
Random between subject effects								
Variance around the intercept	138.00*	71.5	25.30	20.70	523.00*	249	4.60*	2.41
Delayed effect	-70.50	48.8	8.22	30.30				
Relationship baseline level and delayed effect	53.8	45.0	127.00	87.80				
Random within subject effects								
Within participants	155.00**	18.7	217.00**	26.10	77.5**	9.05	8.61**	1.00
Deviance statistics								
Empty model	1,317		1,328		1,441		847	
Final model	1,256		1,303		1,164		799	

* $p<0.05$, ** $p<0.01$

with a dynamic component such as reaching, turning, stepping and walking. On the contrary, postural sway during quiet stance did not improve (Bisson, et al., 2007).

Positive effects of using enhanced visual feedback on the center of pressure in learning to maintain balance in functional activities with a more dynamic component (the BBS) were also reported in a study examining the effects of four-week visual feedback based balance training program on postural control of frail elderly women living in residential care homes. After the training, large improvements were seen in controlling the center of pressure on the force platform, but also on the BBS, indicating improvement in the performance of functional activities (Sihvonen, Sipila, & Era, 2004a).

Contrary to our findings, an improvement in standing balance after a dynamic exercise intervention has been reported in stroke patients (Leroux, Pinet, & Nadeau, 2006). In community-dwelling elderly people with a lowered ability to maintain balance who participated in an eight-week intensive tai chi training program, a significant improvement for the one-leg stance compared to the control group was found (Zhang, et al., 2006). Both studies, however, were obtained in elderly populations with a reduced physical fitness, while the participants in the present study were healthy elderly subjects with good levels of physical fitness.

By means of a multilevel hierarchical analysis, it was shown that the lowest scoring participants at the start of the program improved the most during the intervention and delayed phase. This could be taken to imply that there was room for improvement, especially for the lower scoring participants, but not as much as in patient groups or frail elderly participants, for example.

The results of the present study provide further evidence that videogame-based exercises controlled by shifting weight on a moveable platform can have a positive effect on balance, especially in tasks that require postural control during challenging activities with a dynamic component.

The exergame that the elderly participants played required both goal-directed voluntary movements and corrective balance reactions in order to guide the ball along a desired path – a pathway that changed according to the game's demands. The tilting maze on the screen represented the movements of the platform and provided the learner with instantaneous augmented visual feedback. It has been observed that augmentation of the center of pressure by visual information increases postural stability in healthy young controls during quiet stance (Dault, et al., 2003), but more importantly, earlier studies have shown the importance of vision for elderly subjects in learning how to produce effective postural responses (Hatzitaki, et al., 2009; Sihvonen, et al., 2004b). The exergame also utilizes multitasking, which might be important for motor learning in elderly users (Lamoth, et al., 2011). Playing the balance exergame requires the control of body movements in combination with gaze control in order to quickly react to events and attention to game play strategy. Another advantage is the positive reinforcement provided by feedback on performance and goal attainment which might also serve as a tool to improve postural control. Vision provides the necessary information to navigate effectively through the world (Sturnieks, et al., 2008). Sensory information from receptors in the lower limbs contributes to standing balance. In general, proprioception degrades with age and vision becomes progressively worse (Sturnieks, et al., 2008). Overall, playing a dynamic balance exergame at a sufficiently intensive level for six weeks can facilitate the learning of balance skills in healthy elderly users.

High drop-out rates, low adherence to the exercise programs, and the need for more intense individually-tailored training programs could be the reason some balance programs fail to show positive effects (Nowalk, et al., 2001; Sihvonen, et al., 2004b). Individualized specifically targeted training may seem to demand a large amount of resources, but positive effects can be achieved in a short period of time. New equipment, such as the SensBalance Fitness Board, seemed to motivate older people and their adherence rate throughout the program remained high. Identifying their own capabilities and limitations by means of individualized balance training may also help users overcome fear. Also, previous research showed that using an exergaming system improved enjoyment and dynamic postural control on a case study basis in patients with neurological impairments (Betker, et al., 2006). Increased level of interest and enjoyment can be shown by the participant's focus shifting from simply producing the required movement to playing the game and overcoming the challenge provided by the achievement to completing the game level (Fitzgerald, et al., 2010).

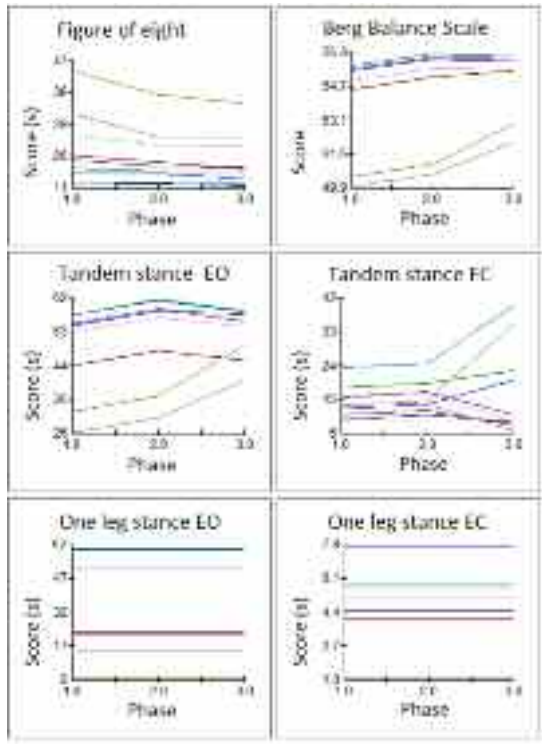

Figure 2. The best-fit models for the balance test. Lines represent the data for the individual subjects. On the x-axis the phases are given: 1 = baseline phase; 2 = intervention phase; 3 = delayed phase.

A limitation of the study is that, although we applied a design and statistical method suitable to analyze small sample sizes, the relatively small healthy group may limit the generalization of the results to different elderly populations such as frail elderly people or elderly people with a high risk of falling. However, despite the small group, we did find significant results and it is encouraging that this kind of intervention can be successfully implemented among healthy elderly users to train balance in the form of prevention programs.

In conclusion, the results of the present study show that healthy elderly users can benefit from exergaming. This study showed that older adults were able to improve their functional balance due to an intervention using visual feedback on postural control.

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Annual Review of Cybertherapy and Telemedicine 2011

Advanced Technologies in the Behavioral, Social and Neurosciences

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

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

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

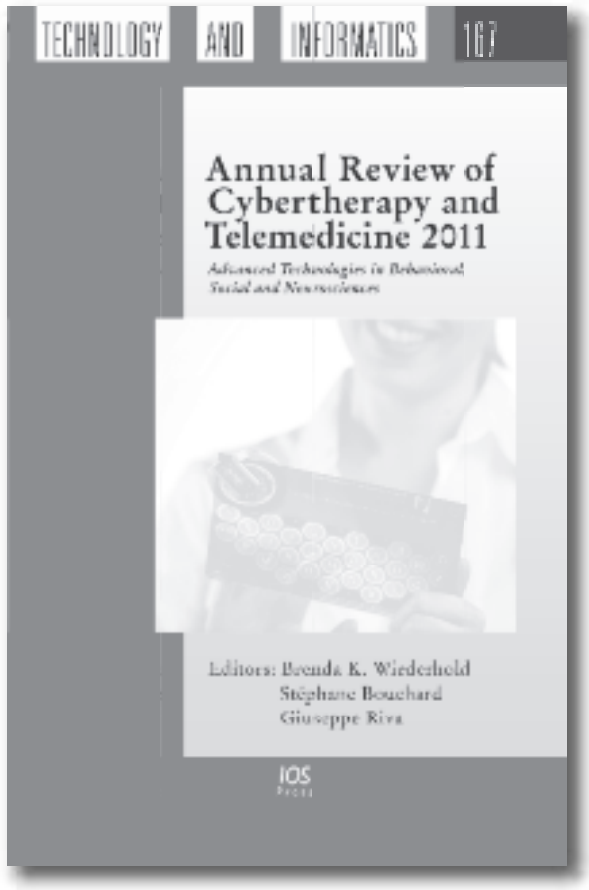
Healthcare systems focus on meeting the needs of patients. Achieving cybertherapy's potential, therefore, depends on patients being convinced of its ability to satisfy their healthcare needs. Acceptance by patients depends crucially on acceptance by the health professionals treating them, given the high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

Contents:
• Critical Reviews summarize and evaluate emerging cybertherapy topics, including Interreality, CyberAddiction and Telemedicine;

• Evaluation Studies are generally undertaken to solve some specific practical problems and yield decisions about the value of cybertherapy interventions;

• Original Research presents research studies addressing new cybertherapy methods or approaches;

• Clinical Observations include case studies or research protocols with a long-term potential.



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CYBERPROJECTS

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

DECODER : Deployment of Brain-Computer Interfaces for the Detection of Consciousness in Non-Responsive Patients

Project Objectives:
The deployment of Brain-Computer Interfaces (BCIs) for non-responsive patients will provide access to modern information and communication technologies (ICTs) such as the Internet, personal computer or home appliances when only a single response of a person is available. In this extreme case, no current assistive technology can help the patient interact with the environment. This situation poses serious ethical issues, since medical treatment can prolong the patient's life, but leave them in a state of unacceptable quality of life.

DECODER will develop a BCI into single-switch based systems to practically enhance inclusion of patients who are otherwise only hardly able, or not at all able, to interact with their environment and share ICT. This achievement will build on the improvement of three components of state-of-the-art BCIs, i.e., signal acquisition (input), signal classification and signal translation (output) and adapt them to the specificities of non-responsive patients such as low arousal, short attention span, and altered electrical activity of the brain. A fourth component is the application; existing assistive technology will be adapted to a single-switch control.

Besides classic EEG paradigms near-infrared spectroscopy will be used for signal acquisition due to its higher spatial resolution. Potential and automated software will identify the best signal for each user and will optimize signal translation. Prior to providing such patients with ICT an unequivocal diagnosis is of utmost importance to define the most appropriate *rehabilitation* strategy and most suitable supportive technology for interaction.

A hierarchical diagnostic approach starting with a simple presentation of stimuli to intentional control of BCI will be developed, validated and disseminated. By implementing existing well-established and currently developed tools at all levels of BCI and bringing together a multidisciplinary team we can ensure the achievement of the goals of DECODER.

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Istituto Auxologico Italiano
Data provided by ICT Results
(http://cordis.europa.eu/ictresults)

CYBERFOCUS

New technologies are developing at a rapid pace. To help you stay abreast of the latest trends in advanced technologies and healthcare, this feature showcases upcoming 2011 events which will provide you with the opportunity to connect with leading experts worldwide and remain on the cutting edge of the most recent developments.

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

CyberPsychology & CyberTherapy[17]: Experience the Future of Health & Well-Being
September 12-15, 2012
Brussels, Belgium
www.interactivemediainstitute.com

The Journal of CyberTherapy & Rehabilitation is the official journal of the CyberPsychology & CyberTherapy Conference (CYBER[17]). CYBER[17] brings together researchers, clinicians, policy makers and funding agents to share and discuss advancements in the growing discipline of CyberTherapy & Rehabilitation, which includes training, education, prevention, rehabilitation, and therapy. The conference will continue to focus on technologies as enabling tools as well as the impact of new technologies on behavior and society. We will continue to explore the uses of advanced technologies such as Virtual Reality simulations, videogames, telehealth, video-conferencing, the Internet, robotics, brain computer interfaces, wearable computing, mobile computing, and non-invasive physiological monitoring devices, in the diagnosis, assessment, and prevention of mental and physical disorders as well as assessment of interactive media in training, education, rehabilitation, and therapeutic interventions. We will, however, embrace as we did this year, the exploration of social networking tools on individual behavior and societal relations.

American Psychological Association Conference 2011
August 4-7, 2011
http://www.apa.org/convention/
Washington D.C., U.S.A.

SIGGRAPH 2011
August 7-11, 2011
http://www.siggraph.org/s2011/
Vancouver, Canada

11th International Conference on Intelligent Virtual Agents (IVA 2011)
September 15-17, 2011
http://iva2011.ru.is/
Reykjavik, Iceland

Joint Virtual Reality Conference 2011
September 20-21, 2011
http://www.nottingham.ac.uk/jvrc2011/
Nottingham, UK

AAL Forum – September
September 26-28, 2011
http://www.aalforum.eu/
Lecce, Italy

14th European Health Forum Gastein
October 5-8, 2011
http://www.ehfg.org/
Bad Hofgastein, Austria

Games for Health Europe
October 24-25, 2011
http://www.gamesforhealtheurope.org/
Amsterdam, Netherlands

Association for Behavioral and Cognitive Therapies (ABCT 2011)
November 10-13, 2011
http://www.abct.org/Conv2011/
Toronto, Canada

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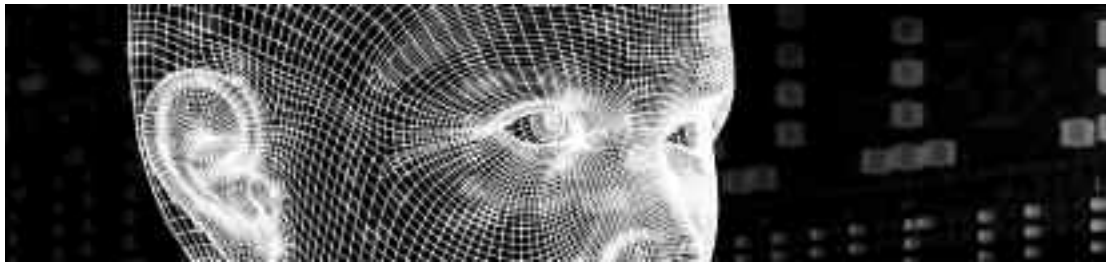
mHealth Summit 2011
December 5-7, 2011
http://www.mhealthsummit.org/
Washington D.C., USA



FOR AUTHORS

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All pages (except figure pages) should be numbered in sequence, starting with the title page.

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True North Logistics Headquarters
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While TNL is a new company, in name only, individuals on the TNL team have over 100 years of industry experience in distribution management and commercial real estate development.

• *Tom Glisson* – Lieutenant General (Ret.) US Army. Former Director of the Defense Logistics Agency, and independent consultant.
• *Dennis Gilhooley* – Former Associate Partner at IBM Consulting and Logistics Director at Zenith Electronics.
• *Steve Kozarits* – Commercial Real Estate Investment/Development Executive with a focus on industrial properties.

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BOOK REVIEW

***Technology and Psychological Well-being*, edited by Yair Amichai-Hamburger, Cambridge University Press, New York, New York, 2009, 287 pages, $39.99**

Composed of articles by a stellar array of authors, *Technology and Psychological Well-being* seeks to create a greater comprehension and awareness of technology's connection with psychological well-being. Issues related to psychological well-being are conveyed through research spanning areas such as Internet communication, medicine, commuting, workplace, and subsistence technology, often through an important and very welcome historically conscious lens.

In Chapter 1, Rodman and Fry begin the book by arguing for a midpoint or *golden mean* (where benefits are optimized) in viewing technology's connection with our psychological well-being. Thus, the authors argue for a so-called "Yin" and "Yang" perspective that values the tension and harmony of opposing extremes. There is a need to see how both positive and negative effects of technology (e.g., improving local/global connectedness and social networks vs. causing isolation, narcissism, and anxiety) work together. These arguments are made amidst the umbrella of a compelling historical examination that is both conscious and sensitive to how both the concept of psychological well-being and communication technologies have shifted throughout history (e.g., connecting oral tradition epoch with social connectedness, and the first notion of individuality and privacy upon the invention of the written word). The next half of the chapter introduces research from a social science, media effects perspective of ongoing debates regarding media addiction, parasocial relationships, and the benefits and concerns of modern communication technologies.

Adding to this discussion, Amichai-Hamburger and Barak proceed to ambitiously survey the role of the Internet environment on the psychological well-being of Internet users in Chapter 2. The authors explore the Internet's environment (e.g., anonymity, diminution of the importance of physical appearance) and its impact on *relating* whether between therapist/client via online counseling, or with online groups formed through similar needs (e.g., support, treatment groups). Implications regarding the role of "control" (or lack of), privacy, and forming multiple selves in one's motivations to meet and/or interact with others on the Internet is discussed, as are the Internet's impact on children, adults and the elderly.

In Chapter 3, Goldman returns to a historically conscious approach evident in the book's first chapter, issuing a call to specificity in our critical evaluation regarding (mis)conceptions of "information." Through a compelling survey of the "evolution" of information throughout history (e.g., from books through printing press to blogs and other Web site content), Goldman contends how information must be seen in three different forms: as "content, content-independent theory, and as an elementary feature of physical reality." Thus, our technologically saturated lives are mostly "evolutionary" products of history, while the only true "information revolution" in the 21st century concerns "information-as-content" (e.g., through E-mails, blogs, social networking). Goldman contends that we must holistically compose different factors (e.g., interactive/shared information, human value judgments, social change) in order to effectively evaluate the costs (e.g., possible personal dislocation in pursuit of information freedom) and contributions (e.g., new relationships, virtual communities) of a world where the psychological reality of life is inseparable from modern technologies.

Chapters 4 through 7 continue the discussion of psychological well-being in the context of work. In Chapter 4, O'Driscoll, Biron, and Cooper report how the impact of increasing information and communication technology (ICT) development for workplaces can contribute to "technostress" of its workers, involving conditions such as anxiety, frustration attributions (due to feeling lack of control), and low self-efficacy. Recommendations offered include enhancing perceptions of control, and the training, development, and application of ICT-related skills that can assist worker's coping skills. Oron-Gilad and Hancock argue in Chapter 5 that while ergonomics is already receiving the primary attention in workplaces due to their serving foundational needs such as safety and functionality, there is a need for industries to "turn" also towards *hedonomics*, which promotes pleasurable experiences, usability and individuation, providing workplace designs that serve the unique needs of the single user as well as

fulfilling their psychological needs. In Chapter 6, Kossek, Lautsch, and Eaton discuss *teleworking* and challenge commonly idealized myths such as benefits like flexibility. Due to costs such as distractions from home life, temptations to overwork at home, and misperceptions by friends of the teleworker's constant availability, flexibility is not necessarily as beneficial as was hoped for. Job control is vitally important in these contexts for psychological well-being, but is affected by one's sense of autonomy, location, timing and work processing, which affects the degree of positive or negative effects on work-home conflicts. Novaco and Gonzalez focus on work travel in Chapter 7, discussing commuting stress via driving (e.g., road congestion) or public transport (e.g., full buses/trains, waiting times) and how different factors such as the environment (e.g., heat, weather, noise), negative emotions and stressful life events (e.g., home conflicts) can moderate one's degree of stress in commuting. In contrast, authors suggest that benefits of commuting involve perceiving it as an opportunity for relaxation, social networking, or an act symbolic of freedom, privacy, or "protected time" for oneself apart from one's burdens and commitments.

Shifting from work to the medical field, Jutai, Coulson, and Russell-Minda review different studies related to medical technology in Chapter 8, especially assistive technologies related to mobility and vision for people with disabilities in relation to "Quality of Living" measures. Their conclusions suggest that using assistive devices does not automatically presume an improved "quality of living" (even if the device fulfills its mandate). For example, medical equipment certainly may prolong one's life (e.g., dialysis life support), but may fail to necessarily provide improvements in quality of living, since such assistance comes with a decreased ability to "participate in society" – a key factor that directly affects one's psychological well-being.

In an illuminating Chapter 9, Blumberg discusses the significance of females/women's relationship with subsistence technologies throughout history. Blumberg challenges misperceptions regarding patriarchal dominance in technological development, and instead empowers women by revealing their historically superior role in subsistence technology innovations. For instance, she cites the "baby-carrying sling" as an essential technology invented by women to survive humanity during foraging culture (e.g., 10,000-12,000 years ago), and follows by emphasizing women's innovations in "horticulture." Blumberg further argues that women's roles continue to be vitally important and necessary in ongoing technological advances for society's health (and thus each person's psychological well-being) as it transitions to the next technological "era."

Finally, in Chapter 10, Amichai-Hamburger emphasizes technology's neutrality, calling for "leadership in the form of *ethical* standards or "lighthouse values" that can contrast society's capitalist values. Such societal values can overstate the importance of individuality, mass consumption, and "time equals money" mentality, which can lead to conditions such as lower self-esteem, burnout, decreased empathy, and other factors compromising psychological well-being. In contrast, lighthouse values central to well-being and positive potential include autonomy, competence, relatedness, self-esteem, and critical thinking as fundamental needs and motivation.

Readers new to these areas of research or experts interested in expanding their areas of knowledge concerning the historical and contemporary issues of technology's impact on psychological well-being will find this book a helpful resource and reference. However, the very strength of this book's ambitious scope makes it impossible to provide an in-depth critical review on *every* issue. Thus, some chapters may disappoint some psychological practitioners and theorists/researchers looking for a more critical review or analytical depth on some issues of interest concerning psychological health. Thankfully, most of the chapters are structured with a compelling *historical* consciousness, providing enough of a refreshing historical background and relevant *context* to the implications of psychological well-being that forgives the other inadequacies. Despite its limitations, the greatest strength of *Technology and Psychological Well-being* is its presence as a *whole*, or a *collection* of works. Thus, the value of its contribution must be seen in the context of its entirety, in order to fully appreciate its ambitions and goals to inform greater awareness and understanding, while introducing tools that can bring an ethical intention for technology and its impact on psychological well-being. In this regard, the book as a whole achieves its ambition, making it well worth reading for readers from all backgrounds.

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Instructions for Continuing Education Quiz
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Evaluation
Please rate this article, "Trauma TIPS: an Internet-based Intervention to Prevent Posttraumatic Stress Disorder in Injured Trauma Patients" (Mouthaan et al., pg. 331), on a scale of 1 to 5 (1=true, 5=false).
_____The information in this article was presented well
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CONTINUING EDUCATION QUIZ

Prepared by Christina Valenti

Trauma TIPS: an Internet-based Intervention to Prevent Posttraumatic Stress Disorder in Injured Trauma Patients (Mouthaan et al., pg. 331)

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

1. All of the following were adjustments made to the Trauma TIPS intervention after the completion of the pilot study, EXCEPT:
a) The 20-item State Trait Anxiety Inventory (STAI) was replaced with a single item Visual Analogue Scale (VAS)
b) During the relaxation exercises, the voice-over was changed to a more neutral voice
c) The intervention was changed from a 30-minute program to an hour-long program
d) Technical difficulties were addressed and eliminated to minimize any inconvenience for future participants

2. Based on the limitations of this particular study, what was stated to be a priority to assess at later points in time?
a) To start the intervention within one week after a traumatic experience
b) To examine the long-term psychological effects of the intervention
c) To test only men with low levels of psychological distress
d) To test only men with high levels of psychological distress

3. Most participants in the study felt that the 20-item STAI, which was used to assess state anxiety online, was:
a) Too short
b) Irrelevant based on the intervention
c) Acceptable based on length and the variety of questions asked
d) Too long to complete twice immediately before and after the intervention and consisted of too much overlap between the questions

4. Which of the following is not a subscale of the Impact of Events Scale-Revised (IES-R) questionnaire used for assessing posttraumatic stress symptoms?
a) Avoidance
b) Intrusion
c) Hyperarousal
d) Depression

5. What is the most frequently applied early psychological intervention?
a) Group therapy
b) Weekly Virtual Reality Cognitive Behavioral Therapy for one month following traumatic experience
c) Single-session psychological debriefing
d) Eye Movement Desensitization and Reprocessing (EMDR)

6. Which of the following are elements consistent with "psychological first aid"?
a) Providing information about various available care options
b) Providing psychoeducational materials about normal reactions to trauma
c) Providing psychoeducational materials about abnormal reactions to trauma
d) All of the above

7. The Trauma TIPS intervention is targeted at decreasing acute psychological stress reactions in traumatic injury patients within:
a) The first week following injury
b) The first month following injury
c) The first six months following injury
d) The first year following injury

8. Which of the following were the main cognitive behavioral elements of the intervention?
a) Information/psychoeducation, social support, and stress management
b) Modeling and in vivo exposure
c) Both a and b
d) None of the above

9. Future early psychological intervention programs in trauma populations should focus on:
a) Increasing hyperarousal
b) Reducing hyperarousal
c) Eliminating arousal
d) Sustaining arousal

10. Which of the following is true of the cognitive behavioral element, modeling, that was incorporated as a section in the intervention?
a) In this section, participants met face-to-face with other trauma victims who had overcome PTSD
b) It contained elements of in vivo exposure
c) The participants watched three videos of actual trauma victims explaining their injury and how they coped physically and psychologically after the incident
d) All of the above

11. *The results of the Internet-based intervention show that:*
a) The intervention had no immediate adverse psychological reactions for the patients or the control subjects
b) The participants showed satisfaction with the end product
c) The intervention was feasible and acceptable, and that individual sections and steps within the program were clear and useful
d) All of the above

12. The Trauma TIPS Internet-based early intervention program for injured trauma victims aimed to:
a) Reduce acute hyperarousal and anxiety symptoms so that long-term PTSD will be less severe
b) Prevent acute hyperarousal from developing before the onset of PTSD
c) Heighten arousal early on so that PTSD symptoms peek and then drop drastically afterwards, reducing the chances of long-term PTSD
d) Reduce acute hyperarousal and anxiety symptoms to prevent the development of long-term PTSD

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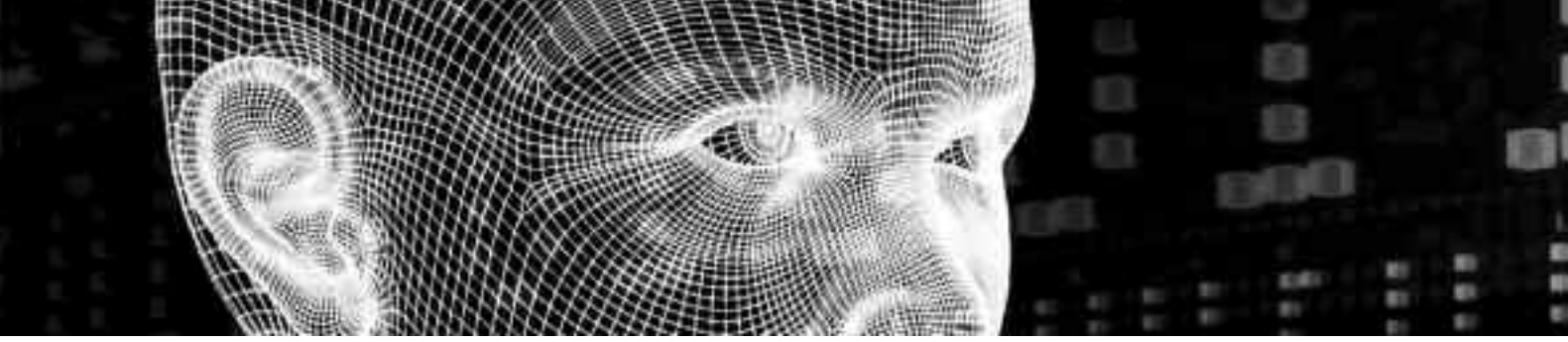

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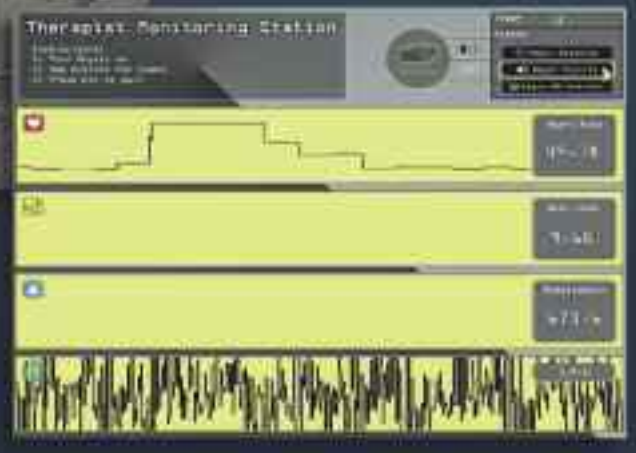

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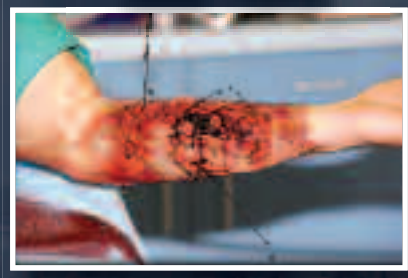

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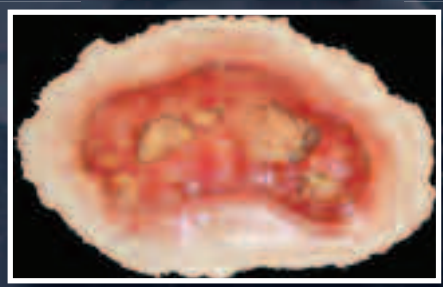

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