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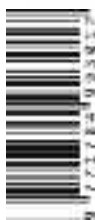
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# JOURNAL OF CYBERTHERAPY & REHABILITATION

Volume 5, Issue 1, Spring 2012



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- Fun and Entertaining
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- Rapid Recovery
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Interreality in the Management  
and Treatment of Stress-Related Disorders

INTERSTRESS  
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**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

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- 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
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  - 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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## AMBIENT ASSISTED LIVING: A CALL TO SPEED RESEARCH AND IMPLEMENTATION

As defined by the European Commission, ambient assisted living (AAL) “refers to intelligent systems of assistance for a better, healthier, and safer life in the preferred living environment and covers concepts, products, and services that interlink and improve new technologies and the social environment. It aims at enhancing the quality of life (the physical, mental, and social well-being) for everyone (with a focus on elder persons) in all stages of their life. AAL can help elder individuals to improve their quality of life, to stay healthier and to live longer, thus extending one’s active and creative participation in the community.” AAL relies on Ambient Intelligence (AmI) to ensure that devices are noninvasive or invisible, personalized to the user’s needs, adaptive to the user and the environment, and anticipatory of the user’s wishes. Its roots are in assistive technologies for people with disabilities, and in accessibility requirements for interactive technologies (e.g., Section 508 Web site requirements in the U.S.).

The impetus for accelerated AAL research and implementation is our elders, who live longer and can remain in their homes longer with the assistance of technology, thereby preventing costly hospitalizations and nursing home admissions. The number of older people worldwide has tripled in the last 50 years, and will more than triple again in the next 50 years.

A recent literature review categorizes AAL into services that handle adverse conditions, assess health state, consult and educate, motivate and provide feedback, facilitate ordering of service, and promote social inclusion. AAL devices use sensors and actuators in the home environment to, for example, detect falls in elders or spikes in blood sugar of people with diabetes, and fuse data to trigger caregiver alerts. Other systems of interest to our readers include those designed to help people who have mild cognitive impairments with activities of daily living. Most challenging to develop are pattern recognition applications that can, for example, sense an elder’s behavior change and prevent depression by motivating the elder to socialize.

Both Virtual Reality and mixed reality (augmented reality and augmented virtuality) environments for AAL have been proposed. For example, in an extension of the current boundaries of telemedicine, the physician could view the whole body of the at-home patient, and the patient could more easily understand (s)he was undergoing a physical examination. At least one paper reports elders’ positive reactions to AAL, so this scenario may not be far in the future.

However, a recent issue of ERCIM News highlighted the fundamental research challenges that remain in AAL and AmI:

- “Knowledge of user requirements. Age-related factors are crucial, and the current understanding of the interaction requirements of older users in complex technological environments is limited.
- Ready-to-use accessibility solutions supporting alternative interaction techniques. Most available assistive technologies are limited to specific devices, and cannot be easily made compatible with complex environments including a variety of devices.
- Architectural frameworks supporting the integration and management accessibility solutions.
- Tools supporting the development lifecycle of accessible AAL environments (e.g., requirements analysis, design and prototyping, evaluation).”

We applaud the clinicians and researchers who are working to solve AAL and AmI research problems, and look forward to the day when smart homes for our elders are the norm.

Brenda K. Wiederhold, Ph.D., MBA, BCIA  
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# ANONYMITY AND LEVEL OF SUPPORT GIVEN ON A HEALTH-RELATED ONLINE SUPPORT FORUM

Rachel Venner<sup>1</sup>, Niall Galbraith<sup>1</sup> and Chris Fullwood<sup>1</sup>

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**Social Identity of Deindividuation Effects (SIDE) Theory (Spears & Lea, 1992) predicts that in online communities comprised of both identifiable and anonymous individuals, the latter will use the group for their own aims before those of the collective. In line with SIDE theory, we examined whether level of support on a social support thread for epileptics or parents of epileptics varied depending on the whether the individual posting was anonymous or identifiable. In line with predictions, anonymous individuals were less likely to offer support. Moreover, when offered, the degree of support given by identifiable people was greater than that of anonymous individuals. Anonymous people were also slightly more likely to request support from others but this association did not reach significance. The findings are consistent with SIDE theory suggesting that in groups comprising both identifiable and anonymous individuals, the latter will be less likely to offer social support.**

**Keywords:** Anonymity, Support, Epilepsy, Forum, Thread

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## INTRODUCTION

It has been suggested that, in comparison to face-to-face interactions, online communication is more likely to be impersonal and hostile (Kiesler et al., 1984; Kiesler et al., 1985; Suler, 2004). This has been attributed, in part, to the attenuation of physical and nonverbal social cues (e.g., eye contact), which are considered important for communicating emotional and intimacy information (Altman and Taylor, 1973; Whitty, 2002). However, more recently it has been acknowledged that computer-mediated communication (CMC) does present opportunities for the formation of intimate relationships (Whitty, 2002) with no indication that it offers less emotional or personal interaction than face-to-face interaction (Derks, Fischer & Bos, 2008). The Internet is a more egalitarian environment which offers the potential for users to remain anonymous from others in certain online spaces. Furthermore, remaining anonymous may allow individuals to communicate more equally (Christopherson, 2007). Equalization theory (Dubrovsky, Kiesler & Sethna, 1991) suggests that this is because individuals are not being treated differently due to their gender, race, age or ethnicity. However, it has been proposed that even though anonymity within CMC can prevent the communication of a number of social cues, some of them, including those related to social category, can seep through (Spears, Lea, Corneliussen, Postmes & Ter Haar, 2002). Therefore, prejudiced behavior may still occur online (Postmes and Spears, 2002).

Due to these research findings, Social Identity of Deindividuation Effects (SIDE) Theory (Reicher, Spears & Postmes, 1995; Spears & Lea, 1992), a reinterpretation of the deindividuation

theory (Zimbardo, 1969), was put forward to predict why individuals choose to remain anonymous in a CMC environment. SIDE theory has two components – cognitive and strategic. Part of the cognitive component predicts that when all members of a group are anonymous, the strength of the group identity will increase. However, if the group is a mixture of anonymous and identifiable individuals, the anonymous members will identify more strongly with their own personal goals than with the goals of the group. The strategic component of SIDE theory suggests that when individuals become aware of how anonymity can influence communication across the Internet, those individuals will use this knowledge strategically to satisfy their own aims. Hence, members will be more likely to work towards the group's aims if they are either all identifiable or all anonymous (Joinson, 2000; Sassenberg and Postmes, 2002; Spears and Lea, 1994).

In recent years, the number of Internet sites relating to health information has rapidly increased, with many offering communication features to enable support for its members (White and Dorman, 2001). In 2007, 36 million people in the U.S. were members of online support groups (Coulson, Buchanan & Aubeeluck, 2007), providing evidence for the importance of this type of support for people coping with illnesses and stigmatized conditions (Coulson, 2005; Coulson and Knibb, 2007; Winzelberg, Classen, Alpers, Roberts, Koopman, Adams, Ernst, Dev & Taylor, 2003), including carers and parents (Mickelson, 1997). Online health-related support groups eliminate geographical and chronological barriers (Mickelson, 1997) and allow for health disclosures that are less risky than in face-to-face situa-

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tions (Wright, 2000b). It has also been suggested that the popularity of Internet support groups can in part be accredited to the fact that users can remain anonymous from other individuals within the group, something which cannot be associated with equivalent face-to-face support groups (Coulson and Knibb, 2007). Little is known about whether anonymous individuals access Internet support groups more or less compared to people who identify themselves (White and Dorman, 2001; Wright, 2000a). However, a recent study by Fullwood and Wootton (2009) suggests that anonymity is important to some members of online support groups as it may allow them to disclose intimate thoughts and feelings that would be more difficult to discuss if their identity was revealed. With this said, relatively few studies have considered whether anonymity has an impact on the level of support or intimacy offered by users of online support groups to their fellow members (aside from those studies cited above, e.g., Fullwood & Wootton, 2009; White & Dorman, 2001). Therefore, the current study will examine the participation of anonymous and identifiable people in a social support thread (a series of messages that have been posted as replies to each other). More specifically, this study will investigate whether the level of support within each message on a social support thread varies depending on whether the individual is anonymous or identifiable. SIDE theory predicts that when groups contain both identifiable and anonymous members, the anonymous people will be more likely to use the group to meet their own personal aims (Spears & Lea, 1994). Therefore, it is expected that anonymous individuals will be less likely to give support. Secondly, if they do give supportive messages, the *degree* of supportiveness will be less than that offered by identifiable individuals. Finally, it is also predicted that anonymous individuals will be more likely to ask for support than identifiable individuals.

## METHOD

### PARTICIPANTS

The participants were made up of 46 individuals who had posted messages on a social support Web site. Twenty-three of the participants were anonymous and 23 were identifiable. The identifiable group contained 16 females and eight males. The participants were all adults, given that the Web site is primarily for adults with epilepsy or parents of children who have the condition. The Web site is hosted by the Epilepsy Society, a large charity for epilepsy based in the United Kingdom.

### MATERIALS

The messages analyzed formed part of a thread on an epilepsy Web site ([www.epilepsyforum.org.uk](http://www.epilepsyforum.org.uk)) which aims to provide information and support to both parents who have children suffering from epilepsy, as well as individuals who have epilepsy themselves. Although there is a proliferation of similar Web sites relating to many other conditions (see Davison, Pennebaker & Dickerson, 2000), this epilepsy Web site was chosen because of the mixture of identified and anonymous users and because it is typical of a health-related support forum which provides a platform for giving and receiving advice. The Web site has various threads which are primarily for the use of adults

or parents. The thread which has been chosen for this report is a thread entitled "Need a virtual (((((HUG)))))) anyone?" People can use this thread to post supportive messages to anybody who needs it, regardless of whether they are a parent or sufferer. Individuals can use the thread both to receive support and to offer it to others; the thread is specifically designed to provide an overall social support network.

### DESIGN

The participants' posts were classified according to four categorical variables. Firstly, *Identifiable Preference*: all individuals using the Web site had to register with the site and provide a name. Thereafter, all their posts on the Web site were initially labeled with this name. Those who used their own name and/or a picture were classed as identifiable. An individual was classed as anonymous if they used an obvious pseudonym or if they had added words to the beginning or end of their name (e.g., Lord Geoff), as this could potentially indicate the creation of an online character for him or herself. Many individuals registered with the Web site using online names such as this, however, in some cases, when typing their posts they would sign off with just their first name (e.g., Geoff). Therefore, those who signed their posts with just their first name were regarded as identifiable. After rating posts for Identifiable Preference, two independent coders (the first two authors) agreed on all posts.

*Giving of Support*: Here each post was categorized as yes, no, or unable to determine. The giving of support is defined as the offering of caring, belonging, esteem, or assistance to another individual (Coulson et al., 2007) and this could be in the form of prose and/or pictorial representations. Posts containing the minimum social expectancy of this thread: "hug" were classed as giving support. Again, two coders achieved good inter-rater reliability ( $\kappa=.8$ ).

*Level of Support* was coded as one of five categories: 1. Both personalized and comforting; 2. Personalized (but not comforting); 3. Comforting (but not personalized); 4. A virtual hug whereby the post simply contained the word "Hug"; and 5. None. The social expectancy of this thread was to provide a "hug" to another as a means of support, therefore, if an individual had provided more than expected within their post, it was rated as providing a higher level of support. Two independent coders reached good inter-rater reliability ( $\kappa=.8$ ).

*Requesting Support* was coded as one of three categories: yes, no, or unable to determine. Requesting of support was defined as an individual asking directly for support, or indirectly, where statements referred to feeling unhappy. Requests could be in prose form or pictorial. Two independent coders achieved strong inter-rater reliability ( $\kappa=.9$ ).

### PROCEDURE

The Web site ([www.epilepsyforum.org.uk](http://www.epilepsyforum.org.uk)) was first accessed on July 27, 2009 and last accessed on July 31, 2009. Starting from the first post on the thread, the names of posters were analyzed for anonymity. After analyzing all pages of the thread,



23 of the posters were labeled as anonymous. Each individual's first post on the thread (i.e., their earliest post) was analyzed in terms of support offered and support requested. Once all the anonymous individuals had been identified, analysis returned to the first page of the thread. From this point, the first 23 identifiable individuals were selected and their first post on the thread was analyzed.

If a post contained a message giving support to a family member or a friend who is not on the forum then this was disregarded, as this study attempted to identify level of social support for members of this specific group of people.

As the posts contained publicly available information, informed consent was not required. However, all other ethical principles as set out by the British Psychological Society were adhered to.

### RESULTS

A series of two-sample chi-square tests were computed to examine whether there were associations between Identifiable Preference and each of the other three categorical variables (frequencies are shown in Table 1). Firstly, the association between Identifiable Preference and Requesting Support did not reach significance ( $\chi^2$  (df = 1) = 1.49;  $p$  = .22;  $\phi$  = .23), but the effect was in the direction expected. As can be seen in Table 1, about half of the anonymous individuals requested support but only about one-quarter of the identifiable people did so.

Table 1

*How Posts Were Coded According to the Categorical Variables*

	Identifiable Preference	
	Anonymous	Identifiable
Giving Support to Others		
Yes	13	21
No	10	2
Level of Support Within Posts		
Personalized & Comforting	3	4
Personalized	2	1
Comforting	3	10
Hugs	5	6
None	10	2
Posts Asking for Support		
Yes	11	6
No	12	17

Secondly, there was a significant association between Identifiable Preference and Giving of Support to others ( $\chi^2$  (df = 1) = 5.53;  $p$  = .019;  $\phi$  = .40). As shown in Table 1, the vast majority of identifiable people offered support to others but only just over half of the anonymous people did so. One of the cell counts was less than five, but a Fisher's Exact test confirmed a significant effect ( $p$  = .017). There was also a significant association between Identifiable Preference and Level of Support ( $\chi^2$  (df = 4) = 9.67;  $p$  = .046; Cramers V = .46). Again, although there were cells with frequencies of less than five, a Fisher's exact test confirmed the significant effect ( $p$  = .036). As can be seen from Table 1, the identifiable people were more numerous in all but one of the giving support categories, but nearly half of the anonymous individuals offered no support at all. Level of support was recoded into three categories to allow for stronger continuity of ranks (none, hugs, personalized and/or comforting), and then correlations between number of months on the forum and giving support/requesting support/level of support were computed, all of which were non-significant ( $\rho \leq .11$ ; df = 44;  $p > .05$ ). Correlations were also computed between total number of posts on the Web site and giving support/requesting support/level of support. Once again, all were non-significant ( $\rho \leq .11$ ; df = 44;  $p > .05$ ).

In all, the total number of posts on the thread was 18,993. The number of posts placed by individuals ranged from 1 to 423, however, the two groups did not differ significantly in this respect (identifiable group:  $M$  = 55.00,  $SD$  = 98.06; anonymous group:  $M$  = 22.10,  $SD$  = 54.53) ( $t$  (df = 42) = 1.36;  $p$  = .182; 95% CI -16.02 to 81.83). All statistical tests were computed with SPSS 16.

### DISCUSSION

Compared to the identifiable group, a higher proportion of anonymous individuals requested support. However, although in the direction predicted, the effect did not reach significance, hence, the first hypothesis was not supported. The other two predictions were supported. Firstly, the proportion of identifiable people offering support was greater than the proportion of anonymous individuals who offered support. Secondly, the identifiable group outnumbered the anonymous group when writing messages that were more supportive (personalized and/or comforting), but the anonymous group were more likely than the identifiable people to give no support at all.

These findings are broadly consistent with the predictions of SIDE theory (Spears & Lea, 1992), which proposes that when a group comprises a mixture of anonymous and identifiable members, the anonymous individuals will seek using the group to achieve their own personal aims rather than the aims of the group. As the data show, the anonymous individuals in this study appear less likely to use the group to give support to others and the support they do offer is less likely to be of a richer quality (personalized and/or comforting). This implies that the anonymous participants were more inclined to engage with the thread in order to receive support, thus satisfying their own needs, but they were less likely to engage so as to fulfill the aim

of the group as a whole, namely to provide support to others. One explanation for this could be the self-presentational dilemma (Caplan and Turner, 2007), whereby individuals who have made themselves identifiable to others on the thread may fear being perceived as weak if they ask for support, whereas an anonymous individual can keep their identity private, and can therefore engage in support seeking without the fear of being ridiculed. There are interesting implications for Internet forums whose purpose is to provide social support: in groups that contain both anonymous and identifiable members, the former may be less supportive. Additionally, forums with sizeable proportions of both anonymous and identifiable members may be less cohesive than those forums that contain exclusively (or mostly) one or the other. It should be noted that the aims of the group have been inferred by the authors: giving support to others may be seen as a group aim, and receiving support may be seen as an individual aim. Of course inference cannot be fully verified, indeed, it may be that many individuals also find giving support to others as a personally gratifying outcome.

There is evidence that individuals who spend more time in chat rooms building their relationships with others are more likely to disclose personal information about themselves and give emotional support to others (Whitty, 2002). However, our analyses show that the amount of time people have spent on the forum did not explain the pattern of giving/requesting support, nor was

there an association between total number of posts on the Web site (an index of participants' wider use of the forum) and requesting/giving/level of support. This finding counters the argument that differences in giving or requesting support are merely due to familiarity with other members of the forum.

Given the nature of the study, age data was not collected, but it should perhaps be noted that this may be an important variable in support-giving behavior. It has been reported that compared to younger individuals, older people are less likely to use the Internet (Hills and Argyle, 2003). Therefore, older participants may be inclined to offer less support as their limited engagement may mean less developed relationships with other members. Additionally, those who are less technologically savvy may be less likely to know how to post pictures of themselves.

In conclusion, it appears that regardless of their identifiable preference, individuals will provide support to others. However, it does appear that, on forums where anonymity is optional, individuals who are identifiable will be more likely to offer support to others and may provide richer types of support compared to anonymous individuals. These findings have important implications for the design and set-up of online support groups. Specifically, the study findings support the notion that where possible, support groups should encourage members to identify themselves.

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# PRESENCE IN THOSE WITH AND WITHOUT SIGHT: AUDIO DESCRIPTION AND ITS POTENTIAL FOR VIRTUAL REALITY APPLICATIONS

Louise Fryer<sup>1</sup> and Jonathan Freeman<sup>1</sup>

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Presence is affected by deficits in cognition and perception. It is thought to be associated with a preference for the visual domain, but has been not been extensively studied in those without sight. Audio Description (AD) is a verbal commentary conveying visual information, enabling blind and partially sighted people to access visual media. AD is currently only provided for low-immersion media, e.g., films. This project compared levels of presence for the same film clip watched with no AD, “standard” AD (describing characters, locations and actions) and a “cinematic” AD, which also includes details of camera shots. Surprisingly, those with impaired sight reported higher presence levels when watching the stimuli with AD, than sighted people watching the stimulus with no AD. Engagement scores reported by blind and partially sighted people for cinematic AD were highest overall. This suggests the need to revisit AD guidelines, which currently advise AD providers not to include filmic terms. It also suggests AD has potential for people who are blind or partially sighted to engage in more immersive Virtual Reality (VR) environments.

**Keywords:** Presence, Blindness, Vision, Audio Description, Film

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## INTRODUCTION

Presence is a multi-construct concept extending the idea of “telepresence”, developed for human interaction with remote-access technology (Minsky, 1980), to embrace the psychological sense of immersion in any mediated environment. Biocca (1997, p.18) sums it up as “the illusion of being there.” Sacau et al. (2008) suggest levels of presence are governed as much by individual factors as the qualities of the media that trigger it. Of the many factors, including personality, cognitive style and ability, age, gender, imagination (Heeter, 1992; Jurnet, Beciu & Maldonado, 2005), the ability to suspend disbelief (Lombard & Ditton, 1997), attention (Carroll, 1993) and deficits in cognition and perception (Stanney, Mourant & Kennedy, 1998), presence is widely believed to be positively associated with a preference for the visual domain (e.g., Chen, 2000). This study compares levels of presence reported by sighted people and those with impaired vision using the low-immersion medium of film: the final sequence of David Lean’s “Brief Encounter” (1945) screened with and without audio description (AD).

## AUDIO DESCRIPTION AND PRESENCE

AD is a verbal commentary, woven around the existing soundtrack, which makes visual media accessible to blind and partially sighted audiences. The practice originated in the U.S. in the 1970s and is currently used in cinema, TV and the visual arts (Hyks, 2005; Diaz-Cintas et al., 2007). AD concentrates on identifying characters, and describes locations and actions to

help users follow the plot. Early studies (Pettitt et al., 1996; Schmeidler & Kirchner, 2001) demonstrated cognitive and social benefits. However, the effect on immersion of AD users has not been explored. Indeed, Gerber (2007) suggests that conventional AD practices have arisen with little research to inform them.

To the authors’ knowledge to date there has not been any application of AD to Virtual Reality environments (VEs). This may be related to VEs being a relatively new phenomenon, largely visually driven, and so, not yet explored with people who are blind or partially sighted. Yet, interactive AD at some level does exist in other contexts. Descriptive audio guides used at museums and galleries include audio instruction (e.g. VocalEyes, 2011) such as orientation information, providing directions to, and around, the venue, or guiding a blind person’s fingers around a raised, tactile image (Canning & Fryer, 2010). In live AD contexts, such as theater, “touch tours” allow AD users to visit the stage before a performance, where they are invited to touch props and costumes as these items are described (Szalwinska, 2009). There is also some description of potential affordances enabling a blind person to operate, for example, a bell that will be used in the play (Pesky People, n.d.) or being told not only how to manipulate a lever, but also its effect in making a puppet horse’s ears twitch (Fryer, 2010a). This suggests there may be potential for a more interactive AD style to increase the accessibility of VEs to blind and partially sighted people in the future.

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This study concentrates on 2-D film, as the use of AD with more immersive AV forms, e.g., 3-D video, has also not been explored extensively. One piece of research in this area (RNIB, 2011) suggested there would be little interest to AD users of explicit descriptions of 3-D effects. However, the study should be interpreted in context – it was a very small, non-experimental study of limited scope.

#### “STANDARD” VERSUS “CINEMATIC” AUDIO DESCRIPTION

Another small-scale study in the early days of TV AD (ITC, 2000) drew a similar conclusion about more basic visual effects. This resulted in guidelines advising that filmic terms, such as camera angles, should generally not be used because “to many, expressions like: ‘in close-up,’ ‘pan across,’ ‘mid-shot,’ ‘crane-shot,’ etc. may not mean anything...” (ITC, 2000, p.8). Film theory, however, suggests the way a movie is shot influences the audience’s emotional engagement (Monaco, 2009). In a study by Kraft (1986), participants reported fast-cut film sequences to be more exciting than an uncut version of the same sequence. Eye-tracking research suggests directorial decisions, at the very least, induce commonality of gaze (Marchant et al., 2009). In a pilot study, the first author trialed a description style incorporating abstract “cinematic” elements into the AD: how a shot was framed and whether an image cut sharply to the next or softly dissolved. Perhaps surprisingly, blind and partially sighted people responded positively to this “cinematic” AD (Fryer, 2010b).

#### AD AND PRESENCE

Anecdotal evidence suggests AD is most effective when users are not consciously aware of it. One blind theater viewer commented:

“I find it very difficult to comment analytically on the quality of the live description, since I hardly noticed it. And there is no greater compliment that I can pay to the audio describers than this ... For me, audio description works best when ... the describers are invisible, when I’m not consciously aware of the vital contribution they’re making to my theatrical experience.” (Thomas, 2009, personal communication)

This “perceptual illusion of non-mediation” (Lombard & Ditton, 1997 p.7) is a classic definition of presence. Rather than relying on qualitative user comments, it suggests presence may provide a useful measure of the effectiveness of AD.

Wan et al. (2010) cite observable differences in neural processing between those with early onset compared to late onset blindness, with the mid-teenage years proving to be an important cut-off. Hollins (1985) also showed that scores on a test of pictorial imagery were lower for people who had been blind for a greater proportion of their lives. Those experiencing sight loss later in life might be expected, therefore, to report higher presence levels for the more visual, cinematic AD compared to those with long-standing sight problems. However, given that Slater et al. (1994) found lower presence levels in those for whom the auditory mode was dominant, fully sighted people might be ex-

pected to report higher presence levels overall. This study aimed to test these hypotheses. It received ethical approval from Goldsmiths College, University of London.

#### METHOD

##### PARTICIPANTS

Fifty-four volunteers (29 men and 25 women), aged 21-83 years ( $m = 54.50$ ;  $S.D. = 16.18$ ), were divided into three groups: those who described themselves as having no useable vision ( $N = 18$ , male = 12; mean age = 51.83;  $S.D. 13.96$ ); some useable vision ( $N = 18$ , male = 9; mean age = 55.78;  $S.D. 14.35$ ) and full vision ( $N = 18$ , male = 8; mean age = 56.5;  $S.D. 20.05$ ). All those with sight loss were registered either blind or partially sighted (see Table 1).

Table 1  
*Sight Loss Characteristics of Blind and Partially Sighted Participants*

Age; gender; useable vision	Age registered (years)	Cause of blindness
21 (M) none	Birth	anophthalmia
37 (M) none	Birth	retinopathy of prematurity
40 (F) none	21	glaucoma
41 (F) none	11	shrunken eye syndrome
42 (M) none	Birth	rubella
42 (M) none	5	glaucoma
44 (F) none	17	retinitis pigmentosa
46 (M) none	22	retinitis pigmentosa
49 (M) none	40	keratoconjunctivitis SICIA
50 (M) none	45	diabetes
57 (M) none	Birth	retinal blastoma
57 (M) none	Birth	rubella
61 (F) none	Birth	infant glaucoma
62 (M) none	Birth	retrolental fibroplasia
62 (M) none	50	retinitis pigmentosa
70 (F) none	5	optic nerve damage
72 (M) none	15	retinitis pigmentosa
74 (F) none	16	retinitis pigmentosa
32 (F) some	27	not stated
38 (F) some	16	double hydrocephalus
38 (M) some	35	strabius
42 (F) some	23	nystagmus
42 (M) some	27	retinitis pigmentosa
45 (M) some	23	not stated
46 (M) some	30	glaucoma
47 (M) some	29	not stated
61 (F) some	48	retinitis pigmentosa
62 (F) some	27	retinitis pigmentosa
63 (M) some	45	stargards disease
64 (M) some	50	stargards macular dystrophy
64 (M) some	8	congenital cataracts
66 (F) some	65	retinal vein occlusion
70 (F) some	37	macular degeneration
74 (F) some	71	stroke
74 (M) some	71	giant cell
75 (F) some	69	glaucoma and haemorrhage

Participants were recruited through the Royal National Institute for Blind People, VocalEyes, East Suffolk Association for the Blind and personal contacts, resulting in a sample with a wide age-range and variety of sight characteristics. Fourteen percent of participants with sight loss were blind from birth, and thus over-represented, as only 5% of the UK blind population is congenitally blind (RNIB, 2010). Sixty-six percent of this population is aged 75 or over (NHS, 2008), making the study sample considerably younger. However, Ofcom (2009) reports that most AD users are of working age, so the sample may be more typical of the market audience for AD.

### MEASURES

Demographic details, provided in advance, comprised age, gender, perceived useable vision (no, some, full) and, where applicable, medical name of sight condition and age registered blind or partially sighted. Participants also rated their love of film and familiarity with AD, using a 5-point Likert scale.

The ITC-Sense of Presence Inventory (ITC-SOPI, Lessiter et al., 2001) produces four separate presence subscales: Sense of Physical Space, Engagement, Ecological Validity (the naturalness of the scene) and Negative Effects. Part A comprises six statements regarding feelings after viewing the stimulus (e.g., “I felt sad that my experience is over”); Part B comprises 38 statements regarding feelings during the experience (e.g., “I had a sense of being in the scenes”). Statements are rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

### STIMULUS

Participants were shown the final seven-and-a-half minutes of David Lean’s film “Brief Encounter” (1945). The clip contains action and changes of location that can only be accessed visually or via AD. The clip was presented with no AD, with “standard” AD and with “cinematic” AD (for an example of the comparative AD styles, see Appendix 1). The researcher wrote and voiced both the standard and cinematic AD in order to control for potential variability between the two AD styles.

### PROCEDURE

Participants watched the film clip in each of the three conditions – no AD, standard, and cinematic. The viewing order was counter-balanced across the sample. Participants completed an ITC-SOPI after each clip and, at the end of the session, stated their clip preference. Most sighted subjects completed their own self-report measures. Two older sighted participants, and all those with sight loss, had the measures read aloud and dictated their responses.

Sessions, lasting approximately an hour, were designed to simulate watching a film in a domestic setting,

with a maximum of five participants. AD was mixed onto the soundtrack of the DVD, shown on a 40” (101cm) TV screen. Participants sat at a distance from the screen they would normally choose at home. Most watched from three meters, but those with partial sight sat much closer. At the start of each session, the researcher read a synopsis of the film plot, up to the point where the clip began.

## RESULTS

### SIGHT AND PREFERENCE FOR AD STYLE

Clip preference (no AD, standard AD or cinematic AD) is shown in Table 2. All participants with sight loss preferred AD, either standard or cinematic. This was significantly different from those with full sight (chi square = 22.46, df (4),  $p < .001$ ), whose preferences were equally divided between AD and no AD. There was no association between clip preference and viewing order ( $r = .106$ ,  $p = .444$ ).

One-way ANOVAs showed no significant difference between the three groups in age, gender or love of film. The fully sighted group was significantly less familiar with listening to AD:  $F(2, 51) = 13.43$ ,  $p < .001$  (bonferroni post hoc test  $p < .05$ ). AD style preference was significantly associated with familiarity ( $F(2, 51) = 13.64$ ,  $p < .001$ ). Of the 36 participants with sight loss, 25 were already familiar with AD. Of these, 11 preferred standard AD and 14 preferred cinematic AD. Of the 11 participants not previously familiar with AD, 10 preferred cinematic AD.

### AGE AT ONSET OF SIGHT LOSS AND AD STYLE PREFERENCE

The age at onset of sight loss was significantly associated with AD style preference ( $F(1, 34) = 11.20$ ,  $p = .002$ ). The majority in Group 1 (age at onset: birth-5 years) preferred standard AD (8/12); the majority in Group 2 (age at onset: 16- 29 years) preferred cinematic AD (8/12); those in Group 3 (age at onset: 30 years and above) unanimously preferred cinematic AD (12/12).

### THE EFFECT OF SIGHT AND AD STYLE ON PRESENCE

Age, gender and age at onset showed no significant associations with any of the four presence subscales of the ITC-SOPI. Group means and SDs are shown in Table 3. Mixed measures ANOVAs showed a main effect of AD style on engagement, ( $F(2, 1.69)$

Table 2  
Clip Preference according to Sight Characteristics (All Participants)

	No AD	Standard AD	Cinematic AD	Participant Total
No vision	0 (0%)	7 (43.8%)	11 (38%)	18 (33.3%)
Some vision	0 (0%)	5 (31.32)	13 (45%)	18 (33.3%)
Full vision	9 (100%)	4 (25%)	5 (17%)	18 (33.3%)
Preference Total	9 (17%)	16 (30%)	29 (53%)	54 (100%)

= 3.43,  $p = .044$ ) and significant interactions between sight and AD style for engagement ( $F(2, 3.38) = 3.65$ ,  $p = .012$ ), spatial presence ( $F(2, 3.23) = 4.82$ ,  $p = .003$ ) and ecological validity ( $F(2, 3.02) = 2.93$ ,  $p = .038$ ). There was no significant main effect or interaction for the subscale of negative effects.

For the stimulus with no AD, participants with no sight and full sight reported higher levels of spatial presence (Fig. 1) and ecological validity (Fig. 2) than those with some sight. Fully sighted participants reported their greatest engagement levels for no AD (Fig. 3) with levels on all three subscales dipping slightly for standard AD and considerably for cinematic AD. By contrast, all those with impaired sight reported higher presence levels for the two AD clips. Highest levels of spatial presence and ecological validity overall were reported for cinematic AD by those with no useable vision. The highest level of engagement overall was reported by those with some sight, also for cinematic AD.

## DISCUSSION

### AD STYLE PREFERENCE

All blind and partially sighted participants preferred the film clips with AD. This might seem unsurprising but several participants commented on the fact that the main character, Laura, narrates much of the action, making AD less essential. Surpris-

ingly, half the sighted sample stated a preference for one or the other of the AD clips. They might have been responding with blind companions in mind, or perhaps were simply interested to encounter AD for the first time.

Of the sample, 66.7% of participants with sight loss expressed a preference for cinematic AD. A man with recent sight loss said, "If you're into film, the technical terms are what you need to know." Another partially sighted woman said, "I was surprised by my interest in the camera views. In the end I preferred the clip with the more detailed AD (cinematic). It had a greater impact."

Those who had lost their sight after the age of 30 were unanimous in preferring the cinematic AD. This may reflect greater familiarity with cinematic techniques or a stronger visual memory. One blind woman said "describing the camerawork was much more dramatic – especially when she (Laura) dashed out on the platform, it was terrific." By contrast, most congenitally blind participants found the description of the cinematic elements unnecessary.

Over 90% of the blind and partially sighted participants previously unfamiliar with AD expressed a preference for cinematic AD. Those used to AD were less likely to prefer this new approach, suggesting expectation may play a role in presence, with the unfamiliar producing a distancing effect.

### SIGHT AND PRESENCE

There was no support for the hypothesis that those with full sight would record higher presence ratings than those with impaired vision. Jurnet et al. (2005) similarly found no connection between presence and a preference for the visual mode when using a stimulus with important dialogue. Brief Encounter has a vivid soundscape, comprising dialogue, sound effects and Rachmaninov's emotive music. For participants with sight loss, the AD presumably provided a further auditory element, presenting visual information verbally.

Across the whole sample, the highest engagement ratings (e.g., "I felt myself being drawn in") were reported by those with some sight for cinematic AD. Perhaps the detailed nature of this AD style allowed more effective use of any residual vision. Highest levels of spatial presence (e.g., "I felt I was visiting the places shown on screen") were also reported for cinematic AD, but by those with no useable sight. Levels of ecological validity (e.g., "The scenes seemed natural") were highest for those with no sight, reporting little difference between the two AD styles. Citing Sas, O'Hare & Reilly (2004) who link higher presence to introversion, Jurnet et al. (2005) propose that introverts find it easier to suppress conflicting information. Various studies (Coren et al., 1995) have linked introversion with reduced visual acuity. Perhaps blind and partially sighted people in this sample were more introverted than their sighted counterparts. A more likely explanation is that limited visual perception reduces such conflict, both within the media form and from the surrounding environment.

Table 3  
Means and Standard Deviations for SOPI Subscales for Each AD Style

	No vision	Some vision	Full vision
Spatial Presence: No AD	2.47 [0.52]	2.27 [0.92]	2.44 [0.58]
Spatial Presence: Standard AD	2.68 [0.73]	2.48 [0.67]	2.24 [0.69]
Spatial Presence: Cinematic AD	2.80 [0.79]	2.52 [0.72]	2.21 [0.41]
Engagement: No AD	3.26 [0.83]	3.22 [1.04]	3.50 [0.52]
Engagement: Standard AD	3.59 [0.75]	3.65 [0.81]	3.52 [0.55]
Engagement: Cinematic AD	3.62 [0.76]	3.76 [0.71]	3.26 [0.69]
Ecological Validity: No AD	3.36 [0.86]	2.71 [1.17]	3.22 [0.73]
Ecological Validity: Standard AD	3.60 [0.98]	3.31 [1.09]	3.27 [0.63]
Ecological Validity: Cinematic AD	3.57 [0.87]	3.34 [1.05]	3.07 [0.74]
Negative Effects: No AD	1.43 [0.51]	1.69 [0.64]	1.48 [0.45]
Negative Effects: Standard AD	1.42 [0.47]	1.44 [0.49]	1.34 [0.41]
Negative Effects: Cinematic AD	1.33 [0.64]	1.51 [0.47]	1.26 [0.38]



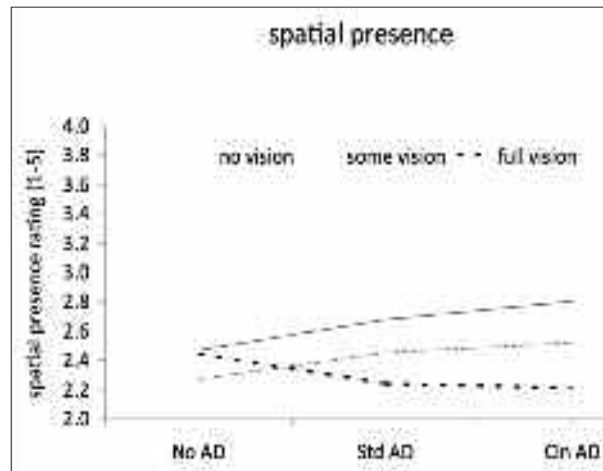


Figure 1. Levels of spatial presence by sight group for each AD style.

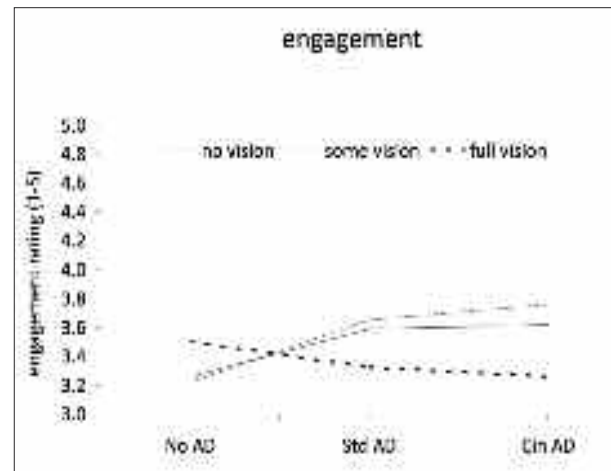


Figure 3. Levels of engagement by sight group for each AD style.

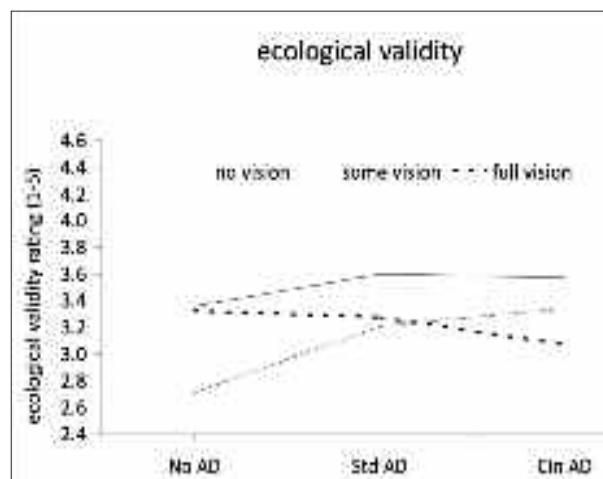


Figure 2. Levels of ecological validity by sight group for each AD style.

#### IMAGINAL PRESENCE VERSUS VIRTUAL REALITY

Biocca (1997) states that, at any one time, individuals can feel present in one of three environments: the physical, non-mediated environment; the virtual environment (VE); or an imaginal environment dependent on the user's internally-generated imagery. While sighted participants reported levels of presence based on their immersion in the VE, blind participants were creating their own imaginal one, triggered by the soundscape of the film combined with the verbal description. Their stronger levels of presence emphasize the role played by the creative imagination in low-immersive media (see Barber & Wilson, 1979; Heeter, 1992). Sighted people reported the lowest levels of spatial presence, engagement and ecological validity for cinematic AD. This might reflect a conflict between immersion in the movie and being made conscious, through the AD, of the technical aspects of the film's construction. In the absence of conflicting, perceptual visual information, blind people were free to draw on their own mental representations.

#### PROCESSING LOAD

As well as a qualitative difference between the two AD styles, there was also a quantitative difference: the standard AD script comprised 330 words, compared to 430 for the cinematic AD. Kerr (1983) suggests congenitally blind people take longer to process imagery. The greater density of the cinematic AD may have increased processing demands on these participants, encouraging a preference for the more minimal, standard style. Alternatively, those without visual experience might be better at interpreting sounds, requiring less explanation than those who were formerly sighted. Interestingly, not all participants perceived the difference in quantity. A man with some useable sight said "the standard AD seemed much more wordy," although it was, in fact, more succinct.

#### IMPLICATIONS FOR VIRTUAL REALITY (VR)

This study suggests that presence levels are lower when people are presented with confusing, competing or conflicting information. For the clip with no AD, blind and partially sighted participants reported mentally "switching off" when they could not follow what was happening. Those with no visual experience were similarly disengaged by cinematic terms they found meaningless. Sighted people were less immersed when visual information was replicated verbally, challenging them to compare what they saw with what they were being told by the describer. These multiple sources of information may have added to their processing load, with a negative effect on presence. This negative effect was stronger for the cinematic, rather than the standard, AD. This may also be a product of familiarity as standard AD in some ways resembles the kind of running commentary used by, for example, sports commentators to draw attention to subtle details within a busy visual environment.

The AD commentary requires the volume of the soundtrack to be lowered. This loss of auditory detail may also explain lower presence levels for sighted participants, as congruent audio in-

formation from sound effects was suppressed. In addition, a verbal commentary is not a normal part of “reality” for sighted people, whereas blind and partially sighted people are familiar with the visual world being mediated through words. Those with sight may also have been distracted by visual information from the surrounding environment. This was not a possibility for blind participants, and those with some sight chose to sit close to the screen, allowing the film image to occupy most, if not all, of their useable visual field.

Although VR developers are engaged on a quest for increasingly sophisticated visual realism, this study is a reminder that visual dominance can blind us to the influence of other senses on presence. Where the visual replication of reality is hard to achieve, immersion can be induced through the user’s imagination. It is a technique long-employed by playwrights and filmmakers, with sex or violence happening off-camera or off-stage, heard but not seen. Simple practices, such as minimizing extraneous information, coordinating visual and auditory detail and avoiding processing overload, may also be effective in raising presence levels.

For those with sight, soundscape design makes an important contribution to presence. However, it has been shown that people are poor at recognizing places through the soundscape alone (Serafin, 2004). While people with impaired sight, especially those who experienced early blindness, have been shown to have enhanced auditory perception (Wan et al., 2010), more research needs to be done on creative use of sound in AD, in particular, as a way of replicating 3-D visual effects in an aural form.

#### LIMITATIONS

The study is based on a clip of a black and white movie, transferred to DVD, and the poor quality of the visual stimulus may have influenced the presence levels of sighted participants. Although there was no evident correlation between viewing order and any of the measures, it was not possible to control for the effect of repeated exposure to the same basic stimulus. The duration of the clip had advantages and disadvantages. For some participants the initial surprise of the unfamiliar, cinematic AD wore off after a few minutes. One blind woman in her 70s commented, “At the beginning I found the cinematic AD distracting but then it melted into the film.” However, another said, “I thought the cinematic AD was great but I don’t know if I could stand to watch the whole film like that.” In order to avoid fatigue, no attempt was made to explore the emotional effect of the film, and the content may have appealed more to some participants than others.

#### FUTURE RESEARCH

Given these limitations, it would be useful to replicate this experiment across complete films, exploring the effect of content and genre. It is also important to test the AD of increasingly immersive media forms. Starting with a purely auditory stimulus, such as audio drama, and exposing participants with and without sight to increasingly visually-immersive media, it

would be possible to compare the relative importance of sight and sound. In addition to the four subscales measured by the ITC-SOPI, other dimensions of presence, such as affect and emotional realism, could also be evaluated.

While it is encouraging that those with sight loss appeared to feel fully present in low-immersive, audiovisual media, the AD requirements of computer games and VEs have yet to be addressed. There is a need for more research as to how variation in AD style affects presence for those with impaired sight, and how it might need to be adapted for VR, perhaps not only through linguistic adaptation but also through a more creative use of sound.

The role played by the voice in fostering presence also requires greater understanding. In particular, as AD proliferates in multimedia environments, there will be a commercial need to reduce production costs. The increasing sophistication of text-to-speech (TTS) applications (Cryer & Home, 2008) may make such technical solutions available to AD users without a detrimental effect on presence. One study in Poland (Szarkowska, 2011) comparing responses to human vocal delivery with AD reproduced by TTS showed that, although the 24 respondents preferred the human voice, most found synthetic speech acceptable.

#### CONCLUSION

This study shows an unexpected interaction between sight, AD style and presence. Lower levels of presence were reported by sighted people viewing an audiovisual stimulus than by participants with impaired sight for whom the missing visual element was replaced by a verbal commentary (AD). The strength of presence experienced by those with no sight casts doubt on the importance of the visual domain – indeed, vision can prove to be a distraction – and highlights the role played by auditory perception combined with the imagination in creating presence for low-immersive media forms.

The cinematic AD style prompted a stronger sense of engagement in those with some sight, and higher levels of spatial presence and ecological validity for those with no sight, than standard or no AD. Cinematic AD was preferred by those who had lost their sight later in life. In contrast, while fully sighted people found both AD styles distancing, this was more pronounced for the cinematic AD. This might help explain why AD guidelines, developed by people who are sighted, do not encourage the use of cinematic terms. It also suggests a need for such guidelines to be reviewed in the context of experimental research rather than as a result of focus group interviews. Although this is a single study with a heterogeneous sample, based on one short clip with all the limitations that that implies, it holds out the possibility that, for movies, AD – and in particular cinematic AD – can actually increase a sense of presence for blind and partially sighted people beyond that experienced by their sighted counterparts. Whether AD can be developed to enable those without sight to access more immersive forms of VR remains to be seen – or heard.

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## Appendix 1

*Brief Encounter AD scripts for final sequence*

Description Number:	159
Time in:	11:15:13:04
Time out:	11:15:18:20
Design Cue	shown in italics
Standard AD	script shown in bold
Cinematic AD	script shown in courier-see 500.

276 11:19:54:01 11:21:00:11

*...milk as plain*

**Laura's gaze intensifies; the room seems to tip...**

*As Dolly moves out of shot, the camera closes in on Laura. Her gaze intensifies as the room seems to tip.*

277 11:20:08:24 11:20:22:13

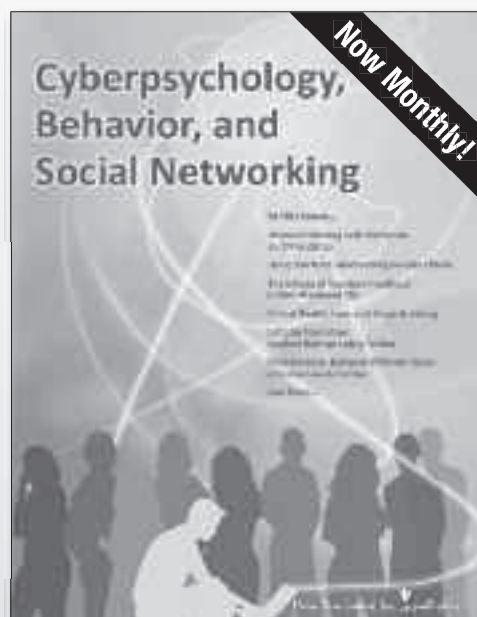
**...her breathing quickens, she tenses then darts to the door. Flinging it open she runs onto the platform as the Express thunders past...Laura pulls up short. The lights of the carriages flicker over her face, her eyes wide and staring, the rush of air blowing her hair away.**

*Her breathing quickens, she almost slides face the table. Cut to mid shot as she darts in the door. Cut to the platform - to Laura - as the wheels of the Express on the rails. Extreme close shot as Laura sways on the platform edge, lights flickering across her face, eyes wide and staring, hair blowing away.*

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# CYBERBULLYING AND TRADITIONAL BULLYING IN RELATION TO ADOLESCENTS' PERCEPTION OF PARENTING

Francine Dehue<sup>1</sup>, Catherine Bolman<sup>1</sup>, Trijntje Vollink<sup>1</sup> and Mienke Pouwelse<sup>1</sup>

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**This study investigates the relation between parenting and involvement in cyberbullying. We predicted that cyberbullies and cyberbully-victims report less responsiveness and demanding reactions from their parents than victims and youths who are not involved in cyberbullying. Furthermore, we predicted that youths with neglectful parents cyberbully the most often and youths with authoritative parents cyberbully the least. The same differences were predicted for traditional bullying behavior and for youth involved in both forms of bullying behavior. Participants were made up of 1,200 youths from 10-14 years old. They responded to a survey measuring cyberbullying and traditional bullying with questions based on the sub-scales from the Bully/Victim Questionnaire, and parenting with an adjusted version of the Parenting Style Questionnaire. Most results confirm our predictions. Results on authoritative, authoritarian, permissive and neglectful parenting styles suggest that for bullies, demanding actions are an important dimension of their behavior and for victims, responsiveness is an important dimension of their behavior.**

**Keywords:** Youths, Cyberbullying, Cyber Victimization, Parenting Dimensions, Parenting Style

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In order to communicate with each other, youths make use of electronic communication tools on the Internet such as chat-rooms, social networking sites and blogs, and cell phones (Patchin & Hinduja, 2011; Lenhart, Purcell, Smith & Zickuhr, 2010). It has been suggested that for the majority of youths these electronic tools are "critical tools for their social life" (Kowalski, Limber & Agatston, 2008, p. 2). The analysis of anonymous posts by youths revealed the importance and regularity of their involvement in interactions on the Internet (Mishna, McLuckie & Saini, 2009). Although these tools provide numerous benefits to young people they are not without their disadvantages. As shown in Tokunaga's review (2010) on cyberbullying, one such disadvantage is the increasing use of these tools to bully other children.

The often referenced definition of bullying of Olweus (1993a) states that an individual is bullied if he is repeatedly and intentionally exposed, over a long period of time by one or more individuals, to negative acts in a situation where a power imbalance exists. Based on this definition, Smith et al. (2008) define cyberbullying as long-term aggressive, intentional, repetitive acts by one or more individuals, using electronic means, against an almost powerless victim.

While both definitions indicate that traditional bullying and cyberbullying share certain characteristics such as repetitiveness, intentionality and power imbalance, they also differ. Unlike traditional bullying, cyberbullying is bereft of non-verbal cues,

thus increasing the risk of misinterpretation: what was intended as a joke could be regarded as intentional and deliberately hurtful (Vandebosch & van Cleemput, 2009). Contrary to traditional bullying, the perpetrators of cyberbullying may be unknown (Dehue, Bolman & Völlink, 2008; Dempsey, Sulkowsky, Dempsey & Srtorch, 2011; Huang & Chou, 2010; Ybarra, Diener-West & Leaf, 2007). This anonymity and the invasion of, hitherto protected, privacy make cyberbullying very painful for victims (Hoff & Mitchell, 2009; Mishna, Saini, & Solomon, 2009). The anonymity, the inability to have any control over acts of bullying and the fact that few places remain for cyberbully victims to escape their tormentors (Dempsey et al., 2011) also results in feelings of powerlessness (Dooley, Pyzalski & Cross, 2009). Moreover, cyberbullying can quickly command a large audience and can be visible for longer periods of time (Patchin & Hinduja, 2011; Slonje & Smith, 2008; Sourander et al., 2010; Vandebosch & van Cleemput 2009; Ybarra et al., 2007). Concerning the latter difference, some researchers argued that repetitiveness is not a prerequisite for cyberbullying since a single act, such as uploading an embarrassing picture, can result in continued and widespread humiliation (Dooley et al., 2009; Mishna, Cook, Gadalla, Daciuk & Solomon, 2010; Vandebosch & van Cleemput, 2009).

Many studies have shown that cyberbullying is a prevalent problem. A significant proportion of youth, ranging from 4-57%, report having been cyberbullied and cyber victimized at some time (Dehue et al., 2008; Erdur-Baker, 2010; Kraft & Wang, 2009;

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Mesch, 2009; Mishna et al., 2010; Patchin & Hinduja, 2011; Raskauskas, 2009; Vandebosch & van Cleemput, 2009; Wang, Nansel, & Iannotti, 2011). Methods of measuring cyberbullying could account for the difference in prevalence figures. Some studies present percentages of youths who occasionally were cyberbullied or cybervictimized, while others used the restriction of at least once per month. Moreover, Vandebosch and van Cleemput (2009) have shown that when asked whether youths were perpetrators or victims of cyberbullying, approximately 10% answered in the affirmative, whereas when asked about specific cyberbullying acts, 62% reported having experienced these situations and 52% admitted to having carried out at least one form of cyberbullying. Apparently, prevalence figures are lower when youths are asked if they have been either victims or perpetrators of cyberbullying than when asked about specific cyberbullying acts. This could indicate that certain forms of cyberbullying are not always regarded as cyberbullying (Dehue et al., 2008; Mishna, Saini et al., 2009) and that the perception is dependent on the context (Vandebosch & van Cleemput, 2009).

There is convincing evidence that being cyberbullied can result in serious psychosomatic and psychosocial health problems. Several studies found that victims of cyberbullying feel depressed, confused, guilty, feared, lonely, embarrassed, angry, sad, and experience low self esteem and more interpersonal problems than non-victims (Mishna, McLuckie et al., 2009; Perren, Dooley, Shaw, & Cross, 2010; Raskauskas, 2010; Tokunaga, 2010; Wang et al., 2011). Other studies found clear evidence for negative behavioral and physical consequences associated with cyberbullying, such as offline interpersonal victimization, use of drugs and alcohol, problems at school and with peers, physical or sexual abuse, delinquency and aggressive behavior (Tokunaga, 2010). Some researchers suggest that the effects of cyberbullying are more severe than the effects of traditional bullying due to the anonymity of the bully and the continuity of the messages (Mishna, Saini et al., 2009; Twyman, Saylor, Taylor, & Comeaux, 2010).

The aforementioned research reveals that cyberbullying is a serious problem with severe consequences. Very little is known about the role of parenting in cyberbullying. Parents are often excluded from the Internet activities of their children because they value their privacy (Subrahmanyam & Greenfield, 2008) and thus, cyberbullying is less visible than traditional bullying. Moreover, youth do not tell their parents they are involved in cyberbullying because they fear punishment, loss of computer privileges, and isolation from peers (Bath, 2008; Kraft & Wang, 2009; Mishna, Saini et al., 2009). As a result, parents are frequently unaware that their child is a cyberbully or is being cyberbullied (Aricak et al., 2008; Dehue et al., 2008). Yet, the role of parents is critical to ensure safe use of the Internet (Bath, 2008; Rosen, Cheever & Carrier, 2008). Moreover, Internet usage is mainly a home-based activity (Dehue et al., 2008; Lee & Chae, 2007). Monitoring and regulating this usage is hard, however, since there is a generational divide in Internet usage. Parents are often less experienced in new communication technologies and feel less confident about using the Internet than

younger generations. They do not fully understand the risks posed by the Internet (Subrahmanyam & Greenfield, 2008; Wong, 2010). This implicates the situation since parents are not aware of a need for Internet education, which stresses the importance of the role of parenting, or the normal variations in parents' attempts to control and socialize their children (Baumrind, 1991) in relation to cyberbullying.

Some studies have examined the relation between characteristics of parenting and cyberbullying. They found that children who cyberbully experience limited parental monitoring, stronger parental discipline and a weaker emotional bond with their parents than children who do not cyberbully (Ybarra & Mitchell, 2004; Wang, Iannotti, & Nansel, 2009; Wong, 2010). It was also found that adolescents who received more support from parents participate in fewer negative and antisocial behaviors (Park, Kim, & Cho, 2008).

However, these studies did not take into account the strong relation between traditional bullying behavior and cyberbullying. Many youths who are involved in traditional bullying are also involved in cyberbullying (Erdur-Baker, 2010; Dehue et al., 2008; Dempsey et al., 2011; Steffgen, König, Pfetsch, & Melzer, 2011; Twyman et al., 2010). The aim of the present study is to provide insight into the relation between parenting and cyberbullying, traditional bullying and both forms of bullying, to investigate which parental practices decrease the risk of bullying and victimization.

It has been suggested that deficient parenting impairs the social competence of these children and the ability to develop positive friendships, whereas parents who are involved in their children's lives and supervise them are instrumental in reducing aggressive behavior within and without the family (Duman, & Margolin, 2007; Knutson, DeGarmo & Reid, 2004; Mazefsky & Farrell, 2005). Parents who interact with their children in a hostile, cold and indifferent manner encourage their children to interact with others in the same manner, which affects the socialization of their children and may increase a child's likelihood of becoming a bully (Pontzer, 2010). Indeed, it is a well established finding that poor supervision, inconsistent discipline and lack of affection and support influence the unfolding of antisocial behaviors in children, whereas effective parenting characterized by warmth and consistency is associated with reduced levels of antisocial behavior (Bacchini, Miranda, & Affuso, 2011; Brown, Arnold, Dobbs, & Doctoroff, 2007; Demetriou & Christodoulides, 2011; Getachew & Sintayehu, 2007; Knutson et al., 2004; Luyckx et al., 2011).

Current theories posit that parental characteristics can be ranked into a category of responsiveness characterized by warmth, support, acceptance and affection, and a demanding dimension referring to supervision, control and monitoring (Baumrind, 1991; Spera, 2005). Some researchers have investigated the relation between parental responsiveness and traditional bullying and found a negative association: as parents were less responsive, their children exhibited more bullying behavior and victimiza-



tion increased (Flouri & Buchanan, 2002; Georgio, 2008; Ok & Aslan, 2010). Some other researchers compared bullies, bully-victims and victims, and found that bullies and bully-victims experienced less parental responsiveness than victims (Demaray & Malecki, 2003; Smith & Myron-Wilson, 1998; Stevens, Bourdaudhuij & Oost, 2002). Also, the relation between parents acting demanding and traditional bullying is investigated and these studies revealed that bullies and bully-victims experience more demanding behaviors from their parents than victims (Marini, Dane, Bosacki, & YLC-CURA, 2006; Rican, Klicperova & Koucka, 1993; Unnever, 2005).

However, both dimensions co-exist and influence each other (Baumrind, 1991; Spera, 2005). A combination of both dimensions results in four parenting styles, as shown in Fig. 1.

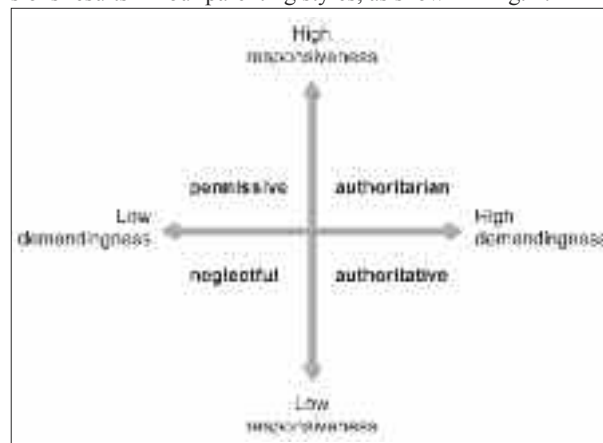


Figure 1. Parenting dimensions and styles.

Responsive and demanding parents adopt an authoritative parenting style, less responsive but demanding parents adopt an authoritarian parenting style, responsive but less demanding parents adopt a permissive parenting style and less responsive and less demanding parents adopt a neglectful parenting style (Baumrind, 1991, 2005). Many studies have shown that children with authoritative parents exhibit less problematic behavior and have greater psychosocial competence and lower levels of psychological and behavioral dysfunction. Children with authoritarian parents exhibit antisocial behavior in public whereas children with permissive parents generally act impulsively and develop aggressive behavior. Children with neglectful parents can suffer from Internet Addiction Disorder, and can manifest, in the long term, antisocial and delinquent behaviors (Baumrind, 2005; Duriez & Soenens, 2006; den Exter-Blokland, Engels, & Finkenauer, 2001; Knutson et al., 2004; Xiuqin et al., 2010). Parenting styles are also related to bullying behavior exhibited by youths. Several studies on traditional bullying show that youths from families characterized by authority and neglect bully more often (Ahmed & Braithwaite, 2004; Baldry & Farrington, 2005; Casas et al., 2006; Knutson et al., 2004; Olweus, 1993a; Stevens et al. 2002), whereas victimization is associated with a permissive parent-

ing style (Georgiou, 2008).

In the present study we address the question of whether a relation exists between cyberbullying, being cyberbullied and parenting dimensions and styles. Based on the aforementioned research, we predicted that cyberbullies and cyberbully-victims report less responsiveness and less demanding behaviors from their parents than victims and youths who are not involved in cyberbullying. We predicted the same differences for youths who are involved in traditional bullying behavior and with both forms of bullying behavior. Furthermore, we predicted that youths with neglectful parents cyberbully the most often and youths with authoritative parents cyberbully the least. Again, the same differences were predicted for traditional bullying behavior and for both forms of bullying behavior. Furthermore, we also investigated the relation between parenting style and cybervictimization, traditional victimization and victimization of both forms of bullying behavior.

## METHOD

### PARTICIPANTS AND PROCEDURE

This study was carried out in the south of the Netherlands under the auspices of the regional Public Health Service (PHS). We did an inventory of all 67 primary schools and seven of the junior high schools in the region to determine school type, school size and location (town or village). Based on this information classic school types with an average student population were selected to participate in the study. Schools from towns and small villages were proportionally represented which resulted in the selection of 34 primary and all seven of the high schools. Of the 34 primary schools 31 (91%) agreed to participate, and of the seven high schools six (86%) agreed to participate. Per school or location, dependent on the school size, at least one group 8 (primary school) and one high school class 1 was randomly assigned to take part in the study. A few students did not fill in the questionnaire due to illness or absenteeism. Of the 1,221 students who completed the questionnaire, 37 students neglected to answer several questions, which were excluded from the study. Of the resulting 1,184 students 580 were girls, 583 were boys and 21 did not fill in their gender. The age of the students ranged from 10-14 with a mean age of 11.7 (SD .74); 66% attended primary school and 34% attended junior high school.

The selected schools received a letter requesting participation plus an informational leaflet for the parents. After the schools' approval and informing parents, the schools received an explanatory letter, the questionnaire and instructions for the teachers. Students filled in the questionnaire under the supervision of their teachers. The questionnaires were collected by the PHS via the schools.

### MEASUREMENT

In line with the study done by Ybarra et al. (2007), the questionnaire began with a definition of cyberbullying, which emphasizes doing nasty and mean things to someone else using a computer or cell phone, the lack of power on the part of the victim, the anonymity of the bully and the exclusion of jokes. In

addition, some examples of cyberbullying were given. The following four questions concerning frequency of cyberbullying and cybervictimization (two on the Internet and two by cell phone), plus two questions concerning frequency of traditional bullying were based on a translation (Liebrand, IJsendoorn & van Lieshout, 1991) of sub-scales from the Bully/Victim Questionnaire (Olweus, 1993b). The answer categories were: "I have not bullied/I have not been bullied this school year," "Once or twice this school year," "Approximately once or twice per month," "Approximately once per week," and "Many times per week."

The parenting dimensions of responsiveness and demanding qualities were measured with an adjusted version of the Parenting Style Questionnaire (den Exter-Blokland et al., 2001). Responsiveness was measured with 10 questions such as, "Do your parents/carers try to help you solve your problems?" Demanding behavior was measured by seven questions, one of which is, "Do your parents know exactly what you do in your free time?" All questions used a 5-point scale with the answer categories: 1 (no, never), 2 (mostly not), 3 (sometimes), 4 (mostly yes), and 5 (yes, always). High average scores reflect a high level of responsiveness and demanding behaviors exhibited by parents. Cronbach's alpha for the responsiveness scale was .80, and for demanding qualities it was .62. Consistent with Exter-Blokland et al. (2001), youths were classified as being parented in an authoritative manner if they reported scores above average on the responsiveness and demanding dimensions and authoritarian if they reported scores below average on responsiveness and above average on parents acting demanding. They were classified as being parented in a permissive manner when scores were above average on responsiveness and below average on demanding, and as being parented in a neglectful way if both responsiveness and demanding scores were below average.

Prior to the study, the questionnaire was pre-tested on 40 students who did not participate in the study. As a result of the pre-test some questions were adjusted to facilitate clarity, understanding and ease in answering the questions.

## RESULTS

To assess whether youths who are involved in traditional bullying behavior also were involved in cyberbullying we calculated Cramer's V which revealed an association between cyberbullying and traditional bullying (.23,  $p < .01$ ). Table 1 shows that 40.1% of the youths were not involved in either form of bullying behavior, 7.1% of all youths were involved in only cyberbullying, 30.1% were involved in only traditional bullying and 22.8% were involved in both forms of bullying behavior as either the bully, victim, or bully-victim.

We then tested our hypotheses that bullies and bully-victims report less responsiveness and less demandingness from their parents than victims and youths who are not involved in bullying. We used ANOVAs with involvement in bullying behavior as the independent variable and responsiveness and demandingness as dependent variables, for involvement in only cyberbullying, for involvement in only traditional bullying, and for involve-

Table 1  
*Percentages (Number) of Youths Involved in Cyberbullying and Traditional Bullying (N=1141)*

Trad. bullying	Cyberbullying			
	Non involved	Bully	Bully-Victim	Victim
Non-involved	40.1 (590)	2.7 (25)	1.1 (13)	3.8 (55)
Bully	11.3 (129)	2.8 (32)	1.6 (19)	1.7 (19)
Bully-victim	11.7 (134)	1.8 (21)	0.6 (52)	0.6 (52)
Victim	7.1 (81)	0.9 (10)	1.0 (11)	3.8 (43)

Table 2  
*Involvement in Bullying Behavior and Mean Score (SD) on Responsiveness and Demandingness*

	Responsiveness	Demandingness
Non-involved	4.41 (.46)	4.76 (.61)
Cyberbully	4.34 (.64)	4.46 (.60)
Cyber victims	4.23 (.61)	4.57 (.69)
Cyber bully-victims	4.26 (.47)	4.56 (.49)
Traditional bully	4.23 (.54)	4.45 (.64)
Traditional victim	4.24 (.51)	4.81 (.52)
Trad. bully-victim	4.27 (.54)	4.64 (.57)
Both bully	3.90 (.80)	3.97 (.81)
Both victim	4.17 (.58)	4.83 (.56)
Both bully-victim	4.23 (.46)	4.38 (.68)
Both bully cyber victim	4.00 (.48)	4.15 (.63)
Both bully trad. victim	4.27 (.52)	4.44 (.61)
Both victim cyber bully	4.10 (.52)	4.21 (.60)
Both victim trad. bully	4.14 (.52)	4.66 (.55)
Cyber bully trad. victim	4.24 (.47)	4.70 (.53)
Cyber victim trad. bully	4.20 (.68)	4.65 (.55)

ment in both forms of bullying behavior. Although cyberbully-victims and victims report the least responsiveness and cyberbullies report less responsiveness than youths who are not involved in bullying (table 2), the differences are not significant ( $F(3, 535) = 2.33, p > .05$ ). The differences for demandingness, however, are significant ( $F(3, 535) = 3.19, p < .05$ ) and Tukey's tests and mean scores show significantly least demandingness reported by cyberbullies and most by youths who are not involved in cyberbullying ( $p < .05$ ).

For traditional bullying the analyses reveal significant differences for responsiveness ( $F(3, 798) = 7.68, p < .01$ ), as well as for demanding qualities ( $F(3, 798) = 10.33, p < .01$ ). Tukey's tests and mean scores reveal that youths who traditionally bullied and/or were victims of traditional bullying report significantly less responsiveness from their parents than youths who are not involved in traditional bullying, and that youths who only bullied report less demanding behaviors from their parents than the other youths ( $p < .05$ ). Also, for youths who are involved in both forms of bullying behavior as bullies, bully-victims or victims, the differences in responsiveness and demanding traits are significant ( $F(9, 706) = 7.02, p < .01$  and  $F(9, 706) = 9.62, p < .01$ ). Games-Howell's tests and mean scores reveal a significantly lower score on responsiveness for youths who bullied in both forms and who were victims of both forms compared to the non-involved youths ( $p < .05$ ). For demanding qualities, Tukey's tests and mean scores reveal significantly low, the lowest, scores for youths who bullied in both forms, followed by the bully-victims of both forms, who score lower than the victims of both forms and the non-involved youths ( $p < .05$ ).

In order to investigate the relation between the parenting style and the frequency of bullying and victimization, ANOVAs were carried out with parenting style as the independent variable and bullying behavior and victimization as dependent variables. Again, we performed these analyses for only cyberbullying, only traditional bullying and both forms of bullying separately. Table 3 presents the number and percentages of youths for each parenting style and form of bullying behavior. Most youths have authoritative parents, except those who are involved in both forms of bullying behavior. The percentage with neglectful parents is highest for this group and lowest for youths who are not involved in bullying behavior ( $\chi^2(9, 1141) = 49.02, p < .05$ ).

Table 3  
*Number (Percentages) of Youths for Parenting Style and Form of Bullying Behavior*

	Non-involved	Only cyberbullying	Only traditional bullying	Both
Authoritative	231 (50.4)	33 (40.7%)	125 (36.3%)	72 (21.3%)
Authoritarian	57 (12.4)	8 (9.9%)	34 (15.7%)	35 (13.6%)
Permissive	79 (17.2)	16 (19.8%)	73 (21.2%)	51 (15.8%)
Neglectful	91 (19.9)	24 (29.6%)	92 (26.7%)	100 (31.1%)

Table 4 presents the mean scores on bullying behavior for each parenting style. Youths with permissive and neglectful parents cyberbullied more often than youths whose parents adopt an authoritative and authoritarian parental style, but the differences are not significant ( $F(3, 535) = 1.81, p > .05$ ). Youths with authoritarian and neglectful parents were cyberbullied more often than youths with authoritative and permissive parents but again, the differences are not significant ( $F(3, 535) = 1.33, p > .05$ ). However, traditional bullying results revealed significant dif-

ferences ( $F(3, 798) = 6.52, p < .01$ ). Games-Howell's tests and mean scores show that youths with neglectful parents bullied significantly more often than youths with authoritative parents ( $p < .05$ ). Youths with authoritarian and permissive parents are most often bullied, youths with neglectful parents somewhat less often and youths with authoritative parents the least often, but these differences are not significant ( $F(3, 798) = 2.23, p > .05$ ). Again, the differences between youths who cyberbullied, as well as traditional bullied, are significant ( $F(3, 581) = 10.83, p < .01$ ), with youths with neglectful parents bullying most often and youths with permissive parents bullying more often than youths with authoritative and authoritarian parents ( $p < .05$ ). Youths with neglectful parents show the highest scores on victimization, followed by youths with authoritarian parents and youths with authoritative and permissive parents showing the lowest scores on victimization. Again, these differences are not significant ( $F(3, 581) = 2.04, p > .05$ ).

Table 4  
*Means (SD) on Bullying and Being Bullied Per Parenting Style*

	Cyberbullying	Traditional bullying	Both
Authoritative	1.06 (.33)	1.11 (.39)	1.13 (.46)
Authoritarian	1.05 (.27)	1.52 (.50)	1.31 (.37)
Permissive	1.16 (.55)	1.50 (.80)	1.47 (.66)
Neglectful	1.12 (.48)	1.74 (1.14)	1.58 (.82)
	Cyber victimization	Trad. Victimization	Both
Authoritative	1.11 (.42)	1.35 (.82)	1.21 (.69)
Authoritarian	1.15 (.55)	1.51 (.86)	1.44 (.80)
Permissive	1.09 (.33)	1.53 (1.12)	1.34 (.61)
Neglectful	1.20 (.57)	1.44 (.34)	1.33 (.82)

## DISCUSSION

Most studies on cyberbullying do not take into account that most youths who are involved in cyberbullying are also involved in traditional bullying, whereas several studies showed significant positive relations (e.g., Erdur-Baker, 2010; Dehue et al., 2008; Dempsey et al., 2011; Steffgen et al., 2011; Twyman et al., 2010; Ybarra et al., 2007). Our study was based on a large population, and therefore we were able to distinguish youths who are only involved in cyberbullying from youths who are only involved in traditional bullying, as well as from youths who are involved in both forms of bullying. Several researchers suggest that cyberbullying is more accessible than traditional bullying because it is possible to remain anonymous and invisible, and because of the lack of feedback (Kowalski et al., 2008; Slonje & Smith, 2008). The anonymity, invisibility and the lack of feedback, however, seem not to be an advantage for youths who are inclined to bully since our study showed that the percentage of youths who only cyberbully is rather small, as is the percentage of youths who are only cyberbullied. Probably, cyberbullies and traditional bullies, and cyberbullied and traditional victims share common characteristics.

The present study investigates the role of parenting, an aspect of which very little is yet known regarding cyberbullying. Cyberbullying is less visible than traditional bullying and parents are often unfamiliar with this phenomenon (Aricak et al., 2008; Dehue et al., 2008). Moreover, there is a generational divide in Internet usage and parents are often unaware of the activities of their children on the Internet because they are excluded for reasons of privacy (Mitchell et al., 2005; Subrahmanyam & Greenfield, 2008; Wong, 2010) and fear of losing computer privileges (Bath, 2008; Kraft & Wang, 2009; Mishna et al., 2009). This suggests that for most parents Internet education is not a topic, which further implicates the situation since parenting, or the way parents control and socialize their children, is especially critical in safe Internet usage.

Based on the literature (Flouri & Buchanan, 2002; Georgiou, 2008; Smith & Myron-Wilson, 1998; Stevens et al., 2002; Unnever, 2005; Ybarra & Mitchell, 2004; Wang et al., 2009; Wong, 2010) our first hypothesis states that cyberbullies and cyberbully-victims report less responsiveness and less demanding behaviors from their parents than cybervictims and youths who are not involved in cyberbullying. The hypothesis was partially supported, since the cyberbullies report less responsiveness and less demanding traits than the non-involved youths, although the difference in responsiveness was not significant. However, this should be explained by the small percentage of youths who are only cyberbullies, cyberbully-victims and cybervictims. For youths who are involved in traditional bullying and in cyberbullying as well as traditional bullying, we found comparable but significant results: bullies, bully-victims and victims report less responsiveness and demanding behaviors than non-involved youths. Limited responsiveness and demanding behaviors may be considered as deficient parenting. Some researchers found that deficient parenting practices impair the social competence of children (Duman & Margolin, 2007; Knutson et al., 2004; Mazefsky & Farrell, 2005; Pontzer, 2010). Thus, it is possible that the lack of responsiveness and demanding behaviors of parents as role models impairs the social competence of both bullies and victims (Perren & Hornung, 2005; Stevens et al., 2002), especially in the case of cyberbullying since peers and teachers, as possible role models, are frequently unaware that a child is a cyberbully or is cyberbullied (Aricak et al., 2008; Dehue et al., 2008). However, Veenstra and colleagues (2005), who found the same differences for emotional warmth and traditional bullying behavior, suggest that multivariate analyses are necessary since in their study the effect for emotional warmth disappeared after adding the socioeconomic status of the parents.

The percentage of youths with neglectful parents is highest for those who are involved in both forms of bullying behavior and lowest for youths who are not involved in bullying behavior. We found support for the hypothesis that youths with neglectful parents bully most and youths with authoritative parents bully least, although the differences for youths involved in only cyberbullying were again not significant, probably due to the small percentage of youths who are only cyberbullies. For

youths who bully both traditionally and in cyberspace we found that they bully less when they have authoritative or authoritarian parents compared to permissive parents, and most when they have neglectful parents. Several studies on traditional bullying also showed that youths with authoritative parents bully the least (Casas et al., 2006; Baldry & Farrington, 2005; Demaray & Malecki, 2003; Georgiou, 2008), and youths with neglectful parents bully the most (Knutson et al., 2004; Olweus, 1993a; Stevens et al., 2002). Other studies on traditional bullying, however, have found that children with authoritarian parents were most likely to bully others. These studies defined an authoritarian upbringing as one in which punishment, conflict and harshness exist (Ahmed & Braithwaite, 2004; Baldry & Farrington, 2005; Stevens et al., 2002) while in this study an authoritarian upbringing was defined as one with little responsiveness and a high level of demanding taking the form of monitoring and rules.

Our last analyses concerned parenting style and victimization. Due to the small sample size, the analyses indicate no significant difference on cyber victimization, although the means suggest that youth with authoritative and permissive parents are less often victimized than youths with authoritarian and neglectful parents. Results for cyber and traditional victims were comparable and significant. Also, traditional victims with authoritative parents were least often victimized and those with authoritarian parents most often victimized.

The finding that youths with authoritative and authoritarian parents bully less frequently than youths with permissive and neglectful parents suggests that the dimension demanding traits is associated with bullying. The difference between the authoritative and authoritarian style on the one hand and the permissive and neglectful style on the other is indeed the level of demanding, which is less in the permissive and neglectful style. For victims of bullying behavior the dimension of responsiveness is probably the most important. Means suggest less victimization by youths with authoritative and permissive parents than with authoritarian and neglectful parents. The difference between these pairs of parenting styles is the level of responsiveness, which is less in the authoritarian and neglectful style.

This study has certain limitations. Although the sample was rather large, the number of youths who are only involved in cyberbullying is rather small. Bullying behavior was measured by a single question for perpetrators and victims. With this method, as shown by Vandebosch and van Cleemput (2009), prevalence figures are lower than when subjects are asked how often they are perpetrators and victims of specific cyberbullying acts. To distinguish between cyberbullies and cybervictims on the one hand and traditional bullies and victims on the other, it is recommended to use a measurement containing specific cyberbullying acts. A second limitation lies in the fact that this study did not measure if parents had rules concerning the use of the Internet. Considering that demanding behaviors seem to play an important role in bullying, it is to be expected that the rules par-



ents have concerning the use of the Internet could influence cyberbullying. Indeed, Mesch (2009) demonstrated that the existence of some rules decreases the risk of cyberbullying victimization. Although the demanding traits of an authoritative and authoritarian parenting style implicate supervision, control and monitoring, it is not clear whether these parents perceived as authoritative and authoritarian use rules concerning Internet use. It may be possible they do not realize they can set rules since they are less acquainted with the use of the new communication technologies (Subrahmanyam & Greenfield, 2008; Wong, 2010 Mitchell et al., 2005). Obviously it is crucial to know if, and how much, children adhere to these rules. The third limitation concerns the use of self-report measures, which increase the risk of socially desirable answers and consequently, distorted results (Goossens, Olthof & Dekker, 2006). In this respect it is not clear what youths would perceive as socially desirable. They may as well be socially influenced by the group norm that disapproves of bullying or by the group norm that bullying is cool, which makes the potential distortion of the results by socially desirable answers difficult to interpret. The literature indicates that the questioning of several groups of witnesses concerning the child's behavior appears to be reliable (Baldry & Farrington, 2005; Elinoff, Chafouleas & Sassu, 2004; Rubin, Bukowski & Parker, 2006). Future research should therefore utilize peer-report methods to measure bullying (Smith & Myron-Wilson, 1998). The use of the Participant Role Scales (PRS), developed by Salmivalli and colleagues and validated in a Dutch study (Goossens et al., 2006), is recommended. Whether such an instrument is helpful to measure cyberbullying should be investigated, since cyberbullies mostly

operate alone and at home, and peers are therefore often not aware of cyberbullying (Dehue et al., 2008). A fourth limitation is the cross-sectional nature of the design, which makes it impossible to establish cause and effect. We therefore recommend longitudinal research. Although earlier longitudinal studies showed that ineffective parental behavior can initiate bullying (Rican, Klicperova, & Koucka, 1993), it is possible that problematic behavior such as bullying can initiate ineffective parental behavior (Cox & Paley, 1997; Huver, Engels & de Vries, 2006; Johnston, Chen & Ohan, 2006).

### CONCLUSION

Our findings indicated great similarities between the different forms of bullying and victimization. However, the importance of parental commitment to cyberbullying is probably more necessary as cyberbullying is less noticeable and less visible (Dehue et al. 2008). In addition, the reactions of victims are less visible due to the lack of nonverbal cues (Vandebosch & van Cleemput, 2009). These aspects ensure that cyberbullies receive almost no feedback concerning their behavior. Also, parents often have no idea whether their child acts as a cyberbully or is cyberbullied (Dehue et al., 2008). Therefore, it is important that parents gain more insight into the negative aspects of Internet usage and become closely associated with their children's use of the Internet. Yet, the role of parenting practices in cyberbullying is barely investigated. The findings of this study suggest that the parental dimension of responsiveness in particular plays an important role for victims, whereas the parental dimension of acting demanding plays an important role for bullies.

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# VIRTUAL REALITY EXPOSURE THERAPY VERSUS COGNITIVE BEHAVIOR THERAPY FOR PANIC DISORDER WITH AGORAPHOBIA: A RANDOMIZED COMPARISON STUDY

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**Our objective was to compare the effects of Virtual Reality exposure therapy (VRET), cognitive behavior therapy (CBT), and a waitlist control condition in patients with panic disorder with agoraphobia (PDA). Ninety two out-patients were initially randomized in three arms, 29 treated with VRET, 31 with CBT, and 32 assigned to the waitlist. At the end of a 12-week period, the patients assigned to the waitlist were re-randomized in VRET or CBT groups. No between-group significant differences appeared at the end of the first phase, however a lower responder rate was observed in the waitlist group. After the second randomization, response rates were not different in the VRET and CBT groups (respectively 38.7% and 48.5%;  $p=0.46$ ). During the 9-month follow-up period, the response rates remained stable without differences between groups. Thus, VRET seems to be an effective treatment for PDA with short-term and long-term therapeutic results equivalent to those obtained with CBT.**

**Keywords:** Agoraphobia, Cognitive Behavior Therapy, Panic Disorder, Virtual Reality, Randomized Controlled Trial

## INTRODUCTION

Panic disorder with agoraphobia (PDA) is a chronic and recurrent psychiatric illness with a lifetime prevalence of about 2% in Europe and a well-known negative impact on the quality of life of suffering subjects (Alonso et al., 2004; Candilis et al., 1999; Goodwin et al., 2005). Drug treatments (specific antidepressants) and cognitive behavior therapy (CBT) are recognized as effective treatments with response rates varying between 40 and 80% according to studies and measures (Mitte, 2005; Otto & Deveney, 2005).

Virtual Reality exposure therapy (VRET), using real-time computer graphics, body tracking devices, visual displays and other sensory input systems, has been developed and proposed as an alternative therapeutic method useful in psychiatric illnesses, especially anxiety disorders (Gorini & Riva, 2008; Pull, 2005; Riva, 2008; de Carvalho, Freire, & Nardi, 2010). VRET is based on the gradual presentation of phobic stimuli to the patient via a computer-generated virtual environment that is synchronized with head and body motion (Wiederhold & Wiederhold, 2005). This desensitization through virtual immersion has been successfully used in most anxiety disorders (Coelho, Waters, Hine, & Wallis, 2009; Gorini & Riva, 2008; Pull, 2005). VRET may

have some advantages when compared to standard exposure (Côté & Bouchard, 2008) as it takes place in the privacy of the therapist's office, can be repeated or prolonged easily, is less time-consuming for the therapist and more acceptable by the patients (Garcia-Palacios, Botella, Hoffman, & Fabregat, 2007; Garcia-Palacios, Hoffman, See, Tsai, & Botella, 2001).

Two meta-analyses of VRET in anxiety disorders have been published (Parsons & Rizzo, 2008; Powers & Emmelkamp, 2008). Both showed marked positive effects of VRET, with mean effect sizes of 0.95 and 1.11 on anxiety measures, which were equal or even superior to those of in vivo exposure techniques. Nevertheless, all these studies were conducted on small samples and a limited numbers of subjects: 13 trials ( $n=397$ ) (Powers & Emmelkamp, 2008) and 21 trials ( $n=300$ ) (Parsons & Rizzo, 2008).

To date, there is only limited evidence for VRET use in PDA. Case studies have been reported (Jang, Ku, Shin, Choi, & Kim, 2000; Wiederhold & Wiederhold, 2005). North et al (North, North, & Coble, 1996) showed the efficacy of VRET in 30 agoraphobic students versus a non-treated control group of the same size. Vincelli et al. (Vincelli et al., 2003) developed a specific

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VRET program for panic disorder and agoraphobia named the experiential-cognitive therapy (ExCT): a package integrating a CBT program with four VR environments (elevator, supermarket, subway and a large open square). A preliminary investigation randomly allocated 12 consecutive patients to ExCT (eight sessions), CBT (12 sessions), and a waitlist (Vincelli et al., 2003). Both CBT and ExCT significantly reduced the number of panic attacks. Another study was conducted by the same group, comparing four sessions of ExCT to 12 sessions of CBT in two samples of 20 patients each (Choi et al., 2005). Results were similar in post-test assessments, but long-term effectiveness of ExCT was relatively inferior to standard CBT. Botella et al. (Botella et al., 2007) reported a controlled study comparing VRET and CBT programs, each including nine weekly sessions, in panic disorder with or without agoraphobia. In post-treatment and follow-up assessments nine months later, VRET and CBT showed the same therapeutic results both being significantly superior to those obtained in the waitlist group. However this study was conducted on a relatively small sample size (12 subjects per group).

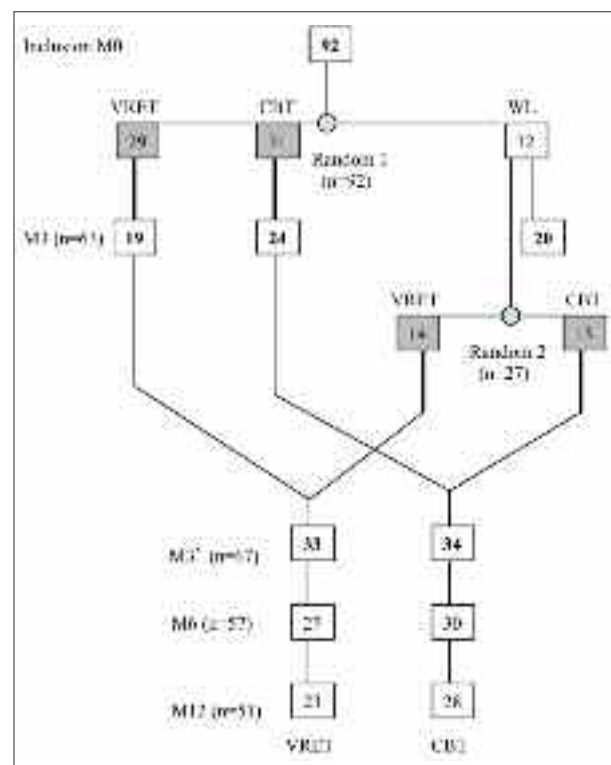
A recent study showed that a computer simulation of a simple 3-D computer animation of a short bus trip, from a first person perspective, may induce anxiety, and electrodermal and respiratory alterations in patients with PDA (Freire, De Carvalho, Joffily, Zin, & Nardi, 2010). The use of VRET in PDA is also encouraged by the knowledge of the role of vestibular dysfunctions in anxiety and by the potent impact of VR exposure on this phenomenon (Jacob, Whitney, Detweiler-Shostak, & Furman, 2001; Redfern, Furman, & Jacob, 2007; Viaud-Delmon, Ivanenko, Berthoz, & Jouvent, 2000; Viaud-Delmon, Warusfel, Seguelas, Rio, & Jouvent, 2006). These data need to be completed with a controlled research designed to clarify the process and outcome of "pure" CBT and "pure" VRET in PDA. In the present study, our primary objective was to compare pure VRET and a standard CBT program on a short- and long-term period. Our secondary objective was to compare both therapies with the absence of treatment (waitlist) on a short-term scale.

#### SUBJECTS AND DESIGN

The sample was made up of outpatients referred to three centers for specialized treatment in Lyon, Paris, and Luxembourg university hospitals. They were screened by the principal investigator of each center using a structured interview based upon the DSM-4 (American Psychiatric Association, 1996), the MINI (Lecrubier et al., 1997), and several anxiety and depression scales. To be included, subjects had to meet the DSM-IV (American Psychiatric Association, 1996) criteria for PDA. Patients with current major depression, or a score greater than 18 on the Hamilton rating scale for depression (Hamilton, 1960) at the screening visit were excluded. Patients with bipolar disorder, schizophrenia or other psychotic disorders, alcoholism, or street drugs use were not eligible. A history of CBT for PDA, or a current psychotherapy, was also an exclusionary factor. Patients who had received treatment with antidepressants, neuroleptics, anxiolytics or mood stabilizers within the two weeks preceding the entry were also excluded. Eligible patients were not allowed to take any psychotropic med-

ication, with the exception of low doses hypnotics, and could not receive psychotherapy during the study.

After the first evaluation, subjects were randomized either to VRET (12 sessions), CBT (12 sessions) or a waitlist control condition for three months (see the flow chart of the study, Figure 1). An assessment was done at the end of this first three-month period to compare the three groups. Then, the waitlist patients were re-randomized into VRET or CBT groups for three months of treatment (12 sessions). Hence, the whole sample was analyzed at three months and nine months after treatment. Patients received a two-page information leaflet about the trial and signed an informed consent. An ethic committee approved the protocol. Randomization was kept secret and delivered by the biostatistics department of the CHU of Lyon through a phone call to the secretary of each center.



### CBT METHODS

Cognitive and behavior methods used were those classically recommended for PDA (Cottraux et al., 1995; Landon & Barlow, 2004), and were highly structured and reproducible. Detailed manuals with guidelines for each session and checklists of the techniques were provided to the therapists and information sheets were given to the patient.

The treatment aimed at reducing both avoidant agoraphobic behavior, and the frequency of panic attacks. Session 1 comprised functional analysis of the relationships between emotions, behavior and cognition, and relaxation teaching. Patients received written information about panic attacks and agoraphobia, and a tape-recorded relaxation program. They were advised to practice relaxation 10 minutes every day. Cognitive and behavioral components were implemented from session 2 to 12. The cognitive component used respiratory control with provoked hyperventilation and cognitive restructuring. The subjects were taught to reattribute their symptoms to hyperventilation and/or tachycardia induced by stressful stimuli. Prolonged exposure in imagination to anxiety provoking scenes and interoceptive exposure to anxiety-related physical sensations were used. Misinterpretations of bodily sensations are discussed in a Socratic manner. A further step was the elicitation and disputing of automatic negative thoughts (e.g., becoming crazy or having a heart attack) and danger schemata. Questioning of automatic catastrophic thoughts and basic danger schemata were maintained outside the sessions through a daily five-column recording form discussed with the therapist. The behavioral component consisted of graduated exposure tasks agreed on by the therapists and patients and evaluated with a behavioral avoidance test form. Homework completion was discussed and cognitive techniques were implemented to facilitate subsequent exposure. During the last session, patients were advised to generalize these techniques to any situation that triggers anxiety.

### VIRTUAL REALITY EXPOSURE THERAPY

The VRET program included 12 sessions using virtual environments developed specifically for this research at the Collège de France (Paris, France) institute. The choice of 12 environments was made by a panel of four experts in CBT for anxiety disorders taking into account the Fear Questionnaire ratings of panic with agoraphobia patients, and their clinical experience: subway scenes; tunnels (walking); elevator and tunnels; shopping in a supermarket; car driving on a road in a lonely countryside or near a ravine; travelling on a plane; entering and sitting in a movie theatre; car driving in a lonely town; car driving in a tunnel and stopped by an accident; travelling by bus in a lonely town; being caught in a sensorial conflict (derealization inducing VRET scenario); and street scenes and crowded subways. For example, the subway scenes included navigating in the stations' tunnels, a subway ride and a moving train (Figure 2a and 2b). According to the subjects' anxiety level, the tasks gradually included walking in the station, getting on the ride, staying in the train while it's at a stop, and finally riding for one or more stops. In the supermarket scene (Figure 2c), the subject was supposed to walk progressively in the shop, look at various items

in the shelves, and when possible checking out at the cash register. In all the scenarios, the subject had the ability and was encouraged to explore visually the scene all around him in order to create an immersion effect and to enhance presence in the virtual world.



Figure 2. Captures of virtual scenes used in the VRET program, for exposure to a subway context (2a and 2b; shown at top) or a supermarket (2c; shown left).

All VR scenes were presented through a head mounted display (HMD) which provided a 60° diagonal field of view (Kaiser Pro view 60™), tracked head movement and was connected to a PC running the VR program developed with Vrttools software.

In the first session, the patient was familiarized with the technique and gave four ratings while he or she was confronted briefly with the images of each of the 12 scenarios:

- Does the scenario represent a significant problem?
- Rating on the 0-100 Subjective Unit of Disturbance (SUD) the level of anxiety that would be felt in real life.
- Rating on the SUD the level of anxiety created by the VR images.
- Classification of the 12 scenarios along a hierarchy (fear thermometer): from the less disturbing (=1) to the most disturbing (=12). This allowed a progressive immersion into more and more fearsome scenarios.

The therapists conducted the computer program while taking into account the verbal and non-verbal reactions of the patients. Some patients, familiar with computer management, were able to carry out the navigation into VR on their own. Each scenario was of graded complexity according to the general difficulties encountered in agoraphobia. The therapists interacted verbally with the patient to enhance the illusion of presence. VRET was presented in blocks of 10 minutes. Patients received the general instruction to expose themselves in real-life situations, but had no formal written and structured exposure homework whereas the CBT group subjects did. They were informed that the therapy included only the VRET sessions and that this method could

be effective to treat their disorder. Detailed manuals with guidelines for each session and checklist of the techniques were provided to the therapists and information sheets were given to the patient.

### MEASURES

In order to assess the impact of the intervention on the phobic symptoms, all patients completed the Fear Questionnaire (FQ) (Marks & Mathews, 1982) at baseline and at each visit. The other phobia measures were the Panic Disorder Severity Scale (PDSS) (Shear, Rucci et al., 2001), the Chambless Agoraphobic Cognitions (CAS) scale (Chambless, Caputo, Bright, & Gallagher, 1984), and the Panic, Phobia and Generalized Anxiety Scale (PPGAS) (Cottraux, Bouvard, & Légeron, 1985). Anxiety and depression were assessed through the State and Trait Anxiety questionnaire (STAI) (Spielberger, 1983), the Hamilton Anxiety Rating Scale (HARS) (Hamilton, 1959), and the 21-item Beck Depression Inventory (Beck, Steer, & Garbin, 1988). The Sheehan Disability Scale (SDS) (Sheehan, Harnett-Sheehan, & Raj, 1996) was also used at baseline and at each visit, as well as the Global Assessment of Functioning scale (GAF) (American Psychiatric Association, 1996) the Dissociative Experience Scale (DES) (Bernstein & Putnam, 1986) and the Work and Social Adjustment scale (WSA) (Mataix-Cols et al., 2005). At the first therapeutic session only, both the therapist and the patient filled out the Expectancies Rating Scale (ERS), rating the expectancies of improvement from zero to eight; the higher the score the worse the expectations of improvement. French validated versions of all the scales were used (Bouvard & Cottraux, 2005). At the end of the treatment, the Therapeutic Relationship Evaluation Scales (TRES) were filled in (the therapists evaluated the patients and the patients their therapists). These scales (Cottraux et al., 1995; Hoogduin, De Haan, & Schaap, 1989) consisted of 12 pairs of bipolar adjectives presented ranging from one (agreeable) to six (disagreeable). The higher the scores, the less favorably the relationship was evaluated.

### STATISTICAL ANALYSES

Values were expressed as mean and stan-

dard deviation (SD) or frequency and percentage. For socio-demographic and clinical scales, baseline comparisons of CBT, VRET and WL groups were done with Fisher's exact test for categorical variables and with Kruskal-Wallis test for dimensional variables. The response criterion was a 50% or more decrease of the FQ agoraphobia sub-score between baseline and post-treatment visits. The three groups were compared on this response rate at M3, and subsequently the two groups three months and nine months after treatment. The response rates were also compared using the Fisher's exact test, and the course of response rates over time in VRET and CBT were compared using two-level hierarchic models: logistic regressions with random intercepts. Secondary outcome criteria were FQ and

other scales' means comparison between VRET and CBT groups at M3, M6 and M12 with the Kruskal-Wallis test. All statistical analyses performed with SAS software Version 9.1.3.,  $p < 0.05$ , were considered statistically significant for all tests (two-tailed).

### RESULTS

Ninety two outpatients (30 males and 62 females) were randomized in three arms: 29 in VRET, 31 in CBT, and 32 in the waitlist (WL) group (see Figure 1). At the end of the first 12-week period (M3), 27 patients from the WL group were randomized in the two treatment arms: 14 in the VRET group, and 13 in the CBT group (five subjects stopped the trial before the second randomization). After three months of treatment (M3'), 33

Table 1  
*Baseline Characteristics of the Total Sample and of the Three Treatment Groups (n=92)*

	VRET	CBT	WL	Comparison
	n=29	n=31	n=32	p value
Sex				0.64
Males	8 (27.6 %)	12 (38.7 %)	10 (31.3 %)	
Females	21 (72.4 %)	19 (61.3 %)	22 (68.8 %)	
Age	37.7 (7.3)	36.6 (10.6)	37 (11.3)	0.89
FQ				
Agoraphobia	18.2 (11.7)	21.2 (9.7)	24.25 (10.3)	0.11
Social Phobia	11.6 (9.0)	12.65 (7.9)	12.8 (10.2)	0.83
Blood-injury phobia	13.0 (9)	14.2 (9.8)	16.3 (9.1)	0.38
Anxiety-depression	18.8 (10.1)	20.4 (7.55)	19.75 (8.2)	0.70
Disturbance	6.1 (1.6)	6.1 (1.9)	6.7 (1.45)	0.26
PDSS	17.8 (5.6)	18.0 (5.1)	17.3 (6.0)	0.9
HARS				
Total	27.7 (11.4)	28.8 (10.7)	28.4 (9.9)	0.97
Psychological anxiety	13.7 (6.15)	14.35 (5.5)	14 (5.7)	0.92
Somatic anxiety	14 (6.1)	14.4 (6.5)	14.4 (4.75)	0.97
SDS	14.9 (8.8)	16.5 (7.2)	15.1 (6.7)	0.73
GAF	50.6 (8.2)	52.1 (11.1)	51.6 (10)	0.95

FQ=Fear Questionnaire; PDSS=Panic Disorder Severity Scale; HARS=Hamilton Anxiety Rating Scale; SDS=Sheehan Disability Scale; GAF=Global Assessment of Functioning



Table 2

Mean Scores (and SD) of Anxiety and Other Scales in VRET and CBT Groups at the Four Visits of the Study (n=87)

	Baseline		M3'		M6		M12	
	VRET	CBT	VRET	CBT	VRET	CBT	VRET	CBT
FQ scores								
- agoraphobia	20.6 (11.6)	21.6 (10.2)	12.8 (10.0)	12.5 (9.2)	13.6 (9.8)	10.5 (10.0)	11.6 (10.2)	10.0 (10.1)
- social	11.6 (8.6)	13.1 (8.5)	9.2 (8.7)	8.2 (7.4)	8.9 (8.4)	6.0 (5.1)	10.6 (8.8)	6.9 (7.1)
- blood/injury	14.1 (9.2)	14.2 (9.8)	11.7 (9.5)	9.7 (7.9)	11.4 (8.6)	7.7 (7.5)	11.9 (10.2)	7.4 (7.7)
- anxiety/dep.	19.6 (9.4)	19.2 (7.5)	14.4 (10.3)	13.2 (9.2)	11.7 (9.7)	9.4 (8.9)	10.9 (8.3)	8.5 (7.4)
- disturbances	6.3 (1.5)	6.0 (1.9)	4.39 (2.2)	3.8 (2.2)	4.4 (2.5)	3.0 (2.3)*	3.6 (2.5)	3.0 (2.8)
PDSS total	18.2 (5.5)	18.2 (5.2)	11.7 (6.3)	9.1 (5.3)	9.3 (6.5)	8.0 (6.5)	8.8 (6.3)	7.7 (8.0)
CAS	34.0 (10.6)	33.6 (9.0)	27.5 (7.7)	26.0 (6.8)	25.4 (9.7)	22.4 (6.5)	20.8 (7.5)	20.9 (8.1)
STAI trait	55.6 (10.8)	55.4 (9.2)	49.4 (11.3)	47.2 (10.6)	48.2 (13.0)	42.5 (11.3)	47.5 (12.0)	43.4 (11.3)
STAI state	46.1 (12.5)	43.7 (11.6)	41.0 (11.8)	37.3 (9.0)	38.6 (12.3)	35.3 (10.4)	40.3 (13.3)	36.9 (13.6)
HARS total	27.7 (10.8)	26.9 (10.6)	20.0 (13.1)	15.9 (10.7)	19.3 (14.8)	14.3 (11.7)	17.2 (13.7)	12.8 (13.1)
- psychological anxiety	11.6 (5.4)	13.6 (5.5)	10.2 (6.9)	7.8 (5.3)	7.9 (5.7)	7.4 (5.5)	7.9 (6.4)	6.5 (6.5)
- somatic anxiety	14.1 (5.9)	13.4 (6.2)	9.4 (6.7)	8.1 (5.8)	7.8 (6.2)	6.8 (6.4)	7.2 (6.1)	6.3 (6.8)
BDI-21	16.5 (10.2)	16.1 (6.8)	10.1 (8.2)	9.8 (7.5)	10.3 (9.4)	8.8 (7.7)	9.2 (7.3)	9.1 (9.7)
DES total	13.6 (11.6)	11.6 (10.3)	10.1 (8.7)	7.5 (7.2)	8.8 (8.5)	6.4 (8.0)	8.2 (11.3)	6.2 (8.7)
PPGAS								
- Phobia 1	7.1 (1.6)	6.9 (1.4)	5.2 (2.5)	4.2 (2.7)	5.0 (2.8)	3.5 (2.3)*	4.2 (2.7)	3.5 (2.7)
- Phobia 2	5.7 (2.6)	6.2 (2.1)	4.1 (2.5)	3.8 (2.5)	4.2 (3.5)	3.5 (2.5)	3.5 (2.4)	3.4 (2.6)
- Panic attacks	2.4 (2.6)	2.6 (2.4)	1.4 (2.6)	1.0 (2.0)	0.7 (1.6)	0.9 (1.5)	1.1 (1.8)	1.4 (2.2)
- No symp.	6.8 (4.1)	7.4 (3.5)	3.6 (4.5)	3.0 (3.7)	3.9 (4.4)	3.0 (3.7)	4.1 (4.5)	3.0 (3.8)
- Gen. Ans.	4.9 (2.2)	5.1 (2.1)	3.3 (2.4)	3.2 (2.5)	3.3 (2.6)	3.1 (2.1)	2.7 (1.9)	3.2 (2.6)
WSA scale	17.5 (10.3)	18.4 (8.5)	11.6 (8.2)	10.3 (8.2)	12.2 (8.4)	9.1 (8.5)	10.9 (9.0)	8.5 (8.5)
SDS	15.2 (8.7)	15.6 (6.6)	10.2 (7.4)	8.5 (6.7)	10.0 (7.1)	7.3 (7.3)	8.4 (6.6)	7.7 (7.5)
TRES								
- patient	-	-	17.3 (4.0)	18.2 (10.8)	-	-	-	-
- therapist	-	-	23.1 (8.6)	22.2 (9.4)	-	-	-	-
ERS								
- patient	1.9 (1.3)	1.6 (1.5)	-	-	-	-	-	-
- therapist	2.5 (1.1)	1.5 (1.1)*	-	-	-	-	-	-

FQ=Fear Questionnaire; PDSS=Panic Disorder Severity Scale; CAS=Chambless Agoraphobic Cognitions; STAI= State and Trait Anxiety questionnaire; HARS=Hamilton Anxiety Rating Scale; BDI=21-item Beck Depression Inventory; DES=Dissociative Experience Scale; PPGAS=Panic, Phobia and Generalized Anxiety Scale; WSA=Work and Social Adjustment Scale; SDS=Sheehan Disability Scale; TRES=Therapeutic Relationship Evaluation Scales; ERS= Expectancies Rating Scale

VRET subjects were compared with 34 CBT subjects, and then 27 versus 30 at M6, and 23 versus 28 at M12.

Demographic and baseline clinical characteristics of the three groups found no significant between-group differences (see Table 1). The mean PDSS and FQ scores indicated relatively severe disorders. The mean scores of the ERS-therapist were significantly more pessimistic in the VRET group than in CBT ( $p=0.01$ ), while ERS-patient scores were not different.

At M3, no between-group significant difference appeared on the response criterion even if a lower responder rate was observed in the WL group: 35% versus 45.8% in the CBT group and 42.1% in the VRET group ( $p=0.77$ ). At M3', no different response rates were observed between VRET and CBT groups, respectively 38.7% and 48.5% ( $p=0.46$ ). During follow-up, no difference emerged between both groups concerning response rates at M6 (VRET 44% versus CBT 56.7%;  $p=0.42$ ) and M12

visits (VRET 47.6% versus CBT 60.7%;  $p=0.40$ ), and the response rates remained stable or tended to slightly increase. In the two-level hierarchic mixed model, with visits (M3', M6, M12) and visit deviations (months) in level 1, and group (VRET versus CBT) in level 2, no difference appeared in the response rates between both groups, taking into account the visit x groups interactions ( $OR=0.58$ ; 0.21-1.61) or not ( $OR=0.58$ ; 0.21-1.62).

The mean Agoraphobia FQ sub-scores showed similar courses in both groups, with a decrease between M0 and M3' and a stability between M3' and M12, without any statistical difference during any visit (see Table 2). The mean of other scales' scores at each visit are presented in Table 2, which shows no significant difference between the VRET and CBT final groups after the second randomization, except for FQ disability sub-score at M6 ( $p=0.05$ ), for Phobia 1 sub-score of the PPGAS scale also at M6 ( $p=0.04$ ), and for ERS-therapist score ( $p=.0001$ ), all measures being higher in the VRET group.



### DISCUSSION

The main result is the equivalent effect obtained with VRET and CBT in post-treatment assessment and during the nine-month follow-up. This is the first report of a controlled comparative trial of pure VRET in PDA conducted on a sample of more than 80 patients. Previous studies were open or controlled but with smaller sample sizes (Botella et al., 2007; Choi et al., 2005; North et al., 1996; Price & Anderson, 2007; Vincelli et al., 2003; Wiederhold & Wiederhold, 2005).

Response rates obtained in both active groups (45.8% for CBT and 42.1% for VRET at M3), using a relatively stringent criteria of a reduction of 50% or more on the FQ agoraphobia sub-scale, were satisfying and in accordance with those observed in reference studies for CBT. For example, in the Barlow et al. (Barlow, Gorman, Shear, & Woods, 2000) study on panic disorder, while using the same type of treatment methods, 48.7% of the patients receiving CBT alone were responders. However, we could not find a significant difference between both active groups and the WL control group. This unusual result may be partially explained by a lack of statistical power, due to unexpected high attrition rates (see below). Another explanation could be the relatively elevated response rate obtained in the WL group (35%), which could be related to therapeutic expectancies in either treatment. This was higher than the 21.7% obtained in the Barlow et al. (Barlow et al., 2000) study in the placebo group. The reasons for this phenomenon are unclear. Our sample exhibited a severe intensity of agoraphobia and panic: mean baseline PDSS score of 18.2, compared to about 12-13 in the Barlow et al. (Barlow et al., 2000) and Shear et al. (Shear, Houck, Greeno, & Masters, 2001) studies, with similar trends for FQ scores (Ost, Thulin, & Ramnero, 2004). Methodological factors should probably be implicated in the high response rates obtained in our control group and in the lack of statistical difference between active and WL group results. The choice of the response criteria can be one of the critical methodological factors as shown in the Barlow et al. (Barlow et al., 2000) study in which both imipramine and CBT were significantly superior to placebo for the acute treatment phase as assessed by the PDSS (with a 21.7% placebo response rate), but were not significantly different on the Clinical Global Impression scale (response rate 37.5%). The FQ-based outcome criteria chosen in our study is, however, one of the more widely used in studies of CBT in agoraphobia (Bandelow, Seidler-Brandler, Becker, Wedekind, & Ruther, 2007; Ost et al., 2004; Roy-Byrne et al., 2005; Shear, Houck et al., 2001; Vincelli et al., 2003).

The main limitation of this study is the elevated attrition rate during the trial (27.2%) although not exceptional; in a meta-analysis of therapeutic studies on panic disorder, Mitte found mean drop-out rates of  $15.1\% \pm 12.8$  for CBT trials, and of  $20.4\% \pm 15.3$  for pharmacotherapy trials (Mitte, 2005). Despite the relatively important sample size at inclusion ( $n=92$ ), the final comparisons concerned two groups of restricted size (33 versus 34 subjects at three months after treatment). This high attrition rate limits the statistical power of the analyses. However, the numbers of missing subjects were about the same in CBT and

VRET groups, respectively 22.7% and 23.2%, resulting in well-balanced final groups. The reasons for dropping out seemed unrelated to the randomly attributed treatment and beliefs in the effectiveness of VRET or CBT. An explanation might be the high severity of the majority of our patients compared to similar studies (Barlow et al., 2000; Shear, Houck et al., 2001). In France and Luxembourg the patients referred to university hospitals are generally severe cases.

The follow-up assessment of efficacy nine months after the end of the treatment showed that the response rates were maintained in both groups throughout this long-term period. The therapeutic effect size was stable with a mean reduction of about 50% of the FQ agoraphobia sub-score and of the PDSS score in comparison with values at inclusion (Table 2). This observation is of importance as agoraphobia and panic disorder are known to be chronic disorders with a natural course lasting many years according to epidemiological studies (Goodwin et al., 2005). The long-term efficacy of CBT has been well established in these conditions unlike what is generally observed after drug treatment ending (Furukawa, Watanabe, & Churchill, 2007). The fact that the same stable therapeutic effects were obtained with VRET is an asset considering the brevity (12 weeks) of the program. To date, only a few studies of VRET application in psychiatric disorders have shown stable outcomes on a comparable follow-up length (Pull, 2005).

Although not significant for primary outcome variables, there is a trend towards a slight superiority of CBT on several secondary measures when compared with VRET (see Table 2). Significant differences were observed at M6 on the FQ disturbance sub-score and PPGAS phobia scale. However, the levels of significance were low and disappeared after corrections for multiple comparisons. This finding is clearly at variance with a meta-analysis comparing VRET and CBT in anxiety disorders and concludes that VRET was "slightly, but significantly, more effective than exposure in vivo, the gold standard in the field" (Powers & Emmelkamp, 2008). Nevertheless, some limitations to VRET efficacy could exist in our program and some technical or psychotherapeutic components could be optimized. An important issue in this domain is to ascertain whether the VRET program should contain only pure VR exposure without any other therapeutic component such as relaxation, cognitive restructuring, and exposure instructions, or if a combination could be more efficient as suggested by some positive results obtained through combined CBT-VRET programs for panic disorder (Vincelli et al., 2003). This issue merges with the more general question, which is unresolved to this date, about the decisive therapeutic elements of CBT in anxiety disorders (Barlow & Allen, 2004).

The phenomenon called illusion of presence (the feeling of being in an environment although virtual) has been shown to be highly variable and unpredictable among subjects (Draper, Kaber, & Usher, 1999; Price & Anderson, 2007; Riva, 2008; Robillard, Bouchard, Fournier, & Renaud, 2003). We initially planned to measure this dimension during the VRET sessions,

but too much data was missing. This point needs to be explored in future research.

Another factor explaining the slight superiority of CBT to VRET could be the more pessimistic expectancies of the therapists regarding VRET compared with CBT, which was statistically significant. A recent study comparing VRET and CBT in fear of flying showed that higher positive expectancies can predict a better acute therapeutic response (Price, Anderson, Henrich, & Rothbaum, 2008). However, only the expectancies of the patients were measured in that study.

Other parameters may mediate the therapeutic response to VRET. For example, Côté and Bouchard (Côté & Bouchard, 2009) showed that changes in perceived self-efficacy and dysfunctional beliefs were the best predictors of change in general outcome of VRET for arachnophobia.

On a wider perspective, the place of VRET in PDA treatment still needs clarification. Some advantages of this method have been underlined: acceptability, confidentiality, feasibility for some exposures such as driving or flying, and time-consumption for the therapist, etc. (Côté & Bouchard, 2008). Another therapeutic interest may be the association of VRET with cognitive enhancers, such as d-cycloserine, especially in anxiety disorders (Meyerbröker & Emmelkamp, 2010). However, two important aspects could for the moment limit its use when compared to CBT: an insufficient knowledge of its specific efficacy on the various symptoms and forms of PDA and the cost of the equipment. The complete apparatus to perform VRET costs at least

about 3000 dollars (with a need for a specific long-term maintenance), which is accessible for specialized and research centers, but not for front line therapists.

From a technical point of view, we used a HMD with relatively poor field of vision (60°). It was, at the time of the research, the best compromise between 3-D glasses and auto-stereo screens in order to create a good immersion effect, limit distractors in the field of vision, and be spatially and materially compatible with a hospital context. Recent progress in HMD devices (e.g., larger field of vision) provide higher immersion effects and, probably, would enhance some exposure and therapeutic effects. In conclusion, our primary objective was to show that “pure” VRET could be effective to treat PDA. This study, despite some limitations, suggests that the acute and long-term efficacy of “pure” VRET and “classical” CBT are similar in PDA. Further studies should now determine the optimal combination of the therapeutic components belonging to each method in order to optimize the outcomes.

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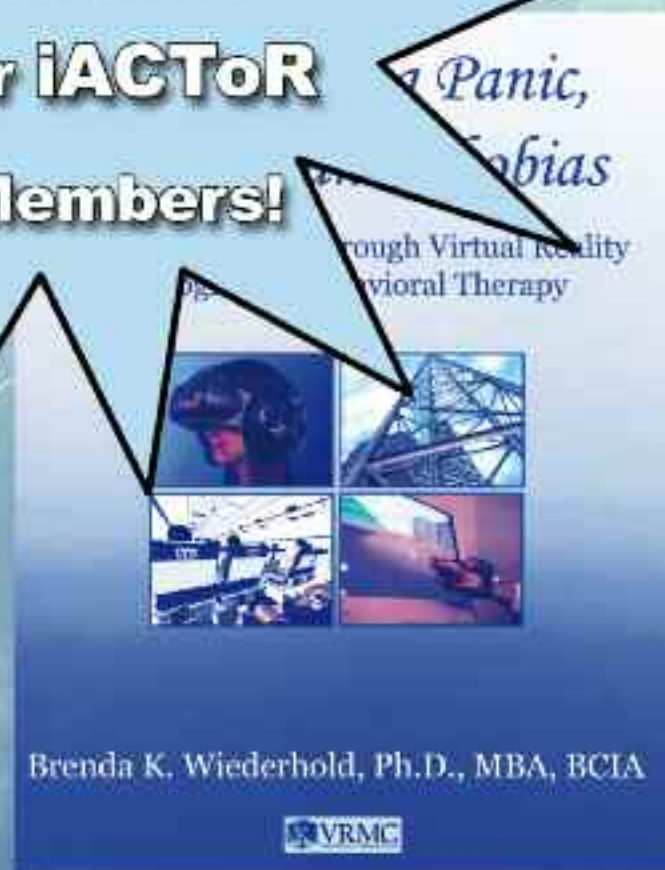
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# USING VIRTUAL REALITY TO ASSESS PROSPECTIVE MEMORY AND EXECUTIVE FUNCTIONS AFTER TRAUMATIC BRAIN INJURY

Frédéric Banville<sup>1</sup> and Pierre Nolin<sup>2</sup>

Deficits in prospective memory are common after traumatic brain injury (TBI), and such deficits can affect people's social participation. Neuropsychological assessment tools have thus far met with limited success in identifying the subtle executive deficits that interfere with performance of prospective tasks. **Objective:** To demonstrate the relevance of an assessment procedure that uses immersive Virtual Reality (VR) to detect posttraumatic prospective-memory disorders. **Method:** Thirty-one participants who sustained a traumatic brain injury (TBI) were compared with 31 control participants. The two groups had to visit two virtual apartments and perform three prospective tasks. They also had to perform two other prospective tasks as part of a traditional assessment. **Results:** Participants in both groups succeeded at the prospective-memory tasks. However, those with TBI were less efficient at the VR tasks. The results from the assessments conducted in this study, both immersive and traditional, enabled us to classify participants by group (i.e., TBI or control) with a 75% success rate. **Conclusion:** The present study shows the relevance of VR as a complement to traditional assessment tasks in assessing prospective memory and executive function post-TBI.

**Keywords:** Prospective Memory, Executive Functions, Multitasking, Virtual Reality, Traumatic Brain Injury

## INTRODUCTION

Each year, approximately 1.9 million people are taken to the hospital for traumatic brain injury (TBI) in the U.S. (Kraus & Sorenson, 1994). Of these, 235,000 receive emergency medical care, and 50,000 lose their lives. Nearly 1.1 million of them receive rehabilitation after their TBI (Trudel, Scherer, & Elias, 2009). Following rehabilitation, an estimated 100,000 persons must learn to cope with serious cognitive deficits or permanent physical or psychosocial disabilities (Trudel et al., 2009).

The Centers for Disease Control and Prevention define TBI as a "craniocerebral trauma associated with neurological or neuropsychological abnormalities, skull fracture, intracranial lesions or death." As part of its work in helping survivors to deal with the consequences of their injuries, the Congressional Brain Injury Task Force (2004) defined TBI as a

"nondegenerative, noncongenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairment of cognitive, physical, and psychosocial functions, with an associated diminished or altered state of consciousness."

Due to the high rate of post-injury neurological lesions, almost all individuals with moderate or severe TBI experienced per-

manent cognitive effects (Fay, Yeates, Wade, Drotar, Stancin, & Taylor, 2009; Pinkston, Santa Maria, & Davis, 2000).

TBI greatly influences people's adaptive behaviors in day-to-day life (Sosin, Sacks, & Webb, 1996). Prospective memory problems are among the most frequent complaints observed after a TBI (Cockburn, 1995; Groot, Wilson, Evans, & Watson, 2002; Knight, Harnett, & Titov, 2005; McDaniel, Glisky, Rubin, Guynn, & Routhieaux, 1999; Shum, Valentine, & Cutmore, 1999), and these tend to persist for a long time after the individual has recovered from the acute effects of TBI (Anderson & Knight, 2010).

Prospective memory is defined as the ability to remember to carry out an intention in the future (Ellis, 1996). Research on prospective memory in individuals with TBI is a major field of study. However, most of this research has taken place in the laboratory, a setting in which tasks are often artificial compared to those encountered in daily life. An ecological approach to prospective memory research, by contrast, would employ tasks that are more realistic with respect to everyday life and consequently yield greater sensitivity in detecting post-traumatic cognitive impairment.

Some research on prospective memory post-TBI has taken an ecological approach. Most of this research has demonstrated the

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relevance of using virtual environments (VEs) in reliably assessing neurological deficits as they are encountered in daily life (Kinsella, Ong, & Tucker, 2009; Knight et al., 2005; Knight, Titov, & Crawford, 2006; Titov & Knight, 2005). More specifically, Knight et al. (2006) showed that VEs could reveal post-traumatic executive deficits involved in prospective memory. Kinsella et al. (2009) also showed that individuals with TBI are less precise at prospective remembering in a Virtual Reality (VR) task when compared with a control group.

Ecological assessment of prospective memory is a key element in detecting post-traumatic problems. Remembering to carry out intentions is a fundamental activity in daily life, and any deficit in this area is liable to carry important consequences for the affected individual, especially with respect to their independence (Cockburn, 1995; Knight et al., 2006; McDaniel et al., 1999; Shum, Fleming, & Neulinger, 2002) and their socialization (Fleming, Riley, Gill, Gullo, Strong, & Shum, 2005; Mangeot, Armstrong, Colvin, Yeates, & Taylor, 2002).

Theory holds that prospective memory has two main components: retrospective and prospective. The retrospective component involves the episodic memory, which refers to the ability to memorize an intention and the actions required to carry it out (Kliegel, Mackinlay, & Jäger, 2008). The prospective component involves the executive functions, including action planning, monitoring of prospective markers in the environment, and activation/inhibition of behaviors based on the intention (Shallice & Burgess, 1991).

Knight et al. (2006) mention that traditional tests of episodic memory have been correlated with prospective tasks only when environmental distractions are minimized; this relationship disappears when interferences are added to the ongoing task (i.e., the task that engages the participant such that the correct time to carry out the action becomes conscious). Executive functions are responsible for managing prospective cues and distractions until the appropriate time to carry out the action is reached. Knight et al. (2006) showed that, in people with TBI, there is a positive relationship between dysexecutive questionnaire (DEX) scores, which measure executive function, and results in prospective tasks carried out in an environment with distractions.

It follows that prospective memory depends on the executive functions (Burgess et al., 2008; Cohen & O'Reilly, 1996) all throughout the process of forming the intention to carrying it out. Meulemans (2006) claims that "executive functions" can be considered an umbrella term for a number of frontal sub-functions. In theory, then, prospective memory – unlike episodic memory or attention – is not a "purely" cognitive function. Prospective memory is a "cognitive construct" in which several independent functions work together in order for the intention to be carried out.

As the intention is being executed, the frontal lobes are thought to be involved in multitasking activities, in which personal mo-

tivation and involvement are major factors. Under these conditions, the person must accomplish tasks that are complex, concurrent and interrelated (Burgess, 2000). According to Burgess, Dumontheil, Gilbert, Okudam Schölvinick & Simons (2008), multitasking is based on the idea that the person coordinates and gets involved in multiple activities over a relatively long period of time, as is the case in prospective memory. Deficits in multitasking caused by TBI can impede performance in common tasks such as planning and preparing a meal (Cockburn, 1995) or planning and completing a shopping trip (Shallice & Burgess, 1991).

Essentially, the network that makes up prospective memory is supported by the multitasking abilities, which in turn call upon specific executive functions. These executive functions enable an individual to manage a prospective task that is tightly linked to the ongoing task (McDaniel & Einstein, 2007). In everyday situations, they also help the individual handle unexpected events and changes of plans whenever these arise. The prospective network's chief role is to help the individual adapt to a wide range of novel occurrences, ones that are not part of their usual routine (Meulemans, 2006). In this context, Kliegel et al. (2008) have advanced that the prefrontal cortex is heavily involved in prospective remembering.

In examining the complex phenomena involved in carrying out an intention, the experimenter's main challenge is to administer realistic tasks that have discriminatory power. In the face of this challenge, researchers are beginning to see immersive VR as a means of representing real life in assessments. The appeal of immersive assessments is that (firstly) the subject is exposed to realistic stimuli and that (secondly) the measure is easily standardized. VR is at the confluence of ecological assessment (in which tasks are lifelike) and traditional assessment (in which reliability, standardization and normalization are crucial). VR has been described as a tool for systematic, rigorous and standardized assessment of cognitive functions (Schultheis & Rizzo, 2002; Tarr & Warren, 2002; Zhang, Abreu, Seale, Masel, Christiansen, & Ottenbacher, 2003). It also represents an ecologically valid means of measuring specific functions by allowing users to interact with computer-simulated objects and environments both in three dimensions and in real time, "like in real life" (Pratt, Zyda & Kelleher, 1995).

Eleven VEs have been used in research to assess prospective memory. The tasks used in prior studies can be grouped into two main categories: (1) prospective-memory tasks that involve moving objects in a virtual apartment (Attree, Dancy, & Pope, 2009; Brooks, Rose, Potter, Jayawardena, & Morling, 2004; Morris, Kotisa, Bramham, Brooks, & Rose, 2002; Sweeney, Kersel, Morris, Manly, & Evans, 2010) and (2) shopping tasks that assess either action planning (Cromby, Standen, Newman, & Tasker et al., 1996; Klinger, Chemin, Lebreton, & Marié, 2006; Lee et al., 2003; Werner, Rabinowitz, Klinger, Korczyn, & Josman, 2009) or multitasking (Rand, Katz, Shahr, Kizony, & Weiss, 2005; Rand, Katz, & Weiss, 2007; Rand, Basha-Abu, Weiss, & Katz, 2009; Raspelli et al., 2009).

All eleven environments, with the exception of that used in Lee et al. (2003), have a demonstrated ability to help identify specific problems in participants. However, detailed examination of these studies has uncovered a number of shortcomings in these environments that interfere both with the psychometric quality of the tool and with its ecological validity. These shortcomings include the following: too few participants, too great a diversity in etiology among participants and difficulty in finding enough patients with lesions in the same areas of the brain, the artificial nature of the task, the lack of an ongoing task, and finally, lack of data on the reliability of the measure.

Only three of the eleven research teams used VR to describe the performance of individuals with acquired cerebral lesions in prospective memory tasks: McGeorge, Phillips, Crawford, Garden, Della Sella & Milne (2001), Sweeney et al. (2010) and Zalla, Plassiard, Pillon, Grafman, & Sirigu (2001). The study by McGeorge et al. (2001) compared the performance in the Virtual Errands Test between two groups of participants: one comprised of people with TBI and the other a control group. The Virtual Errands Test is analogous to Shallice and Burgess's (1991) Multiple Errands Test. In that study, the participants with a neurological condition accomplished significantly fewer of the required tasks than the control group, in both the VE and the real environment.

Sweeney et al. (2010) examined individuals with a variety of neurological problems (e.g., TBI, stroke, encephalopathy). The group with neurological problems was paired with a control group. All participants had to perform a number of prospective-memory tasks in a virtual warehouse. The participants with neurological problems performed similarly to those in the control group in event-based and activity-based prospective-memory tasks. However, they performed significantly worse than the control group in time-based tasks and broke the rules more often.

In Zalla et al. (2001), participants with various neurological problems (e.g., TBI, stroke, astrocytoma, brain aneurism) were paired with a control group. The experimental task was to formulate and then execute a plan of action on the theme of "morning routine." Participants with neurological problems performed at a level similar to that of the control group in terms of action production performance and the number of actions executed. However, the experimental group committed many more errors than the control group with respect to the continuity and the consistency of the actions. Specifically, they performed more actions that failed, skipped more steps, expressed intentions without performing the actions, and started actions without finishing them.

#### RESEARCH OBJECTIVES AND HYPOTHESES

The goal of this study is to show that VR in immersive mode is a good means of detecting prospective-memory problems. To this end, two specific objectives were developed.

The first objective was to determine if there was a significant

difference in ability to carry out an intention between participants with TBI and control participants. The second objective was to determine if the results obtained from the prospective-memory tasks would allow us to distinguish between the two groups.

#### METHOD

##### PARTICIPANTS

Thirty-one individuals with TBI resulting from motor vehicle accidents participated in this study. This experimental group was composed of eight women and 23 men, all French-speaking. The mean age was 27 years (standard deviation = 11 years), and the mean level of education was 12 years (standard deviation = 2.5 years). Seven of these participants had moderate TBI, while the other 24 had severe TBI. The mean elapsed time since the accident was 3.78 years (standard deviation = 2.5 years). Most participants had frontal lesions (left, right or bilateral); a few had lesions in the temporal region. Each participant's diagnosis was confirmed by a doctor when they were admitted to the hospital, shortly after the accident.

The participants were contacted in accordance with the recruitment procedures at each of the four participating establishments. The establishments were all physical disability rehabilitation centers (CRDP) in the province of Quebec, Canada: Le Bouclier CRDP, La Maison, InterVal and the Quebec Institute of Rehabilitation for Physical Disabilities. All participants had previously completed the intensive functional rehabilitation phase and were living at home.

The control group was recruited from five workplaces in the province of Quebec, Canada. They were employees of Le Bouclier, La Maison Rehabilitation Centre, University of Quebec at Trois-Rivieres, University of Quebec in Abitibi-Témiscamingue and Drummondville CEGEP. This group was made up of eight women and 23 men, all French-speaking. The mean age was 27 years (standard deviation = 11 years), and the mean level of education was 12 years (standard deviation = 1.61 years).

Comparison of means for age [ $F(1,60) = 2.21$ ,  $p = 0.14$ ] and education level [ $F(1,60) = 2.15$ ,  $p = 0.15$ ] showed no significant difference between the groups for these variables.

##### COMPLEMENTARY MEASURES

Kennedy, Fowlkes, Berbaim, & Lilienthal's (1993) Simulator Sickness Questionnaire (SSQ), translated into French by Bouchard, Renaud, Robillard, St-Jacques, Côté & Courmoyer (2003), was used to check for cybersickness, which is sometimes experienced during immersion. In the validation study, the authors found three factors with factor weights between 0.50 and 0.75. This questionnaire served as a complementary measure for the present study because individuals with TBI may be more susceptible to experiencing cybersickness.

Schubert, Friedman & Regenbrecht's (2000) Igroup Presence Questionnaire (IPQ), translated into French and validated by

Viaud-Delmon (2007), measures the sense of presence, i.e., the feeling of “really being there” in the VE. Reliability studies have revealed that only two of the three subscales were psychometrically acceptable: spatial presence (SP = 0.80) and involvement (INV = 0.76); the figure for realism was lower (REAL = 0.68). The overall scale used in this study had an acceptable level of reliability (IPQ = 0.85). The IPQ was intended to verify that the sense of presence was equivalent between the two study groups; a weak sense of presence might have indicated problems with involvement in the VR task.

#### TRADITIONAL ASSESSMENT

Our traditional prospective-memory assessment was based on the most commonly cited tool in the literature: the Rivermead Behavioral Memory Test. The participant's first task was to ask the experimenter for a business card (CARD) halfway through the assessment. In the second task, having lent the experimenter a personal item, the participant had to ask for it back at the end of the assessment (BELONGING). Before proceeding with the experiment, each participant had to correctly state what the two prospective-memory tasks were. The total score for these laboratory measures is 6. Points were given for performing the correct action (1 point) at the correct time (1 point) without prompting from the experimenter (1 point). A high score indicates good performance in prospective-memory tasks. Scoring for the traditional assessment was labeled TRAD in the MANOVA procedure.

#### IMMERSIVE ASSESSMENT

The prospective-memory assessment in VR began with a scenario designed to render the task more realistic to everyday life. During the briefing, the participant was informed that he would soon have to move to a new apartment in a new city. His task was to visit two apartments (one small and one large) and choose the one he would prefer to live in. He was informed that his voice would be recorded during his visit and that he must give opinions on the apartments based on his personal tastes and needs and on practical housing considerations. Over the course of carrying out this task (which we designate here as the “ongoing task”), he was also responsible for performing three prospective-memory tasks: picking up a lease in the smaller apartment (LEASE); feeding a fish (while saying “I am feeding the fish”) upon seeing that the clock showed 11:41 (FISH); and turning off a fan (while saying “click”) in the master bedroom of the large apartment (FAN).

Our scoring system for the participants' performance in the immersive prospective-memory tasks was inspired by the studies conducted by Brooks et al. (2004) and Sweeney et al. (2010). Points were given as follows:

1. Prospective memory score (PMS): The maximum possible PMS was 9. For each of the three items, one was given for performing the correct action (1 point) at the correct time (1 point) in the correct place (1 point). A high score indicated good performance in carrying out intentions.

2. Precision score (PS): The maximum possible PS was 3. This score measured the precision with which the participant carried out the intention as specified in the instructions. The participant had to (a) verbalize “I am feeding the fish” while feeding the fish (1 point); (b) say “click” while turning off the fan (1 point); and (c) consciously, i.e., not by chance, pick up the lease in the small apartment and also not pick up the lease in the large apartment (1 point). A high score indicated close adherence to small details in the instructions, which makes the PS a measure of quality in carrying out intentions.

3. Total time (TT): The total duration of the immersion was also measured. Each participant was given as much time as necessary to complete all the tasks and was free to complete them in any order. A short time indicated a more effective strategy or better planning in carrying out intentions. The TT serves as a measure of the quality of planning. It also serves as a measure of the quality of managing interferences and cognitive overload.

#### MATERIALS AND PROCEDURE

The VR experiment was conducted using a personal computer (Dell XPS M1530; operating system: Windows Vista, Full Version) equipped with an nVidia 8600M GTO graphics card supporting video-game environments as well as an eMagin Z800 immersion lens (resolution: 600 x 800) with an integrated head tracker. Movement in the VE was controlled with a standard Logitech mouse. The VEs used in this study were created by Bouchard et al. (2007) and inserted into the video game Max Payne™. Participants had to visit a virtual city (learning phase) and then visit the two virtual apartments. Questionnaires dealing with sense of presence and cybersickness were later completed; the results were compiled directly into a database using File-Maker Pro 8™ software.

#### RESULTS

The study design was quasi-experimental. We performed multivariate analyses of variance (MANOVA), as well as a logistic regression as a means of answering the research questions.

**Data distribution.** Two tests on data distribution and equality of variance were conducted: the Levene test (equality of variance) and the Box test (equality of covariance). All scores measured prospective memory, PS and TT were not distributed normally, and the variance was not equal. Since most participants performed relatively well in the different tasks, the data were distributed mainly to the right of the normal curve. A logarithmic transformation ( $\log_{10}$ ) was applied to the data and served to correct for this effect. The complementary measures, i.e., the level of cybersickness and the sense of presence, showed normal distribution and homogenous variance.

#### PRELIMINARY ANALYSIS

In most studies that use VR technology, researchers control for cybersickness and sense of presence experienced by participants in the VE. Previous research on individuals with anxiety disorders (Alsina-Jurnet et al., 2010; Grove, 2010) has indicated that physical illness or difficulty feeling present in the VE has a neg-



ative effect on performance in prospective-memory tasks. Our statistical tests on these variables indicated that the two groups did not differ in VR sickness [ $F(1,60) = 0.023$ ,  $p = 0.88$ ] or in the sense of presence [ $F(1,60) = 0.433$ ,  $p = 0.51$ ]. An analysis of averages obtained for the two groups led us to confirm that no participants in either group showed severe symptoms and that, on average, there was no cybersickness experienced after the immersion (mean  $TBI_{group} = 0.42 \pm 0.09$ ; mean  $control_{group} = 0.40 \pm 0.49$ ; scale of 0–3). We were also able to confirm that participants in both groups felt “moderately present” on a Likert scale of 0–4 (mean  $TBI_{group} = 2.13 \pm 0.33$ ; mean  $control_{group} = 2.18 \pm 0.31$ ).

#### MEASURING PERFORMANCE AT PROSPECTIVE-MEMORY TASKS

The first specific research objective was to determine if participants with TBI and control participants differed significantly in their ability to carry out intentions (which corresponds to prospective memory). To answer this question, we conducted a multivariate analysis of variance (MANOVA), which would show if the groups differed with respect to the four dependent variables considered simultaneously.

The first analysis, the MANOVA, allowed us to observe the main effect by testing for the presence of a significant difference between the two groups. The Pillai's trace test (the most robust test when the groups are equal) showed that a significant difference exists between the groups when the four independent variables (i.e., PMS, PS, TT and TRAD) are considered simultaneously [ $F(1,50) = 8.79$ ,  $p = 0.002$ ]. The finding of this significant difference called for a second step: to determine the

simple effects of each variable. Cross-tabulation showed no strong correlations (strong being defined as  $> 0.30$ ) between variables. However, given that there are multiple dependent variables and that adding variables could result in false positives (Alain, 2008), we decided to conduct a stepdown test, which would allow us to determine each variable's separate contribution while controlling for the other variables. Based on a literature review, the following order of entry was used for the variables: precision score (PS), total time (TT), score from the VR test (PMS) and the score from the traditional test (TRAD).

Table 1 shows the real and transformed means, as well as the results from the simple effects analysis. We observed that, contrary to the first research hypothesis, participants in the two groups performed similarly in prospective-memory tests both in VR immersion [ $F(1,50) = 1.25$ ,  $p > 0.05$ ] and in the traditional setting [ $F(1,50) = 2.73$ ;  $p > 0.05$ ]. However, those with TBI were significantly less precise at performing prospective-memory tasks in VR [ $F(1,50) = 5.70$ ,  $p < 0.05$ ], precision being an indicator for quality of carrying out intentions. They also took more time performing the tasks in the VR environment [ $F(1,50) = 7.57$ ,  $p < 0.01$ ], time being an indicator for quality of planning and management of interference and cognitive overload.

#### DISCRIMINATORY ABILITY OF PROSPECTIVE-MEMORY TESTS

The second specific research objective was to determine if the results from the prospective-memory tests made it possible to discriminate which group – TBI or control – an individual belongs to. To this end, a logistic regression analysis was conducted. This statistical tool gives the researcher greater control

over the equation than do discriminant analysis tests, which only allow the researcher to analyze the main effects (in other words, no different from the MANOVA) (Tabachnick & Fidell, 2001). The main advantage of logistic regression in this research is its ability to produce the best equation to predict the dependent variable (i.e., the variable “group”), the values of which are dichotomous in this case. This test, unlike discriminant analysis and multiple linear regression, does not require normal distribution or homogeneity of variance; it was performed on the non-transformed scores, which will make the clinical interpretation easier.

The logistic regression used in this research is of the hierarchical (or sequential) type, thus allowing us to evaluate each predictor variable's contribution to the classification of participants by group. The equation was constructed by entering the traditional measures (TRAD), followed by the measures gathered in VR (PMS) and

Table 1

*Comparison of Groups: Real Means, Transformed Means and MANOVA Results*

Variables		Real mean	Standard deviation	Transformed mean	Standard deviation	Mean difference	
						F (1,50)	Sig.
VR	TBI	5.71	2.82	0.74	0.22	1.25	0.268
	Control	7.10	1.81	0.83	0.13		
TRAD	TBI	4.65	2.97	0.67	0.25	2.73	0.105
	Control	4.45	1.59	0.61	0.20		
Precision	TBI	1.77	1.06	0.29	0.18	5.70	0.021
	Control	2.58	0.76	0.41	0.13		
Time	TBI	13.48	9.07	1.07	0.22	7.57	0.008
	Control	9.45	3.90	0.95	0.16		



finally, the measures of precision (PS) and of total time (TT). The last two indicators were entered simultaneously because of their combined efficiency in measuring the realization of the intended action. We were able to detect improvements in classification quality each time a new predictor variable was added to the others. The order of entry for the variables was based on a literature review and on clinical experience. The score from the traditional tests was entered first (on the presumption that it would have a maximum of variance) because this tool would need to be able to reliably identify the individuals' problems if used in clinic. The scores from VR were entered second because studies in the literature have shown significant differences in performance between groups of participants with various problems in VR tests. The scores on precision and time were entered last because they were deemed complementary to the data on participants' success in prospective-memory tasks. Also, by dichotomizing the predictor variables (0 = failure; 1 = success) based on the median, we were able to estimate the likelihood of obtaining a correct classification based on different values in the predictive variable.

In the first step of the analysis, the results were generated when the equation contained only the "constant." The  $X^2$  (84.55) of the log-likelihood test ( $-2LL$ ) indicated that the constant alone is not sufficient to predict which group participants belong to. This repartition is, in fact, comparable to what would be obtained in a random distribution.

In the second step, the prospective-memory data from the traditional tests were entered into the logistic regression equation. We observed a marginal change in the  $X^2$  (decrease of 0.177), which renders the model not significant; this indicates that the variable TRAD alone is not sufficient to classify the participants into their groups (classification rate = 52.5%).

In the third step of the analysis, the predictive variable PMS was entered into the equation to determine the contribution of this

variable. The log-likelihood test showed a slight change in the  $X^2$  (decrease of 2.25), which was still not significant. Therefore, the combined prospective memory scores, i.e., those from the traditional and the VR tests, were not enough to correctly classify the participants into their groups (classification rate = 59.0%).

The final step of analysis consisted of adding the predictors PS and TT to the equation. This step significantly lowered the initial  $X^2$  by 16.70 ( $p = 0.002$ ). A Hosmer–Lemeshow test also showed that the data adjusted well to the model ( $X^2 = 7.58$ ;  $p = 0.475$ ) after this step. This version of the equation shows discriminatory ability. We are thus able to comment on the model's predictive ability: the prospective-memory assessment make it possible to correctly predict which group a participant belongs to 75.4% of the time.

Table 2 shows the beta (B) of the logistic regression equation. Note that the variables precision and time are significant when the other variables in the equation are kept constant. This indicates that they can serve as reliable predictors and are thus able to improve the classification of participants by group. The  $\text{Exp}(B)$  results, which reflect the change in the likelihood of success for a one-unit change in the independent variable, also provide interesting information: a person considered "precise" in the VR tasks is 7.04 times more likely to not function like a person with a TBI; similarly, a person who is considered "fast" at the test is 4.17 times more likely to function like a person with no TBI.

## DISCUSSION

This study was intended to confirm the relevance of using VR to identify prospective-memory problems post-TBI. Thirty-one experimental participants, each with a moderate or severe TBI resulting from a motor vehicle accident, were compared to 31 healthy adult participants.

The first research question centered on comparing participants' performance in different prospective-memory tests in an immersive VR assessment with that observed in traditional assessment procedures. Our results showed that participants in the TBI group performed similarly to the control group in both traditional and immersive prospective-memory tasks. However, the second and third scores from the VR test – quality (i.e., precision score) and efficiency (i.e., total time) – did show a difference between the two groups.

The second research question was to determine whether the

Table 2  
*Logistic Regression Equation: Results by Variable*

							95.0% C.I. for		
							EXP(B)		
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 <sup>a</sup>	TRAD	1.003	0.662	2.293	1	0.130	2.725	0.744	9.979
	VR	0.397	0.623	0.406	1	0.524	0.672	0.198	2.280
	Precision	-1.953	0.619	9.857	1	0.007	0.142	0.040	0.506
	Time	-1.425	0.663	4.354	1	0.037	0.240	0.067	0.917
	Constant	1.527	0.711	4.568	1	0.033	4.602		

<sup>a</sup>Variable(s) entered in step 1: precision, time

VR assessment procedure could serve to discriminate participants by classifying them by group (i.e., either TBI or control). Our results showed that the prospective-memory assessment procedure – the equation for which incorporated traditional measures and the three immersive measures – could be used to correctly classify 75% of the participants by group.

In a more thorough analysis, we used a logistic regression to determine each predictor variable's contribution to the classification of participants by group. In analyzing the components of the equation, we observed that the variables precision and time (both from the immersive test) were reliable indicators; their inclusion in the model improved classification when the other variables were kept constant.

Kliegel et al. (2008) looked at 17 studies on individuals with TBI using traditional assessment methods. They observed that people with TBI were deficient in most aspects of prospective memory (time-based, event-based and activity-based). In related work, a number of researchers have shown that participants with lesions in the prefrontal lobes experience major difficulties in everyday multitasking situations, which require prospective remembering (Burgess, 2000; Fortin, Godbout & Braun, 2002, 2003).

In the present study, participants with TBI scored within the normal range for prospective-memory tasks, both in the traditional assessment and in VR. Our results are comparable with those of Knight et al. (2006) and Sweeney et al. (2010), which showed that individuals with TBI perform well at prospective tasks in VEs. In their conclusion, Sweeney et al. (2010) advanced the hypothesis that participants succeeded at the prospective-memory tasks in their study simply because the tasks were easy. The same criticism could be made of the tasks in the present study, which might have been more sensitive to the phenomena under study had they been more complex. We also suggest that the ongoing task could be made more difficult by increasing the number of external distractions, thereby raising the level of cognitive overload.

The addition of time-based tasks could also increase the difficulty of the assessment procedure. Knight et al. (2006) have shown that tasks that are more demanding in terms of distractions and time management are more difficult for individuals with TBI to carry out because they have difficulty managing the distractions and dividing their attention. Under these conditions, executive deficits become more apparent and account for lower performance.

Given that the participants in our study had completed their rehabilitation nearly four years ago on average, their high performance could be attributed to the beneficial effects of their rehabilitation programs. It could also be the result of posttraumatic recovery; this might explain why, according to the classification analysis (second research objective), six individuals with TBI performed at a level comparable with that of the control group. It is less obvious, however, why nine control partic-

ipants were classified as having TBI. Close analysis of our logistic regression equation provides a few tentative explanations for the classification problems encountered in this study (i.e., a number of false positives in the predicted TBI group and false negatives in the predicted control group). Since performance at prospective-memory tasks was, on the whole, good, perhaps the equation itself lacks sensitivity. The false positives may be because of control participants whose execution times were more typical of participants with TBI. This slower speed might be due to phenomena that would impede performance, such as performance anxiety or unfamiliarity with the technology. An a posteriori descriptive analysis designed to support this hypothesis was carried out; 16 control participants were found to be as slow as the participants with TBI. The use of time as a metric of cognitive overload can therefore be nuanced: a measure of efficiency that incorporates both time and precision may prove more sensitive and precise.

It is also important to mention that the prospective-memory assessment conducted in VR included three components: the measure of success (PMS), the measure of precision (PS) and the measure of efficiency (TT). In comparison with traditional testing methods, the VR assessment procedure is, in our opinion, more complete and representative of real-life demands, as these three are the components that best discriminate between participants with TBI and those without. Our research has revealed that individuals with TBI do not perform "as well as all that" in prospective-memory tasks, as they differ in the quality and efficiency of their executive function.

Specifically, participants with TBI performed tasks more poorly either because they were less attentive to their environment during the monitoring phase (e.g., picking up the lease by accident) or because they did not complete the task according to the instructions given (e.g., not verbalizing "I am feeding the fish" when carrying out this task). Our results also demonstrated that individuals with TBI were less efficient, as they took more time to accomplish all the tasks. Sweeney et al. (2010) obtained similar results and suggest that these patterns may result from difficulty organizing and planning, as well as susceptibility to cognitive overload in individuals with TBI.

In a study that assessed participants in a virtual shopping activity, Kinsella et al. (2009) demonstrated that individuals with TBI were less precise in prospective remembering. Similarly, our measure of precision resembles the "errors score" in Shallice & Burgess (1991) and Sweeney et al. (2010), which both showed – one in a traditional setting and one in VR – that individuals with TBI made more errors than participants in the control group. Prospective-memory assessment procedures must not only measure success at a given task but also describe, insofar as possible, the underlying processes involved in carrying out the intention (e.g., efficiency, precision, ability to adjust, management of interferences, monitoring frequency, etc.).

Kliegel et al. (2008) propose that the manner in which the task was performed is more important than the final result. In this

view, even if participants with TBI succeed at accomplishing a task more or less correctly, the cognitive inconsistency (Schmitter-Edgecombe & Wright, 2004) observed during the performance of the task is probably evidence of inefficiency related to executive function in individuals with TBI.

Knight & Titov (2009) discuss current challenges in assessing prospective memory. Brooks et al. (2004) claim that the lack of assessment tools in this field is mainly the result of researchers' difficulty designing exhaustive assessments that do not involve conducting tests in participants' homes and the logistical challenges this would entail. A number of researchers have suggested using VR to develop assessment tools as a means of avoiding this problem. The present study belongs to this current of research; our results show that VR is indeed useful in discriminating between individuals with TBI and those without. More specifically, the assessment procedure in this study offers acceptable reliability, as it minimizes the number of false negatives (i.e., erroneously classifying individuals with TBI as healthy); our statistical analyses showed a success rate of 80%. Our results are consistent with those of Mathesis et al. (2007), who showed that VR immersion represents a reliable means of assessing posttraumatic memory and learning problems in adults with TBI.

#### STRENGTHS AND WEAKNESSES

Over the course of this research, it was found that VR shows promise as an assessment tool for detecting prospective-memory problems as they are likely experienced in real life, in all their subtleties and complexities. By offering a standardized procedure in an environment that simulates everyday activities, VR makes it possible to assess, in an interactive way, a person's capacity to coordinate the multiple cognitive abilities needed to carry out an intention. Using this procedure, we were able to correctly classify a high proportion of individuals by group (i.e., TBI or control). We observed that precision scores and time spent carrying out the task were more telling than success in performing the tasks in and of itself, as an individual's level of precision can be indicative of subtle problems. This observation will be of major importance in the

future development of ecologically valid neuropsychological assessment tools.

Notwithstanding, the relative easiness of the tasks constitutes the main drawback of this study. This probably compromises the psychometric quality of the tool, especially with respect to reliability, because the data do not naturally have a normal distribution. Accordingly, the tool could be improved by adding items or by making the tasks more difficult. In a study on multitasking ability in healthy subjects, Law, Logie & Pearson (2004) showed that people's ability to manage interruptions could be distinguished from their ability to organize and perform multiple tasks in a limited time. Based on these results, two specific improvements to our procedure could be made. The first would be to impose time limits for certain tasks by adjusting the number of interruptions. The second would be to include unforeseen elements in the assessment, thereby requiring the individual to reorganize himself while performing an intention. In a study on action planning, Klinger et al. (2006) observed that participants with Parkinson's disease took more time to complete the experiment; that they covered a greater distance; and that their movement was characterized by numerous stops, redundancy (e.g., retracing steps) and hesitation. In light of these findings, revisions to the assessment procedure should examine the quality of the participants' action planning by measuring the efficiency of their movement within the apartments. We also observed that the time score alone is not enough to gauge the quality of a person's cognitive function. For this reason, an efficiency score could be generated by combining the scores for time and precision; these two measures proved the most reliable in our VR assessment.

#### CONCLUSION

This study showed that VR is a promising means of assessing and observing cognitive function in everyday situations – situations in which complex and subtle executive dysfunctions related to prospective memory can be revealed. Subsequent researchers could endeavor to obtain greater specificity in complementary measures of executive function by using tests expressly designed for this.

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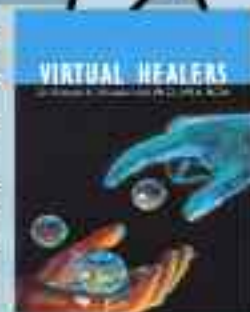
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# VIRTUAL REALITY CUE EXPOSURE THERAPY FOR THE TREATMENT OF TOBACCO DEPENDENCE

Christopher S. Culbertson<sup>1,2</sup>, Stephanie Shulenberg<sup>2</sup>, Richard De La Garza<sup>3</sup>, Thomas F. Newton<sup>3</sup> and Arthur L. Brody<sup>1,2</sup>

Researchers and clinicians have recently begun using Virtual Reality (VR) to create immersive and interactive cue exposure paradigms. The current study aimed to assess the effectiveness of individual cue exposure therapy (CET), using smoking-related VR cues (smoking-VR) as a smoking cessation treatment compared to a placebo-VR (neutral cue) treatment. The sample consisted of healthy treatment-seeking cigarette smokers, who underwent bi-weekly cognitive behavioral group therapy (CBT) plus either smoking-VR CET or placebo-VR CET (random assignment). Smoking-VR CET participants had a higher quit rate than placebo-VR CET participants ( $P = 0.015$ ). Smoking-VR CET treated participants also reported smoking significantly fewer cigarettes per day at the end of treatment than placebo-VR CET treated participants ( $P = 0.034$ ). These data indicate that smoking-related VR CET may prove useful in enhancing the efficacy of CBT treatment for tobacco dependence.

**Keywords:** Tobacco Dependence, Virtual Reality, Cognitive-behavioral Therapy, Smoking Cessation, Nicotine

## INTRODUCTION

Tobacco-dependent cigarette smokers develop associations between cigarette smoking and people, places, and objects. Subsequently, these smoking-related cues generally elicit craving and induce withdrawal when presented to smokers (Abrams, Monti, Carey, Pinto, & Jacobus, 1988; R. Niaura, Abrams, Pedraza, Monti, & Rohsenow, 1992; R. S. Niaura, et al., 1988; Tiffany & Hakenewerth, 1991). This cue-induced craving propagates smoking behavior and may provoke relapse in abstinent smokers (Abrams, et al., 1988; Abrams, et al., 1987; R. Niaura, Abrams, Demuth, Pinto, & Monti, 1989; R. Niaura, Abrams, Monti, & Pedraza, 1989). Smoking cessation therapies aimed at reducing overall craving have proven successful in increasing the likelihood of quitting; however, few therapies have demonstrated success in attenuating cue-induced craving (Drummond, 2000; Ferguson & Shiffman, 2008).

Extinction learning involves the repeated presentation of a cue, previously paired with reinforcement, in the absence of that reinforcement. This process eventually ceases to elicit the originally learned behavior (Shaham, Shalev, Lu, De Wit, & Stewart, 2003). The original association between cue and reinforcement remains intact, however, and may reemerge under a number of different scenarios. Animal models have shown that reinstatement of drug-seeking to previously extinguished cues occurs upon returning to the context where drug-cue conditioning took place (renewal effect), the presentation of a drug-cue some time after extinction training (spontaneous recovery), re-exposure to the reinforcing stimulus (reinstatement), or by the cue predicting

the availability of reinforcement (instrumental learning) (Self & Nestler, 1998). Each of these antecedents parallels situations reported to elicit relapse in drug-dependent individuals (Katz & Higgins, 2003), and therefore must be taken into consideration when developing behavioral therapy intended to reduce drug craving and relapse (Conklin & Tiffany, 2002).

Based on preclinical models of extinction learning, treatments have been developed to examine the efficacy of cue exposure therapy (CET) in humans (Hammersley, 1992; Heather & Bradley, 1990; Heather & Greeley, 1990). During CET, drug-dependent individuals are repeatedly exposed to drug cues (e.g., guided imagery or paraphernalia) in the absence of reinforcement (drug administration) in an attempt to extinguish previously learned drug-cue associations. Coping strategies commonly used in cognitive behavioral therapy (CBT) may also be included in CET to provide guidance on managing craving during high-risk situations (Rohsenow et al., 2001). CET has been administered in a variety of forms to treat tobacco (R. Niaura et al., 1999), alcohol- (Monti et al., 2001; Rohsenow et al., 2001), opiate- (Franken, de Haan, van der Meer, Haffmans, & Hendriks, 1999), and cocaine- (O'Brien, Childress, McLellan, & Ehrman, 1990) dependence with varying levels of success (Conklin & Tiffany, 2002).

Recently, clinicians have used Virtual Reality (VR) to create immersive and interactive cue exposure paradigms. These systems have been successfully applied to CET for the treatment of anxiety, specific phobias, posttraumatic stress (Parsons & Rizzo,

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2007; Rizzo et al., 2009) and substance-dependent disorders (J. Lee et al., 2004; J. H. Lee, Kwon, Choi, & Yang, 2007). Clinical trials have shown that VR elicits significantly greater cue-induced craving than either neutral cues (Baumann & Sayette, 2006; Bordnick et al., 2004; Bordnick, Graap, Copp, Brooks, & Ferrer, 2005; Bordnick et al., 2008; Kuntze et al., 2001; J. H. Lee et al., 2003; Saladin, Brady, Graap, & Rothbaum, 2006) or traditional models of cue exposure (Kuntze et al., 2001; J. H. Lee et al., 2003). Applying immersive, multimodal VR cue exposure to appropriately spaced CET sessions may alleviate deficiencies in traditional cue exposure methods and significantly enhance the efficacy of smoking cessation treatment (Conklin & Tiffany, 2002).

The current study aimed to assess the effectiveness of individual CET, conducted with VR smoking-related cues (smoking-VR) as a smoking cessation treatment, compared to a placebo-VR treatment. To ensure that all participants received treatment for tobacco dependence, group CBT was administered in combination with individual CET. We hypothesized that participants treated with smoking-VR would have higher abstinence rates and report greater reductions in craving for cigarettes than participants treated with placebo-VR.

## MATERIALS AND METHODS

### PARTICIPANTS

Healthy treatment-seeking cigarette smokers ( $\geq 10$  cigarettes/day), who met DSM-IV criteria for tobacco dependence, were recruited through Internet advertisements. Potential participants underwent telephone and in-person screenings. During the telephone screening, participants provided medical, psychiatric, and substance-abuse histories without personal identifiers. The in-person screenings included administration of the Smoker's Profile, Fagerström Test for Nicotine Dependence (FTND) (Fagerstrom, 1978; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991), Urge to Smoke (UTS) Scale (Brody et al., 2002; Jarvik et al., 2000b), and Hamilton Depression (HAM-D) (Hamilton, 1967) and Anxiety (HAM-A) (Hamilton, 1969) rating scales. Potential participants provided breath samples for measuring carbon monoxide (CO) levels using a MicroSmokerlyzer (Bedfont Scientific Ltd, Kent, United Kingdom), at the time of initial screening to verify recent smoking. All participants received detailed verbal and written descriptions of the study procedures before giving informed consent, as approved by the VA Greater Los Angeles Healthcare System Institutional Review Board.

Exclusion criteria included: 1) history of any Axis I psychiatric diagnosis other than tobacco dependence, 2) medical conditions that might interfere with treatment, 3) and current illicit drug use, except occasional marijuana use. Potential participants were required to test negative for drug use in a urine toxicology test during the in-person screening. Participants reporting recreational alcohol ( $\leq 1$  drink/day) or marijuana ( $\leq 1$  use/week) use, not meeting criteria for abuse/dependence, were allowed to participate, but were instructed to abstain for at least 24 h prior to each treatment session.

### CUE-INDUCED CRAVING ASSESSMENT

Prior to the initiation of treatment, participants completed a one-hour cue-induced craving assessment. During this assessment, participants engaged in two VR sessions (smoking-VR and placebo-VR) for 10-min each with a 10-min break between sessions (presentation order was randomized between participants). Participants provided self-reports of cigarette craving prior to (time = 0), during (time = 5), after (time = 10), and following (time = 15) each VR session. Self-reports of craving were determined using the Urge to Smoke (UTS) Scale (Jarvik et al., 2000a).

### COGNITIVE BEHAVIORAL THERAPY (CBT)

All participants attended bi-weekly (Tuesday & Thursday) CBT group therapy sessions (60 min) over eight weeks. Participants initiated CBT on a rolling schedule following the completion of the cue-induced craving assessment. A licensed psychotherapist (S.S.) performed twelve continuous CBT sessions from a standardized manual for small groups of participants (group size varied from 2-6 participants). Participants provided self-reports of the number of cigarettes smoked the previous day and exhaled CO during each group CBT session. CBT specifically included: 1) education about smoking addiction, withdrawal, and relapse; 2) making preparations for a quit date; 3) recognizing dangerous situations (triggers) that could lead to relapse; 4) developing coping skills, such as avoiding temptation, coping with negative affective states, reducing overall stress, and distracting attention from smoking urges with other activities; and 5) social support (Abrams et al., 2003).

### VIRTUAL REALITY CUE EXPOSURE THERAPY (CET)

Participants were randomly assigned to either smoking-VR or placebo-VR CET prior to the initiation of treatment. For CET, participants attended bi-weekly 30-min individual VR sessions prior to or following group CBT (depending on availability). The VR sessions included two 10-min exposures to VR cues (smoking-related or placebo), separated by a 10-min break. During the 10-min break, participants reviewed the coping skills taught in the most recent group CBT session, and were encouraged to apply the skills during the second VR exposure. Successful completion of VR treatment required attendance of at least eight CET sessions.

The VR environments used here were constructed and presented in a similar manner to those in a previous report by our group (Culbertson et al., 2010). The smoking-VR sessions were individualized for each participant's self-reported triggers (e.g., objects, people, places, and music associated with smoking). Varieties of environments were created and accessed using Second Life, a freely available online gaming program. These environments included a modern apartment with outdoor seating area, a driving simulation, a replica of Venice beach, a bus stop in Los Angeles, an outside area in front of a bar/restaurant, and a coffee shop. During each session, the participant navigated the VR environment from the first-person point of view while their virtual self, or avatar, smoked a virtual cigarette. Each participant's avatar was modified to replicate his or her physical



appearance. Additional avatars were added to each environment and modified to perform cigarette smoking animations. Other individualized smoking paraphernalia (e.g., box of preferred brand of cigarette, lighter, coffee, etc.) were also placed in each environment where possible (Figure 1).



Figure 1. Screenshots from the smoking-related virtual reality cue environment (smoking-VR) on top and placebo-related.

The placebo-VR cues sessions were selected for each participant's personal interest from a variety of settings available in Second Life. These environments included an art show, a carnival, an outdoor sports center, a space museum, and a university. Participants listened to their preferred genre of music during the placebo cue exposure. Each environment was inspected prior to participant exposure to ensure the absence of any smoking-related cues.

#### TREATMENT RESPONSE MEASURES: SMOKING AND CRAVING

Participants provided self-reports of smoking (cigs/day) and exhaled breath CO samples during each CET session to monitor recent smoking behavior. Abstinence was determined by a self-report of no cigarettes per day and an exhaled CO  $\leq$  5ppm. Participants also provided craving ratings using the UTS scale prior to (time = 0), during (time = 15), and following (time = 30) each treatment session.

#### STATISTICAL ANALYSIS

Means ( $\pm$  standard deviations) of demographic and treatment variables were determined independently for each treatment group. Student's *t*-tests and a Fisher's exact test (for gender) were compared between treatment groups for the demographic variables. To evaluate treatment outcomes, groups were compared together, and independently, using unpaired and paired Student's

*t*-tests, respectively, for the primary smoking outcome measures. A Fisher's exact test was applied to assess differences in quit rates between groups.

UTS-raw and UTS-change scores were analyzed to measure overall and cue-induced craving (craving change in response to each cue condition). The UTS-change score was calculated by subtracting the baseline rating (time = 0) for each cue condition from the following ratings (time = 5, 10, 15). This method eliminates baseline variability between participants, while also accounting for carry-over effects between cue conditions. A within-subjects general linear model (GLM) for repeated measures was used to assess the effect of cue condition and time on UTS-raw and UTS-change scores independently. An unpaired Student's *t*-test was used to compare UTS-raw and UTS-change scores between cue conditions at each time point. Additionally, a Pearson correlation was determined to assess relationships between demographic and smoking characteristics, and UTS-raw and UTS-change scores.

To examine cigarette craving during treatment, a within-subject GLM for repeated measures, including a between-group variable, was used to test for interactions and/or effects of treatment type (smoking-VR and placebo-VR CET), repeated individual CET treatments (from session 1 to 8), and treatment time (time = 0, 15, 30) on self-reported UTS-raw scores. An unpaired Student's *t*-test was used to assess group differences in UTS-raw scores at the start and completion of CET. A paired Student's *t*-test was also used to assess the UTS-change score from the first to last CET session in all participants, and each treatment group separately. Statistical analyses were performed using SPSS 17 for Mac OS X.

## RESULTS

### DEMOGRAPHIC AND SMOKING CHARACTERISTICS

The study sample included craving assessment of 15 (13 men, two women) tobacco-dependent, treatment-seeking adults (mean  $\pm$  SD age  $42.2 \pm 12.5$  yr) with, on average, two years of post high school education (mean  $\pm$  SD  $13.8 \pm 2.6$  yr). Eleven participants completed treatment (smoking-VR: *n* = 5; placebo-VR: *n* = 6), and these participants reported smoking  $19.8 \pm 3.9$  cigs/day for  $20.8 \pm 9.8$  years, and had CO levels of  $17.9 \pm 12.5$  prior to treatment. No significant differences were observed prior to treatment between groups on demographic or smoking characteristics (Table 1), other than the placebo-VR participants having smoked for significantly more years than smoking-VR participants (Student's *t*-tests, two-tailed,  $P < 0.05$ ).

### CUE-INDUCED CRAVING ASSESSMENT

A within-subject GLM for repeated measures demonstrated a significant effect of cue type (smoking-VR versus placebo-VR) on self-reported UTS-raw scores ( $F_{1,14} = 11.19$ ,  $P = 0.005$ ) and UTS-change scores ( $F_{1,14} = 15.54$ ,  $P = 0.001$ ) (Figure 2). No effect of time was observed for self-reported UTS-raw or UTS-change scores. A paired Student's *t*-test demonstrated that participants reported significantly greater UTS-change scores during (time = 5) ( $t_{14} = 4.18$ ,  $P = 0.001$ ), after (time = 10) ( $t_{14} = 3.08$ ,  $P = 0.008$ ), and following (time = 15) ( $t_{14} = 2.76$ ,  $P = 0.015$ ) the

smoking-VR cues, compared to the placebo-VR cues. No significant difference in UTS-raw scores was observed between cue conditions at any time point. A negative association was observed between age and UTS-raw scores during (time = 5) and following (time = 15) the smoking-VR cues, and during (time = 5) and after (time = 10) the placebo-VR cues ( $P < 0.05$  for all). A positive association was observed between FTND scores and UTS-raw scores after (time = 10) and following (time = 15) the smoking-VR cues ( $P < 0.05$  for both), with a trend towards an association between FTND scores and UTS-change scores for the after (time = 10) and following (time = 15) smoking-VR cues ( $P < 0.06$  for both).

Table 1

*Demographic and Smoking Characteristics for Smoking-VR and Placebo-VR Treated Participants*

	Treatment Group	
	Smoking-VR ( $n = 7$ )	Placebo-VR ( $n = 10$ )
<b>Gender</b>		
	Male (%)	80
	Female (%)	20
<b>Ethnicity</b>		
	White (Not Hispanic) (%)	60
	Hispanic or Latino (%)	0
	African American (%)	0
	Other (%)	40
<b>Age</b>	36.4±4.7	46.8±3.8
<b>Education</b>	15.2±1.4	13.2±0.8
<b>Cigarette Use</b>		
	Cigarettes per Day	17.6±1.1
	Years Smoking	13.9±2.8*
	Exhaled Carbon Monoxide (ppm)	22.0±6.0
		16.5±6.0

Values represent mean ± S.E.M.; \* =  $p < 0.05$

#### BETWEEN GROUP TREATMENT OUTCOMES

Smoking-VR CET participants had a significantly higher quit rate than placebo-VR CET participants (Fisher's exact test,  $P = 0.015$ ). Smoking-VR CET participants also reported smoking significantly fewer cigarettes per day at the end of treatment than placebo-VR CET participants ( $t_9 = 2.54$ ,  $P = 0.034$ ). Smoking-VR CET participants had (non-significantly) lower exhaled CO levels at the completion of treatment than placebo-VR CET participants (2.8 ppm vs. 8.5 ppm, respectively) (Figure 3).

#### CIGARETTE CRAVING DURING TREATMENT

A within-subject GLM for repeated measures, including a between-group variable, revealed a significant effect of repeated CET sessions on self-reported UTS-raw scores ( $F_{1,10} = 3.64$ ,  $P = 0.032$ ); however, no effect of treatment type was observed. An exploratory analysis (using a within subject GLM for repeated measures) revealed a significant effect of time when considering UTS scores provided following each VR exposure (time = 15 and time = 30) in smoking-VR CET treated participants ( $F_{1,4} = 3.64$ ,  $P = 0.046$ ), but not placebo-VR CET treated participants. The study group as a whole demonstrated a significant reduction in UTS scores from the first to last treatment session ( $t_{10} = 3.96$ ,  $P = 0.003$ ). This effect was also observed in each group independently ( $P < 0.05$ ).

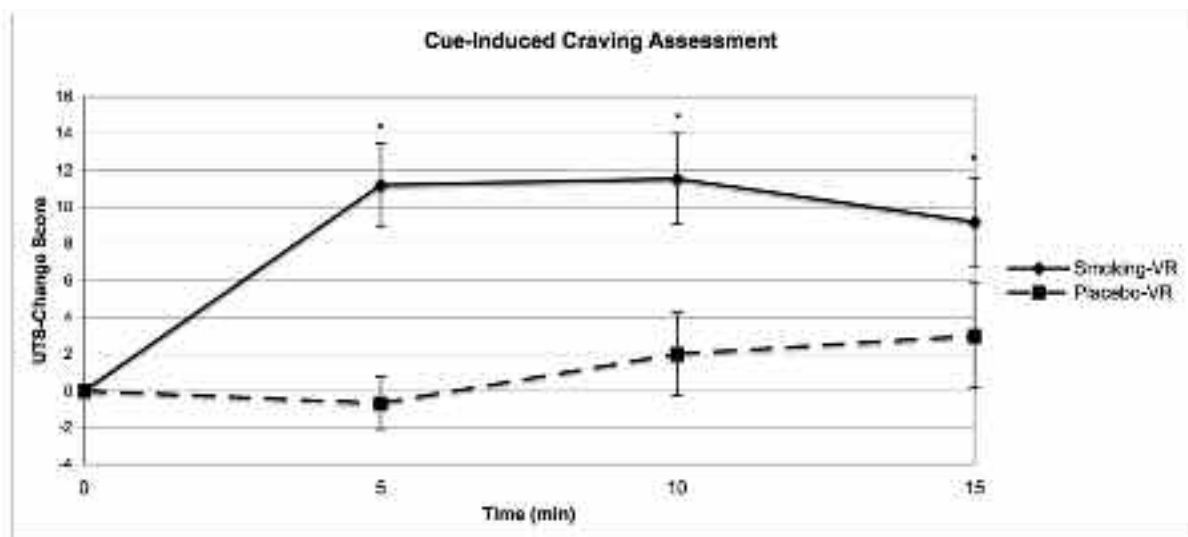


Figure 2. Self-reported cigarette craving during (time = 5), after (time = 10), and following (time = 15) each cue condition (smoking-VR and placebo-VR) presented in the cue-craving assessment (values represent mean change in UTS score from baseline ± standard error mean for each treatment group).

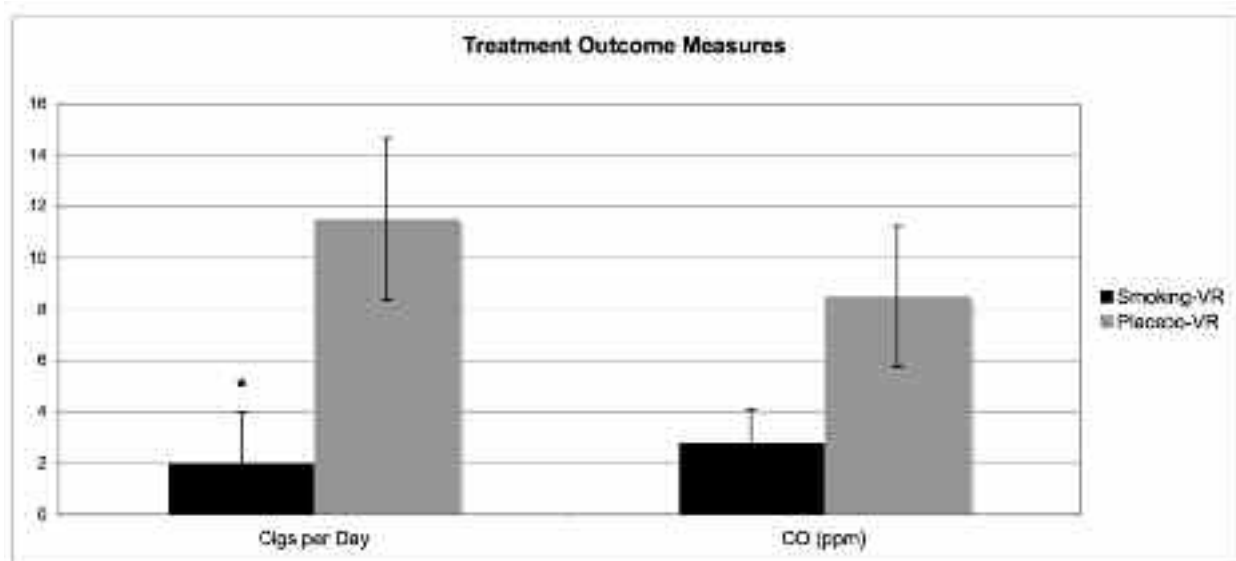


Figure 3. Treatment outcome measures: self-reported cigarettes per day and exhaled CO (ppm) measured at the completion of treatment (values represent treatment group mean value  $\pm$  standard error mean).

### DISCUSSION

Smoking-VR cues elicited significantly higher levels of overall craving and greater increases in cue-induced craving than placebo-VR cues. Tobacco-dependent smokers treated with smoking-VR CET demonstrated a significantly higher quit rate and reported smoking significantly fewer cigarettes per day at the completion of treatment. Although not significant, smoking-VR treated participants also provided substantially lower exhaled CO levels than placebo-VR treated participants at the end of treatment. All participants reported significant decreases in cigarette craving across treatment, as well as significant reductions in craving from the start to the completion of treatment. Taken together, these preliminary findings establish the potential for smoking-VR CET, in combination with CBT, to be a useful treatment for tobacco dependence.

Previous studies of CET in substance-dependent individuals have used a range of treatment paradigms and outcome variables, leading to varied success (Conklin & Tiffany, 2002). The largest and most well-controlled study to apply CET in tobacco dependence did not demonstrate enhanced smoking cessation rates when combined with CBT (R. Niaura, et al., 1999) however, the current report is distinct since the previous study used CET consisting of participants imagining themselves in smoking situations, which may have accounted for the disparate results.

Relapse to smoking following treatment commonly occurs when a recently abstinent smoker encounters an environment previously associated with smoking (Wikler, 1973). Studies of CET in smokers have, for the most part, been conducted in non-smoking environments (e.g. clinic, laboratory) (Conklin & Tiffany, 2002), which may present a problem since extinction learning is context dependent, and may not generalize across environments (Bouton & Moody, 2004). Furthermore, environ-

ments paired with smoking elicit greater cue-induced urges to smoke than environments not paired with smoking (Dols, Willems, van den Hout, & Bittoun, 2000), even in the absence of smoking-related cues (Conklin, 2006; Thewissen, van den Hout, Havermans, & Jansen, 2005). For these reasons, the present study supports the theory that CET must incorporate multiple, context-relevant environments for extinction learning to translate beyond the treatment setting. Some researchers have addressed this issue by treating people with drug dependence in the environment where they use drugs (Dawe, et al., 1993; Kasvikis, Bradley, Powell, Marks, & Gray, 1991). The method used here has potential advantages for practicality and safety. More recently, VR drug cue environments have been applied to CET and demonstrated efficacy in reducing craving and cue-induced brain activation in smokers (J. Lee, et al., 2004; J. H. Lee, Lim, Wiederhold, & Graham, 2005).

Preclinical models of reinstatement have discovered that manipulating intra- and inter-session intervals of extinction learning may reduce cue-associated relapse. Short, repeated presentation of cues, with sufficient time between cue exposures to allow for recovery of responding, increases the rate and duration of extinction learning (Berman & Katzev, 1972; Mackintosh, 1974). Spreading out the intervals between extinction learning sessions to allow responding to reemerge also attenuates spontaneous recovery of extinguished behaviors (Bouton, 1993). Previous studies of CET in smokers have applied long extinction sessions, focusing on singular cues, with short inter-session intervals (Conklin & Tiffany, 2002). In the current study, smoking-VR CET treated participants received twice-weekly CET sessions across eight weeks, with each session including two cue exposures. Appropriate spacing of CET sessions would lead to higher craving during the initial cue exposure in a CET session (i.e. return to responding), followed by

an incremental decrease in craving after each subsequent cue exposure (i.e. re-extinguish responding). Smoking-VR CET treated participants demonstrated significantly greater levels of craving following the first smoking-VR cue exposure than the second exposure across treatment. This difference was greatest during the first half of the CET session, presumably when extinction learning was first developing. Furthermore, this effect was absent in placebo-VR CET treated participants suggesting that this reduction in craving was not attributable to general CET procedures, which were matched between groups.

To our knowledge, previous applications of CET for tobacco dependence did not specifically address lapse episodes during treatment. Following a self-reported lapse in the current study, smoking-VR CET treated participants were exposed to a VR context intended to replicate the environment where the lapse occurred. Although no direct measure was applied to assess the efficacy of this intervention, 80% of smoking-VR treated participants proved able to remain abstinent following lapses, while all placebo-VR treated participants returned to smoking.

This study had several limitations. Although the observed dropout rate (~27%) is within the expected range, the exclusion of four participants led to a low sample size. Consequently, the study population reported here lacked gender and ethnic diversity, and was not entirely balanced (e.g. placebo-VR CET treated participants reported more years of smoking). Demo-

graphic variables such as age (negatively associated with overall craving to smoking-VR and placebo-VR cues) and tobacco dependence (positively associated with overall craving to smoking-VR cues) may have also influenced individual treatment responses. Applying CET as an outpatient treatment constrains the number of controls and measures (e.g. physiological reactivity) that can be taken to assess treatment efficacy, which could enhance extinction learning and abstinence. This lack of control (e.g. time since last cigarette) also led to between subject variability in self-reported cravings during CET sessions, though this method may be more applicable to actual clinical treatment situations.

In conclusion, smoking-related VR cues proved useful in eliciting cue-induced craving and, when applied with the parameters used here, may significantly enhance the efficacy of CET as a treatment for tobacco dependence.

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## USING VIRTUAL REALITY FOR PTSD TREATMENT IN CRIMINAL VIOLENCE VICTIMS

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Criminal violence is associated with mental health problems such as depression and substance use and abuse. However, one of most important psychological repercussions linked with victims of violence is Posttraumatic Stress Disorder (PTSD). In Mexico, 11% of the population over 18 years has experienced a crime. In Ciudad Juarez, a border city in northern Mexico considered the country's most dangerous place, one in four victims of violence develop PTSD symptoms. Due to this socially relevant problem and based on the efficacy of Virtual Reality (VR) treatments, it is important to design treatments involving the use of VR because it can help overcome some of the limitations of traditional therapy using exposure. The present paper presents data from 10 participants, made up of victims and witnesses of shootings, assaults and kidnappings. Our pilot study reveals a treatment success rate of 80%. The application of the VR prolonged exposure (PE) technique was effective in reducing clinical levels of PTSD and depression, which confirms the clinical preference for this technique to treat PTSD.

**Keywords:** Virtual Reality, PTSD Treatment, Criminal Violence, Assault, Prolonged Exposure

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### INTRODUCTION

Violence is inherent in all societies around the world and almost always has adverse outcomes for victims. From the perspective of public health, violence results in dire consequences, both psychological and physical, which are a major problem for the health system. Criminal violence is linked to mental health problems, such as depression and substance use and abuse. However, one of most the important psychological problems experience by victims of violence is Posttraumatic Stress Disorder (PTSD). In Mexico, according to the ENSI-6 in 2010, 11% of the population over 18 years old has experienced a crime.

Ciudad Juarez, a border city in northern Mexico, is considered to be the country's most dangerous place. More than half of all crimes that occur in the country are concentrated there, in particular, kidnappings and shootings. According to a recent estimate, between 14-30% of Ciudad Juarez's more than 1 million residents suffer from PTSD due to exposure to violent acts or from being a direct victim. Contemplating this background, it is important to note the great impact of criminal violence on mental health. The prevalence of PTSD requires attention because those suffering from the disorder experience elevated degrees of anxiety, fear and avoidance, thereby interfering in their personal development and everyday life.

Currently, there are effective cognitive-behavior therapy (CBT) treatments for PTSD. These treatments employ exposure techniques that help patients to overcome the presence of feared objects or situations related to the traumatic event.

Prolonged exposure (PE) is the preferred exposure technique for treating PTSD. However, this technique is poorly used in clinical treatments. The low success rate can, in part, be attributed to cognitive avoidance of patients in recalling traumatic memories and the difficulty for some patients to effectively engage in imaginal exposure.

Virtual Reality exposure therapy (VRET) can help to overcome some restrictions of traditional exposure therapy (in-vivo or imagined). VRET can simulate the traumatic situation with a high degree of reality, helping patients irrespective of their ability for imaginal engagement. Another benefit is that therapists can control the characteristics of the situation presented to the patient. These aspects could reduce cognitive avoidance in order to increase emotional engagement during exposure.

There are several studies supporting the effectiveness of VR for the treatment of PTSD in different populations (Difede & Hoffman, 2002; McLay, Wood, Weebb-Murphy, Spira, Wiederhold, Pyne et al., 2011; Rizzo, Pair, McNermey, Eastlund, Manson, Gratch et al., 2004; Rothbaum, Hodges, Ready et al., 2001) including war survivors, active soldiers and victims of terrorism attacks. In Mexico the development of such systems is non-existent, and its empirical validation is emerging, which gives evidence of the relevance of the study in our socio-cultural context.

Based on this socially relevant problem and centered on the efficacy of previous studies for war violence, our research

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team initiated a project supported by the National Science and Technology Council, and the municipal government of Ciudad Juarez in Mexico. The purpose was to evaluate the efficacy of a treatment program for PTSD using VR exposure, involving criminal violence victims and eyewitnesses in Ciudad Juarez.

We presume this treatment program, supported by the latest generation technology devices, is both effective and efficient, which will support the spread of empirically validated and effective treatments in the mental health field to influence this problem, which is of particular social relevance for the Mexican population. Long term, it may also be viable for other Latin American countries that share similar social and cultural idiosyncrasies with Mexico to use this technique.

The study was established in two phases. The first focused on the development of the virtual environments (VEs) designed to be used during the exposure technique, and the second consisted of a randomized controlled trial (RCT) in Ciudad Juarez, providing VRET to PTSD victims of criminal violence.



*Figure 1.* The VR-system lets the patient know the VE is handled by a therapist through a keyboard or electronic panel, ensuring total control of exposure in real time.

### PTSD SCENARIO SETTINGS

The PTSD scenario settings (Cárdenas & de la Rosa, 2010) were based on the design of common locations in Ciudad Juarez. This system is divided into four interactive environments: the streets of Ciudad Juarez scenario (Fig. 2), a gunfire scene (Fig. 3), an assault/robbery scene (Fig. 4), a lock (police checkpoint) (Fig. 5), and a kidnapping room (Fig. 6). These VEs aim to expose the patient to the memories of their trauma. In order to achieve immersion for each participant, each scenario is navigable and interactive. VEs were designed considering the social and cultural context appropriate for the target users of the system.

The VR models contain variables exteroceptives, such as environmental sounds (sound of beating or shooting a firearm, footsteps, etc.) that are controlled by the therapist, thus exposing the patient to their own symptoms, teaching him to confront and manage them.

- Streets of Ciudad Juarez scenario: As a public space, it is considered a scenario feared by patients since it is perceived as an unsafe place, which puts them in a vulnerable situation for assault or kidnapping. In this scenario, the user walks freely down the avenue.
- Assault scenario: This interaction can be triggered at any place during the scenario; a hand holding a gun will appear and the user will hear the aggressor's voice threatening them.
- Gunfire scenario: The user will have to turn the corner to witness a shooting between some soldiers and two criminals. In this scene, there will be avatars shooting each other, two avatars that have been shot, and another avatar hiding.
- Police checkpoint scenario: The user will be able to walk around the streets of Ciudad Juarez. At the edge of the scenario, next to the highway, the user will see a crime scene where two victims have been shot. There are police present and people around watching the same scene.
- Kidnapping scenario: The user will navigate through the scenario and the interaction can be triggered at any point. First, the user will see a van coming towards him/her playing a typical drug cartel related song. Next, two kidnappers, pointing at him/her with a gun and shouting, take the user inside of the van. The lights will fade out and the scenario will finish.

We have preliminary data from 10 participants (five women and five men) with a mean age of 25.5 (15.41), who are victims and witnesses of shootings, assaults and kidnappings. Our pilot study reveals a treatment success rate of 80%. Clinical levels of PTSD and depression were significantly reduced and their level of anxiety was measurably reduced from their pre-treatment assessment to post-treatment assessment. Specifically, at the end of 12 sessions of VR program treatment, the CAPS score decreased by 75% from a



pre-treatment total score ( $M=80$ ). The PTSD Symptom Scale ratings decreased from  $M=40$  to  $M=10$ . The participants were assessed at the end of the treatment and did not meet the DSM-IV criteria for PTSD.

From data obtained from a case study (Cárdenas & de la Rosa, 2010) and pilot clinical trial, application of the VR prolonged exposure (PE) technique was effective in reducing symptoms of re-experiencing, avoidance and hyper arousal, which confirms the clinical preference for this technique to treat PTSD. The participant informed the therapists of feeling comfortable with the technology, as well as experiencing an improvement in functioning in many areas of his life as a result of treatment.

We anticipate analyzing data from the RCT implemented in collaboration with the University of Ciudad Juarez in February 2012. We expect these findings will encourage our team to conduct studies with larger samples, and to test the VR treatment program with other types of criminal violence.

#### DISCUSSION

The incorporation of advanced technologies for psychological treatment seems to be a promising alternative for the care of PTSD in victims of criminal violence, which have a great impact on our country. Additionally, this work supports the dissemination of empirically validated treatments in the Mexican mental health field.

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Figure 2. Juarez City view.



Figure 3. Gunfire view.



Figure 4. Assault view.



Figure 5. Police checkpoint view.

Recently, new forms of criminal violence are emerging in various countries, severely impacting the local populations, as criminal violence related to drug dealers, power abuse, insecurity, etc., generates deterioration in the communities' mental health. Our group is addressing this challenge by developing VR environments for the treatment of pathological grief, PTSD and adjustment disorders related to this new threat to psychological well-being.

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## PHYSIOLOGICAL RESPONSES TO VIRTUAL SELVES AND VIRTUAL OTHERS

Jesse Fox<sup>1</sup>, Jeremy N. Bailenson<sup>2</sup> and Tony Ricciardi<sup>3</sup>

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Previous research indicates that photorealistic virtual representations (i.e., agents and avatars) of the self can influence attitude and behavior change. This study was designed to test participants' physiological reactions to exercising or still agents that resembled the self or a stranger. A within-subjects experiment tested participants' (N = 10) skin conductance in response to running and loitering virtual selves (created from participants' photographs) and virtual others. Participants entered a fully immersive virtual environment and observed the agents as their physiological response was measured. Arousal was greatest when exposed to a running virtual self or a loitering virtual other. The finding that the virtual self causes physiological arousal may explain why a running virtual self has been shown in previous research to increase exercise behavior after exposure. Implications for the development of Virtual Reality exercise treatments and other virtual therapies are discussed.

**Keywords:** Avatars, Immersive Virtual Environments, Virtual Agents, Virtual Reality, Cybertherapy

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The use of virtual environments (VEs), including video games and virtual worlds, is becoming increasingly common for social interaction (Kaiser Family Foundation, 2010; Pew Research Center, 2010). VEs are also becoming an increasingly popular place for persuasive messages, from health campaigns to marketing efforts. Virtual representations (i.e., avatars and agents) are often implemented in these interactions, and thus it is important to determine how users respond to these representations (Blascovich, Loomis, Beall, Swinth, Hoyt, & Bailenson, 2002; Gaggioli, Mantovani, Castelnuevo, B. K. Wiederhold, & Riva, 2003) and what characteristics influence the utility of these representations (e.g., Nguyen, Merienne, & Martinez, 2009).

Virtual representations may attempt to persuade us through direct interaction, or they may be used as models to depict desirable behavior that observers may imitate based on several factors. Social cognitive theory argues that when models are similar to us, the process of *identification* occurs and we are more likely to imitate the behaviors models portray (Bandura, 1977, 2001). New technologies allow us to use photographs to build virtual humans that look remarkably like the self, thus creating highly similar models with which users can identify (Fox & Bailenson, 2010). Indeed, previous research has indicated that these photorealistic virtual selves are powerful persuasive tools (Fox, Bailenson, & Binney, 2009; Yee & Bailenson, 2007) causing people to prefer an advertising brand (Ahn & Bailenson, 2011) or leading children to create false memories (Segovia & Bailenson, 2009). Virtual selves have the potential to be powerful tools in virtual therapies. For example, socially anxious people could observe

their virtual selves successfully engaging in social interaction, thus bolstering their self-efficacy. Users undergoing physical rehabilitation could see their virtual selves achieving both proximal and distal goals, providing motivation and encouragement to continue therapy (Fox & Bailenson, 2010).

Virtual selves have been tested in the exercise domain. In a previous study (Fox & Bailenson, 2009), participants were exposed to one of three virtual representations under the pretense that they were performing a memory task. Participants viewed a virtual representation of the self running (Running Self), a virtual self loitering (Loitering Self), or a virtual representation of another person running (Running Other) for approximately five minutes. The next day, participants' physical activity for the 24 hours following the experiment was tallied; participants who had seen the Running Self exercised significantly more (approximately one hour more) than those who had seen the Loitering Self or the Running Other. The reason for these findings, however, was unclear; thus, a follow up study was designed.

For this study, we wanted to address whether observing the self or other models, or running or loitering models, resulted in differing levels of physiological arousal. Physiological responses provide objective measurements that can determine the effects of virtual treatments on users (B. K. Wiederhold, Jang, Kim, & M. D. Wiederhold, 2002). Because the Running Self in the previous study led to more exercise, we hypothesized that this model may yield greater physiological arousal than a Loitering Self, a Running Other, or a Loitering Other.

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## METHOD

### APPARATUS

Participants were placed in an immersive virtual environment. They donned a head-mounted display (HMD) through which they were able to view each stimulus. Sensing equipment tracked users' head motion so that a realistic visual depiction of the environment could be updated constantly based on their movements.

Physiological signals were measured, amplified, and recorded using a Thought Technology ProComp Infiniti module linked to a computer. Thought Technology's Infiniti software program coordinated the sampling and storage of physiological data. Skin conductance was recorded using standard Ag/AgCl electrodes placed on the ring finger of the non-dominant hand. The signal was sampled at a rate of 32 times per second and converted to conductance values in microSeimens (uS). See Figure 1 for the experimental apparatus setup.



Figure 1. The experimental setup. The participant wears a head-mounted display (HMD) to view the stimulus while the sensors on her hand collect physiological data.

### PROCEDURE

The sample ( $N = 10$ ) consisted of five men and five women ranging in age from 18-29 ( $M = 22.22$ ,  $SD = 4.29$ ) for which within-subjects comparisons were performed.

Participants were instructed that their task was to watch four sequences featuring different agents. They were also advised to limit their movements as much as possible (i.e., sit still) while observing the virtual stimuli to prevent unnecessary noise in the physiological output. Participants were seated at a table, connected to the physiological equipment, and fitted with an HMD. An empty virtual room was portrayed for 2 min as participants adjusted to the virtual world and baseline physiological data were gathered. Participants then observed all four stimuli; each stimulus lasted 2.5 min and was followed by a 1.5 min recovery period in the empty virtual room to allow participants' physiological response to normalize before proceeding to the next stimulus. The stimuli, which were randomized for each participant, included a Running Self, Loitering Self, Running Other, and Loitering Other. Figure 2 depicts a virtual representation running and loitering. In total, participants were immersed in the virtual environment for approximately 18 min.

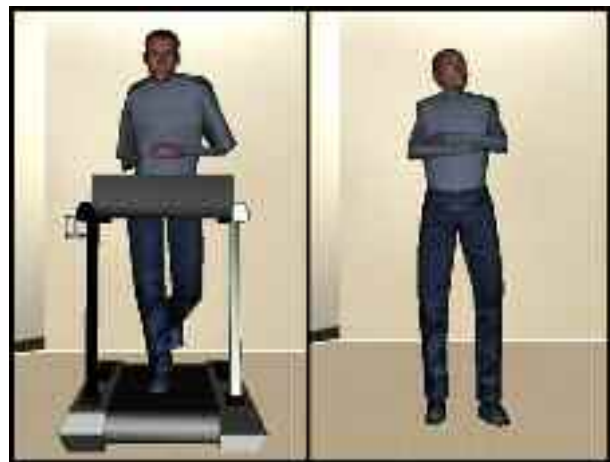


Figure 2. An example of a running and loitering virtual human.

### PHYSIOLOGICAL DATA PROCESSING

Skin conductance data is characterized by rapid spikes of varying amplitudes, referred to as skin conductance responses (SCRs) that indicate increases in arousal (Lang, 1994). From this data we extracted the mean amplitude of all SCRs for analysis.

### RESULTS

Results indicated a significant difference in skin conductance across conditions,  $F(3, 27) = 3.50$ ,  $p < .05$ , partial  $\eta^2 = .28$ . See Table 1 for means and standard deviations. Planned contrasts in the form of paired t-tests revealed that participants demonstrated significantly greater skin conductance during the Running Self phase than the Loitering Self phase,  $t(9) = 3.27$ ,  $p < .01$ , Cohen's  $d = 1.31$ , and the difference from the Other Running phase bor-



dered on significance,  $t(9) = 1.91, p = .088$ , Cohen's  $d = 1.08$ . Interestingly, there was no difference between Running Self and Loitering Other,  $t(9) = .06, p > .05$ , Cohen's  $d = .04$ . Additional analyses revealed that participants experienced greater skin conductance in the Other Loitering phase than during the Self Loitering,  $t(9) = 2.40, p < .05$ , Cohen's  $d = 1.30$ , or Other Running phases,  $t(9) = 2.26, p = .05$ , Cohen's  $d = 1.09$ .

Table 1  
*Means and Standard Deviations for Conditions*

	Running	Loitering
	<i>M (SD)</i>	<i>M (SD)</i>
Self	.29 (.49)	-.30 (.41)
Other	-.29 (.58)	.51 (.52)

### DISCUSSION

Participants experienced greater skin conductance in response to running selves and loitering others than to running others or loitering selves. It may be that running selves are arousing because participants feel as if they are actually engaged in the exercise as they watch. Alternatively, the running self may serve as a cue that summons the feelings of previous experiences with exercise, causing the body to respond in a similar physiological manner. The memory of exerting oneself may cause the physical body to perspire without actually engaging in the behavior.

These results may offer some insight on the results of previous research (Fox & Bailenson, 2009) wherein a running self promoted more exercise in the 24 hours following the experiment than a loitering self or a running other. Participants experienced greater physiological arousal at seeing the virtual self run than the self loitering or another person running, which may have served as a physical impetus to exercise after exposure. Given the findings of this study, one possible explanation for the previous result is that participants experienced excitation transfer (Zillmann, 2003) and felt the need to engage in physical activity to manage their increased physiological arousal after seeing the virtual self running. It is also possible that participants' bodies were attempting to mimic the actions of the exercising virtual self, thus leading to greater arousal.

The finding that the loitering other also caused greater physiological arousal is somewhat puzzling. However, it is possible that, in contrast to the running other (which had a clear purpose), the loitering other made participants uncomfortable (Langer, Fiske, Taylor, & Chanowitz, 1976). Essentially, the experience mimicked that of being watched by a stranger. The loitering self may not have resulted in discomfort and the resultant peak in arousal because it is not dissimilar to looking in the mirror. An important implication of this finding is that unfamiliar virtual humans have the potential to increase physiological arousal, which may affect or confound the desired impact of a virtual treatment or therapy.

This study has shown that virtual selves have the power to stoke a physiological response that may also serve as an impetus for physical behaviors and exercise applications. A woman who has trouble initiating a morning run might watch her virtual self jogging to get a kick start. Virtual selves also have a key advantage in that they can be manipulated to represent future states as well. If the woman is significantly overweight, she could see her future healthy self jogging and losing weight. Or, if she wants to run a marathon, she could watch her virtual self crossing a finish line. Additional research should investigate physiological responses to such virtual rewards to see how they can be incorporated in treatments.

These findings also lend insight on how Virtual Reality (VR) therapies in other realms may be developed for maximum effectiveness. An individual may be more psychologically and physiologically motivated to comply with a health treatment if the model is not a stranger, but rather the self capably performing these behaviors. Virtual selves, and the resultant identification, might lead to greater engagement, performance, and adherence to desired behaviors such as physical therapy or healthy dietary choices. Virtual selves also have the potential for implementation in other areas, such as cultivating a healthy body image (Gutiérrez-Maldonado, Ferrer-García, Caqueo-Urizar, & Moreno, 2010) or treating anxiety (Pallavicini, Algeri, Repetto, Gorini, & Riva, 2009).

This study was limited as it sampled from a limited age range; further research should examine physiological responses of different groups. Although consistent with many physiological studies (Lang, 1994), the small sample size yielded power (.72) less than the desired level (.80). This study addressed one measure of physiological arousal; examining other physiological responses (e.g., breathing, heart rate, muscle responses) may substantiate these findings. Subjective data from participants may also offer additional insight into the variation in response to these virtual representations.

Future studies are needed to determine how and why virtual selves and others cause physiological arousal, as well as how participants manage that arousal. Virtual selves may demonstrate other healthy behaviors (such as making good dietary choices) or engage in risk behaviors such as smoking. Manipulating different aspects of virtual selves (e.g., realism, accuracy, or attractiveness, or showing rewards or punishments associated with certain actions) and measuring resulting levels of arousal may also lend insight on how these models may be maximally effective in influencing attitude and behavior change. Understanding physiological responses to virtual representations is crucial to understand many of the processes that occur during and after experiencing a virtual world.

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

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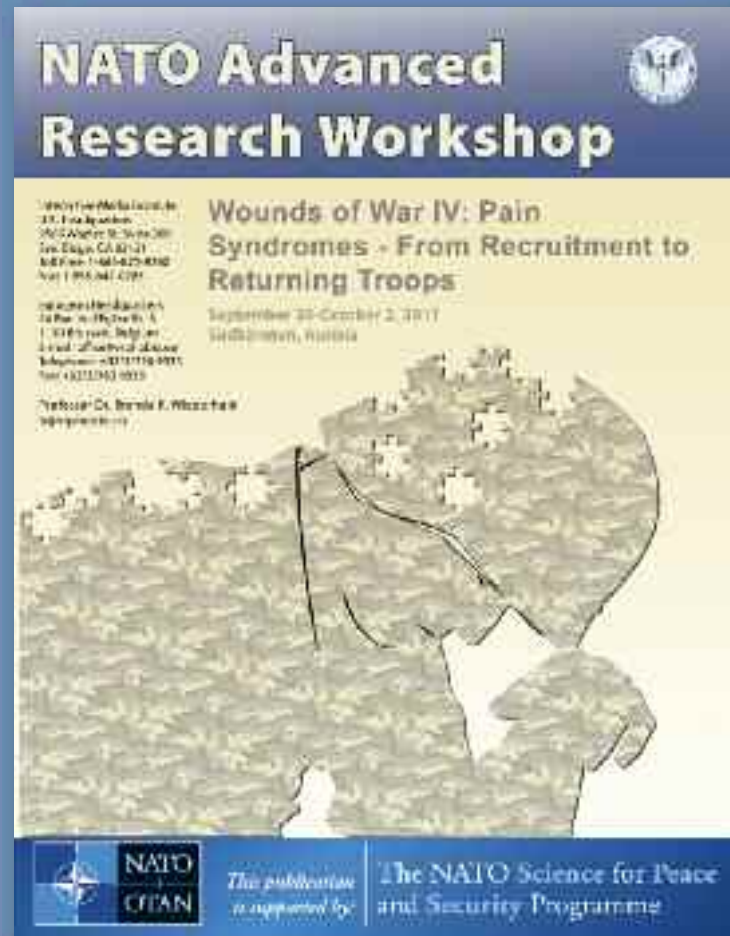
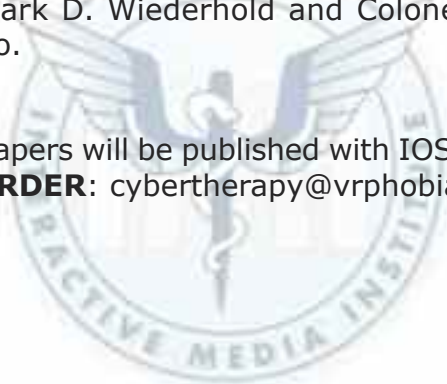
**Professor Dr. Brenda K. Wiederhold, Ph.D., MBA, BCIA**

## **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" drew over 25 eminent experts from 11 countries to discuss the topic of increased pain syndromes in our service men and women.

Held in Südkärnten, Austria at the Hotel Amerika-Holzer, discussion topics included 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 was critical assessment of existing knowledge and identification of directions for future actions. The co-organizers of the workshop alongside Professor Brenda K. Wiederhold included Professor Kresimir Cosic, Professor Mark D. Wiederhold and Colonel Carl Castro.

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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.

### **MIAUCE: MULTIMODAL INTERACTION ANALYSIS AND EXPLORATION OF USERS WITHIN A CONTROLLED ENVIRONMENTS**

Can a computer read your body language? A consortium of European researchers thinks so, and has developed a range of innovative solutions from escalator safety to online marketing.

The keyboard and mouse are no longer the only means of communicating with computers. Modern consumer devices will respond to the touch of a finger and even the spoken word, but can we go further still? Can a computer learn to make sense of how we walk and stand, to understand our gestures and even to read our facial expressions?

The EU-funded MIAUCE project set out to do just that. "The motivation of the project is to put humans in the loop of interaction between the computer and their environment," explains project coordinator Chaabane Djeraba, of CNRS in Lille, France.

"We would like to have a form of ambient intelligence where computers are completely hidden," he says. "This means a multimodal interface so people can interact with their environment. The computer sees their behavior and then extracts information useful for the user."

It is hard to imagine a world where hidden computers try to anticipate our needs, so the MIAUCE project has developed concrete prototypes of three kinds of applications.

#### **ESCALATOR ACCIDENTS**

The first application aims to monitor the safety of crowds at busy places such as airports and shopping centers. Surveillance cameras are used to detect situations such as accidents on escalators.

"The background technology of this research is based on computer vision," says Djeraba. "We extract information from videos. This is the basic technology and technical method we use."

It's quite a challenge. First, the video stream must be analyzed in real time to extract a hierarchy of three levels of features. At its lowest, this is a mathematical description of shapes, movements and flows. At the next level this basic description is interpreted in terms of crowd density, speed and direction. At the

highest level the computer is able to decide when the activity becomes "abnormal," perhaps because someone has fallen on an escalator and caused a pile-up that needs urgent intervention.

It is at the second level and the third "semantic" level of interpretation that MIAUCE has been most concerned.

One of the MIAUCE partners is already working with a manufacturer of escalators to augment existing video monitoring systems at international airports where there may be hundreds of escalators. If a collapse can be detected automatically then the seconds saved in responding could save lives as well.

But safety is only one possible kind of application where computers could read our body language.

#### **FACE SWAPPING**

A second application could be in marketing, specifically to monitor how customers behave in shops. "We would like to analyze how people walk around in a shop," Djeraba says, "and the behavior of people in the shop, where they look, for example."

The same partner is developing two products. One will be a "people counter" to monitor pedestrian flows in the street outside a shop. It is expected to be particularly attractive to fashion stores who wish to attract passers-by. Another is a "heat map generator" to watch the movements of people inside the store, so that the manager can see which parts of the displays are attracting the most attention.

The third application addressed by MIAUCE is interactive web television, a technology of increasing interest where viewers can select what they want to see. As part of the project, the viewer's webcam is used to monitor their face to see which part of the screen they are looking at.

It could be used to feed the user further information based on the evidence of what they have shown an interest in. Project partner Tilde, a software company in Latvia, is commercializing this application.

MIAUCE has also developed a related technology of "face swapping" in which the viewer's face can replace that of a model. This could be used for trying out hairstyles and clothing.

#### **ETHICS AND ANONYMITY**

These are all ingenious applications but are there not ethical and legal worries about reading people's behavior in this way?

Djeraba acknowledges that the project team took such issues



very seriously and several possible applications of their technology were ruled out on such grounds.

They worked to establish some basic rules, such as placing cameras only on private premises and always with a warning notice, but the fundamental principle was anonymity. “We have to anonymize people,” he says. “What we are doing here is analyzing user behavior without any identification, this is a fundamental requirement for such systems.”

They also took account of whether the applications would be acceptable to society as a whole. No one would reasonably object to the monitoring of escalators, for example, if the aim was to improve public safety, but the technology must not identify individuals or even such characteristics as skin color.

“Generally speaking, anonymity is the critical point. If we anonymize it’s okay, if we don’t anonymize it’s not okay,” Djeraba says.

MIAUCE received funding from the Sixth Framework Programme for research.

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Therapeutic Innovations in Light of Technology

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## CYBERFOCUS

New technologies are developing at a rapid pace. To help you stay abreast of the latest trends in advanced technologies and health-care, this feature showcases upcoming 2012 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](mailto:office@vrphobia.eu).

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March 4-8, 2012

<http://conferences.computer.org/vr/2012/>

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April 16-18, 2012

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*Prepared by Bruno Seraglia, Ph.D.*

### Anonymity and Level of Support Given on a Health-related Online Support Forum (Venner, Galbraith and Fullwood, pg. 9)

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

**Indicate the correct statement among the following:**

- 1) a) SIDE Theory stands for Individual Society Deidentification Effects.  
b) SIDE Theory stands for Social Identification of Deindividual Effects.  
c) SIDE Theory stands for Social Identity of Deindividuation Effects.
- 2) a) The opportunities offered by computer-mediated communication (CMC) could enhance relationships.  
b) Computer-mediated communication (CMC) does present opportunities for the formation of intimate relationships.  
c) Intimate relationships are supported by computer-mediated communication (CMC).
- 3) a) In forum groups that contain both anonymous and identifiable members, the latter may be less supportive.  
b) Forum groups that contain only anonymous members may be less supportive.  
c) When forum groups are made up of both anonymous and identifiable members, the former may be less supportive.
- 4) a) The cognitive component of the SIDE Theory predicts that when all members of a group are anonymous, the strength of the group identity will decrease.  
b) The cognitive component of the SIDE Theory predicts that when all members of a group are identifiable, the strength of the group identity will increase.  
c) According to the cognitive component of the SIDE Theory, when all members of a group are anonymous, the strength of the group identity will increase.
- 5) a) According to Joinson (2000), members of the group will be more likely to work towards the group's aims if they are all both identifiable and communicative.  
b) If the members of the group are either all identifiable or all anonymous they will be more likely to work towards the group's aims (Joinson, 2000).  
c) According to Joinson (2000), members will be more likely to work against the group's aims if they are either all identifiable or all anonymous.
- 6) a) Geographical and chronological barriers become relevant factors in online health-related support groups.  
b) Online health-related support groups are influenced by geographical and chronological barriers.  
c) Chronological and geographical barriers are eliminated in online health-related support groups.

- 7) a) The popularity of Internet support groups can in part be accredited to the fact that users can remain anonymous from other individuals within the group.  
b) The popularity of Internet support groups can in part be accredited to the fact that users are identifiable individuals within the group.  
c) Users' ability to be identified represents the reason for the popularity of Internet support groups.
- 8) a) Younger participants may be inclined to offer less support as their limited engagement may mean less developed relationships with other members.  
b) Older participants may be inclined to offer less support as their limited engagement may mean less developed relationships with other members.  
c) Older participants may be inclined to offer more support as their engagement may mean more developed relationships with other members.
- 9) a) The first experimental hypothesis predicts that anonymous individuals will be less likely to give support.  
b) The first experimental hypothesis predicts that anonymous individuals will give support more than the identifiable ones.  
c) The first experimental hypothesis predicts that both anonymous and identifiable individuals will be less likely to give support compared to face-to-face situations.
- 10) a) Results show that members of the anonymous group were more likely than the identifiable members to give no support at all.  
b) Results show that members of the identifiable group were more likely than the anonymous members to give no support at all.  
c) According to the results, the proportion of anonymous members offering support was greater than the proportion of identifiable individuals who offered support.
- 11) a) According to the results, a higher proportion of anonymous individuals requested support compared to the identifiable users, but the effect did not reach significance.  
b) A significantly higher proportion of anonymous individuals requested support compared to the identifiable group.  
c) A higher proportion of identifiable individuals requested support compared to the anonymous group.
- 12) a) The second hypothesis was not supported by the results.  
b) The second and third hypotheses were supported by the results.  
c) All hypotheses were supported by the results.

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## **Annual Review of Cybertherapy and Telemedicine 2011**

Advanced Technologies in Behavioral, Social and Neurosciences

Volume 167 Studies in Health Technology and Informatics

Editors: B.K. Wiederhold, S. Bouchard and G. Riva

June 2011, 220 pp., hardcover

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The field of cybertherapy is becoming more widely accepted and implemented worldwide. The advantages that tele-health and mobile health have to offer, such as more readily accessible medical records, reliable user-friendly health advice on demand and patient-centric care are undeniable, and have resulted in exciting advances in how the needs of patients and caregivers alike are addressed. Better educated patients are becoming more responsible and proactive, taking charge of their own health and adopting and adhering to healthier lifestyle choices, and the goal of a healthy population and more efficient and effective healthcare becomes more attainable each day.

This book presents contributions from researchers and practitioners in the field of cybertherapy which not only illustrate the progress made in treating a variety of disorders, but also identify the challenges still faced in this field; such as the development of easy to use and more affordable hardware and software as well as the need to address potential side-effects and implement more controlled evaluation of cybertherapies as compared to more traditional treatments.

The book, which will be of interest to health professionals and patients alike, is divided into four sections: Critical Reviews contains summaries and evaluations of emerging cyber therapy topics; Evaluation Studies includes chapters which undertake to solve some specific practical problems and assess the value of cybertherapy interventions; Original Research addresses new cybertherapy methods or approaches; finally, Clinical Observations explores case studies and research protocols with long-term potential.





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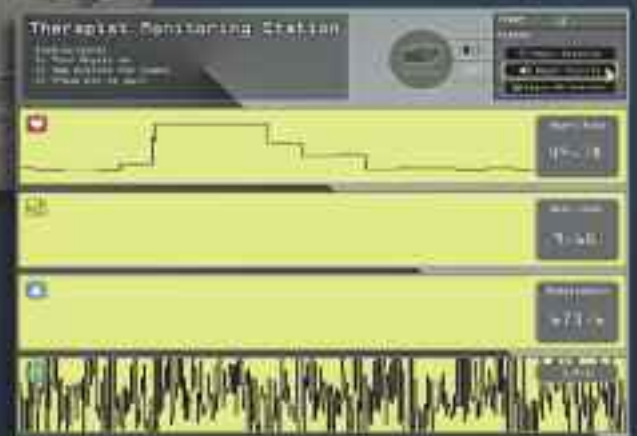
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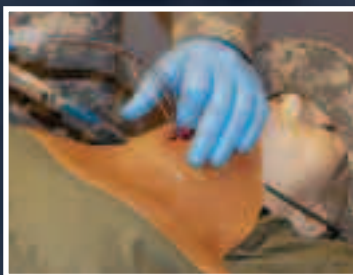
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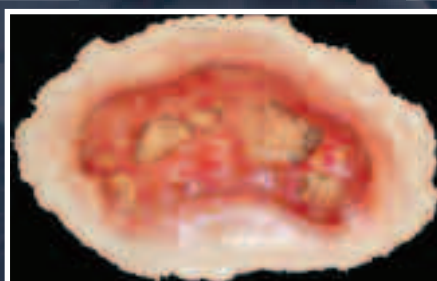
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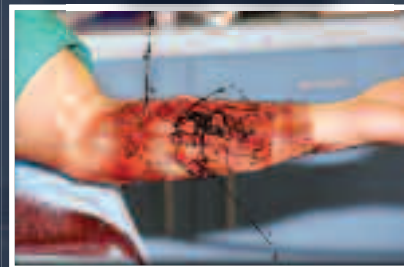
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FOR MORE INFORMATION, CONTACT:  
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# CyberPsychology & CyberTherapy <sup>17</sup>

Conference Organizers:

Interactive Media Institute

a 501 c3 non-profit organization

in collaboration with Virtual Reality Medical Institute

Experience the Future of Health & Well-Being

25-28 September 2012

Brussels, Belgium

## The Official Conference of the International Association of CyberPsychology, Training & Rehabilitation (iACToR)

CYBER<sup>17</sup> will bring together researchers, clinicians, funders and policymakers to share and discuss trends in healthcare and technology. CYBER<sup>17</sup> continues to seek input from a wider segment of the scientific community, and is interested in attracting experts in clinical therapy and rehabilitation, cognitive sciences, social sciences, and computer sciences dedicated to *shaping the future of health & well-being*.

### Key focus areas will include:

- 1. The Impact of Technologies as Tools:** technology's use in training, therapy, rehabilitation, and education to improve the quality and availability of healthcare.
- 2. The Influence of New Technologies:** technology's influence on behavior and society (e.g., positive technology for well-being, healthy ageing, and inclusion).
- 3. The Imprint of Social Networking:** the exploration of social networking tools on individual behavior and societal relations.
- 4. New Technologies/New Terms:** studying the psychological aspects of new areas influenced by technology (e.g., cyberfashion, cyberadvertising, cyberstalking).

For more information please visit

<http://www.interactivemediainstitute.com/conferences.html>  
or e-mail [cybertherapy@vrphobia.com](mailto:cybertherapy@vrphobia.com)

### 2012 CALL FOR PAPERS SUBMISSION/REGISTRATION DEADLINES:

Abstract Deadline

Submission: March 1, 2012

Notification of Acceptance/Rejection of

Abstract: April 1, 2012

Full Paper/Presenter Requirements

Deadline: June 1, 2012

Early Registration Deadline:

July 1, 2012