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Treatment of Social Anxiety Disorder Using Online Virtual Environments in Second Life

Erica K. Yuen
Medical University of South Carolina, Ralph H. Johnson Veterans Affairs Medical Center, Charleston, SC, and Drexel University

James D. Herbert
Evan M. Forman
Elizabeth M. Goetter
Ronald Comer
Jean-Claude Bradley
Drexel University

Over 80% of people with social anxiety disorder (SAD) do not receive any type of treatment, despite the existence of effective evidence-based treatments. Barriers to treatment include lack of trained therapists (particularly in non-metropolitan areas), logistical difficulties (e.g., cost, time, transportation), concerns regarding social stigma, and fear of negative evaluation from health care providers. Interventions conducted through electronic communication media, such as the Internet, have the potential to reach individuals who otherwise would not have access to evidence-based treatments. Second Life is an online virtual world that holds great promise in the widespread delivery of evidence-based treatments. We assessed the feasibility, acceptability, and initial efficacy of an acceptance-based behavior therapy in Second Life to treat adults with generalized SAD. Participants (n=14) received 12 sessions of weekly therapy and were assessed at pretreatment, midtreatment, posttreatment, and follow-up. Participants and therapists rated the treatment program as acceptable and feasible, despite frequently encountered technical difficulties. Analyses showed significant pretreatment to follow-up improvements in social anxiety symptoms, depression, disability, and quality of life, with effect sizes comparable to previously published results of studies delivering in-person cognitive behavior therapy for SAD. Implications and future directions are discussed.

Keywords: social anxiety; virtual reality; Second Life; telehealth; telepsychology

Social Anxiety Disorder (SAD) is the third most common psychiatric disorder in the U.S. (Kessler, Berglund, Demler, Jin, & Walters, 2005). Given its chronicity, early onset, and unremitting course, SAD is associated with extensive economic and personal costs (Grant et al., 2005).

Cognitive behavioral therapy (CBT) encompasses a family of evidence-based interventions that target changes in both the content and context of behaviors, thoughts, and feelings. Research has demonstrated the effectiveness of several CBT protocols for SAD, including cognitive behavioral group therapy (CBGT; Heimberg & Becker, 2002; Heimberg et al., 1998; Herbert et al., 2008; Liebowitz et al., 1999), cognitive therapy (Clark et al., 2003; Mörtberg, Clark, & Bejerot, 2011), and acceptance-based behavior therapy (ABBT; Dalrymple & Herbert, 2007). Systematic exposure is a key component of most CBT programs

Address correspondence to James D. Herbert, Ph.D., Department of Psychology, 119 Stratton, 1341 Chestnut Street, Philadelphia, PA 19104; e-mail: james.herbert@drexel.edu.

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for SAD (Rodebaugh, Holaway, & Heimberg, 2004), and the majority of the research does not support the idea that cognitive restructuring adds incremental effects to exposure-based treatments (Fedoroff & Taylor, 2001; Feske & Chambless, 1995; Gould, Buckminster, Pollack, Otto, & Yap, 1997).

ABBT for SAD combines exposure with psychological acceptance principles for coping with anxiety. Acceptance-based approaches do not attempt to modify cognitions directly, but instead foster mindful acceptance of thoughts and feelings while pursuing specific behavioral goals. Research indicates that acceptance-based CBT is at least as effective as other CBT programs for anxiety and depression (Forman, Herbert, Moitra, Yeomans, & Geller, 2007; Hayes, 2008; Hayes, Bissett et al., 1999; Herbert & Forman, in press; Lappalainen et al., 2007). A pilot study found that ABBT for SAD led to large improvements of comparable magnitude to those reported by other CBT programs for SAD (Dalrymple & Herbert, 2007).

Despite advances in interventions for SAD, over 80% of individuals with the disorder receive no treatment (Grant et al., 2005). By comparison, 50% of individuals with generalized anxiety disorder and 40% of those with major depressive disorder do not receive treatment (Grant et al., 2005). The most commonly reported reasons for not seeking treatment for SAD are financial barriers, uncertainty about where to seek help, and fear of negative evaluation (Olfson et al., 2000). An insidious "catch-22" of SAD is that the very symptoms of the disorder (fear and avoidance of social interactions) leave many sufferers unwilling to seek treatment, which requires social interaction. Even among those who do receive treatment, only a minority receives an evidence-based treatment such as CBT (Goisman, Warshaw, & Keller, 1999; Wang, Berglund, & Kessler, 2000). In addition, there is a geographical maldistribution of mental health providers; over three-quarters of the counties in the U.S. have a notable shortage of mental health professionals, with more than half of their needs going unmet (Thomas, Ellis, Konrad, Holzer, & Morrissey, 2009). The lack of available therapists with specialized CBT training is a major barrier for disseminating effective treatments to patients.

New and innovative methods (e.g., Internet-based therapies) are needed to improve dissemination of specialized psychological services and are an appealing option for individuals who are unwilling or unable to receive in-person treatment by a trained CBT therapist. More than three-quarters of Americans now have Internet access in their homes (Horrigan, 2008), and an increasing number (63% in 2009; Horrigan, 2009) are adopting high-speed Internet connections. Several research studies support the efficacy of Internet-based self-help CBT for SAD (Andersson, 2009; Berger, Hohl, & Caspar, 2009; Carlbring et al., 2007; Titov, Andrews, & Schwencke, 2008; Titov, Andrews, Schwencke, Drobny, & Einstein, 2008), with significant improvements maintained at follow-up (Carlbring, Nordgren, Furmark, & Andersson, 2009; Hedman et al., 2011; Titov, Andrews, Johnston, Schwencke, & Choi, 2009). However, the self-help format may be a challenge for patients who find difficulty motivating themselves to engage in anxiety-provoking situations without the presence of a therapist who provides support and fosters accountability (Carlbring et al., 2007).

Another innovative treatment modality for anxiety disorders is Virtual Reality Therapy (VRT), which can be conducted either in person or via the Internet. VRT allows therapists to choose the scenarios and adjust intensity of anxiety-provoking stimuli to tailor exposure exercises to individual patients' needs, and to provide an intermediate step when patients are unwilling to undergo the exposure in real life (Klinger et al., 2005). Several meta-analyses of studies using VRT to treat anxiety disorders found large reductions in anxiety symptoms following treatment (Parsons & Rizzo, 2008), with effect sizes comparable to in-person treatment (Powers & Emmelkamp, 2008). With respect to SAD in particular, Klinger and colleagues reported significant improvements for participants with SAD who received 12 weeks of exposure in a virtual reality environment, with results comparable to participants who engaged in real-life in vivo exposure exercises.

Second Life is an online virtual environment created by the company Linden Research, Inc., and released to the public in 2003. Users create avatars and maneuver them around the virtual environment to participate in activities and interact with other avatars. Conversations occur through typed messages, or through vocal conversations among users wearing voice-over-IP (VoIP) headsets. Second Life technology provides an online virtual environment that therapists and patients can potentially utilize to meet remotely for therapy sessions. Furthermore, the virtual environment, including the presence of avatars and virtual locations, provides a highly flexible array of visual stimuli for potential in-session exposure exercises.

The current study assessed the feasibility, acceptability, and initial efficacy of a cognitive behavioral therapy for SAD using Second Life to treat adults with generalized SAD. A particular concern was how the remote nature of the treatment might affect treatment adherence and level of engagement during exposure exercises. ABBT for SAD was chosen as the treatment protocol because of its components that emphasize acceptance of internal experiences,

and willingness to engage in anxiety-provoking behaviors (including participation in exposure exercises) for the purpose of living a meaningful life (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Herbert, Forman, & Dalrymple, 2009). A wait-list control condition was not included in this study because this was an exploratory study and the first of its kind. Given the literature with preliminary support for remote treatment, VRT, and in-person ABBT for SAD, we hypothesized that patients and therapists would rate this program as acceptable and feasible. We further hypothesized that symptoms of social anxiety, depression, psychosocial functioning, and quality of life would show clinically significant improvements from pre- to posttreatment, which would be maintained over a 3-month follow-up.

Methods

PARTICIPANTS

Participants, 14 adults (57% female) with a mean age of 36.1 ($SD = 11.9$), ranged in age from 21 to 64 years old (see Table 1). The majority was White (86%) and single (57%), and half were employed full-time (50%). Twenty-one percent of participants lived in a rural area, as defined by the Census 2000 Urban and Rural Classification (U.S. Census Bureau Geography Division, 2000). Participants were recruited through community media and professional referrals through a university-based anxiety clinic. Participants were required to meet standard diagnostic criteria for the generalized subtype of SAD (operationally defined as significant anxiety or avoidance in at least 3 distinct social situations) as their primary Axis I disorder, as determined by the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID; First, Spitzer, Gibbon, & Williams, 1996) and the Anxiety Disorders Interview Schedule—Revised (ADIS-R; DiNardo & Barlow, 1988). Twenty-nine percent of participants had major depressive disorder in full or partial remission, 14% had comorbid generalized anxiety disorder, and 7% had comorbid panic disorder with agoraphobia. Twenty-one percent of participants were maintained on their existing stable dose of psychotrophic medications for mood or anxiety, while the others refrained from beginning medication trials for the duration of the study. Participants agreed to refrain from participating in any other therapy for the duration they received treatment through this study. Participants were also required to have access to a computer that could download and run the Second Life application, and to have access to a broadband connection to the Internet (DSL, cable, wireless). Exclusion criteria included psychotic symptoms, acute suicide potential, history of substance dependence within the past 6 months, mental retardation, and pervasive developmental disorder.

Sixty-four percent of participants had received prior mental health services for anxiety or depression, but only 21% had ever received a form of CBT. None of the participants had previously received exposure-based CBT for social anxiety. Of those who had received prior therapy, 67% reported they had derived minimal to no benefit. Most participants (71.5%) had no prior experience using Second Life.

Table 1
Demographic Data

	Percentage *(n = 14)*
Gender	
Male	43% (6)
Female	57% (8)
Ethnicity	
African American	7% (1)
Asian	7% (1)
Caucasian	86% (12)
Education	
Some college	29% (4)
College Degree	50% (7)
Graduate Degree	21% (3)
Employment	
Unemployed	29% (4)
Part-time	21% (3)
Full-time	50% (7)
Student Status	
Part-time	14% (2)
Full-time	7% (1)
Non student	79% (11)
Marital Status	
Single	57% (8)
Married	36% (5)
Separated	7% (1)

MEASURES

Assessment Interviews

Assessors administered the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID; First et al., 1996), a widely used structured diagnostic interview for Axis I disorders based on DSM-IV criteria with excellent interrater reliability (kappa = 0.85; Ventura, Liberman, Green, Shaner, & Mintz, 1998), and the social phobia section of the Anxiety Disorders Interview Schedule—Revised (ADIS-R; DiNardo & Barlow, 1988), the gold-standard diagnostic interview for anxiety disorders. After each clinical interview, assessors completed the Clinical Global Impression Scale (CGI; National Institutes of Mental Health, 1985), an established clinical rating system for symptom severity and improvement.

Primary Self-Report Measures

The Social Phobia and Anxiety Inventory Social Phobia Subscale (SPAI-SP; Turner, Beidel, Dancu, & Stanley, 1989) has demonstrated good psychometric properties (Beidel, Borden, Turner, & Jacob, 1989; Herbert, Bellack, & Hope, 1991; Turner, et al., 1989), with a Cronbach's alpha of .96 for this sample. The self-report Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987) has demonstrated good internal consistency (Cronbach's alpha = .95), convergent validity, and discriminant validity (Baker, Heinrichs, Kim, & Hofmann, 2002), with a Cronbach's alpha of .92 (LSAS-Fear subscale) and .94 (LSAS-Avoidance subscale) for this sample. The Brief Version of the Fear of Negative Evaluation Scale (Brief FNE; Leary, 1983) has excellent inter-item reliability (Cronbach's alpha = .97) , good concurrent and discriminant validity, and adequate construct validity (Collins, Westra, Dozois, & Stewart, 2005), with a Cronbach's alpha of .93 for this sample.

Secondary Self-Report Measures

The Beck Depression Inventory–II (Beck, Steer, & Brown, 1996) has good reliability ($r = .90$), concurrent validity (Osman et al., 1997), and construct validity (Steer, Ball, Ranieri, & Beck, 1997), with a Cronbach's alpha of .94 for this sample. The Quality of Life Inventory (QOLI; Frisch, Cornell, Villanueva, & Retzlaff, 1992) has good internal consistency (Frisch et al., 1992), with a Cronbach's alpha of .88 for this sample. The Sheehan Disability Scale (SDS; Leon, Olfson, Portera, Farber, & Sheehan, 1997), which measures work, social, and family life impairment, has satisfactory reliability, construct validity, and criterion-related validity (Leon, Shear, Portera, & Klerman, 1992), with a Cronbach's alpha of .90 for this sample. The Acceptance and Action Questionnaire–II (AAQ-II; Bond et al., 2011), which measures experiential avoidance, has good convergent and discriminant validity, with a Cronbach's alpha of .93 for this sample.

Treatment Acceptance and Feasibility

The Patient Satisfaction Survey (PSS; Dalrymple & Herbert, 2007) assesses patient satisfaction and treatment acceptability in the following domains: satisfaction with treatment, satisfaction with therapist, symptom reduction, avoidance reduction, and expectations of symptoms and avoidance 1 year and 5 years from now. The Reaction to Treatment Questionnaire (RTQ; Holt & Heimberg, 1990) assesses patient expectancies of the treatment and perceived credibility of the treatment rationale. The Post-Treatment Therapist Survey asks therapists to rate treatment feasibility through Second Life. To assess presence (i.e., an individual's subjective perception of being immersed in the virtual environment, and producing cognitive and physiological responses similar to responses produced by the scenario in real life), participants were asked at posttreatment, "When you think back to your experience, do you think of the therapy room more as images you saw, or more as somewhere that you visited, on the following 1 to 7 scale? (1 = *images I saw*; 7 = *somewhere I visited*)"; however, a validated and comprehensive measure of presence was not utilized.

PROCEDURE

Potential participants underwent a brief telephone screening, downloaded the consent form, and then faxed or mailed the signed consent form to our anxiety clinic in Philadelphia. They also downloaded, installed, and tested Second Life on their computers to ensure they were able to run the application. To determine eligibility for the study, as well as primacy of SAD, potential participants were administered the SCID-IV for Axis I disorders and the social phobia section of the ADIS via telephone. Those ineligible for the study were provided with referrals for receiving in-person treatment elsewhere (see Figure 1 for participant flow).

At each assessment occasion (pre-, mid-, and posttreatment, and 3-month follow-up), participants completed online self-report measures, and clinical assessors administered a structured clinical interview over the telephone and completed the CGI. Clinical assessors were psychology doctoral and advanced undergraduate students who were trained and supervised by licensed psychologists with expertise in clinical assessment and who concurred with all diagnoses. Clinical assessors were aware of the treatment protocol that patients received.

The therapy environment was constructed on private virtual space called "Drexel Island," paid for by Drexel University. Importance was placed on teaching participants the basics of using Second Life in an easy-to-understand fashion. Participants were given instructions on purchasing a VoIP headset on their own, and then had a 30-minute orientation meeting in the Second Life environment with a clinic staff member to learn how to navigate the virtual environment, control their avatar's body movements and facial expressions, and have voice conversations through the VoIP headsets. Patients were given avatar creation guidelines in order to promote patient identification with their avatar; for example, the avatar had to be the same gender as that identified by the patient. Participants then read online psychoeducational handouts about social anxiety, completed an online quiz, and then began therapy sessions.

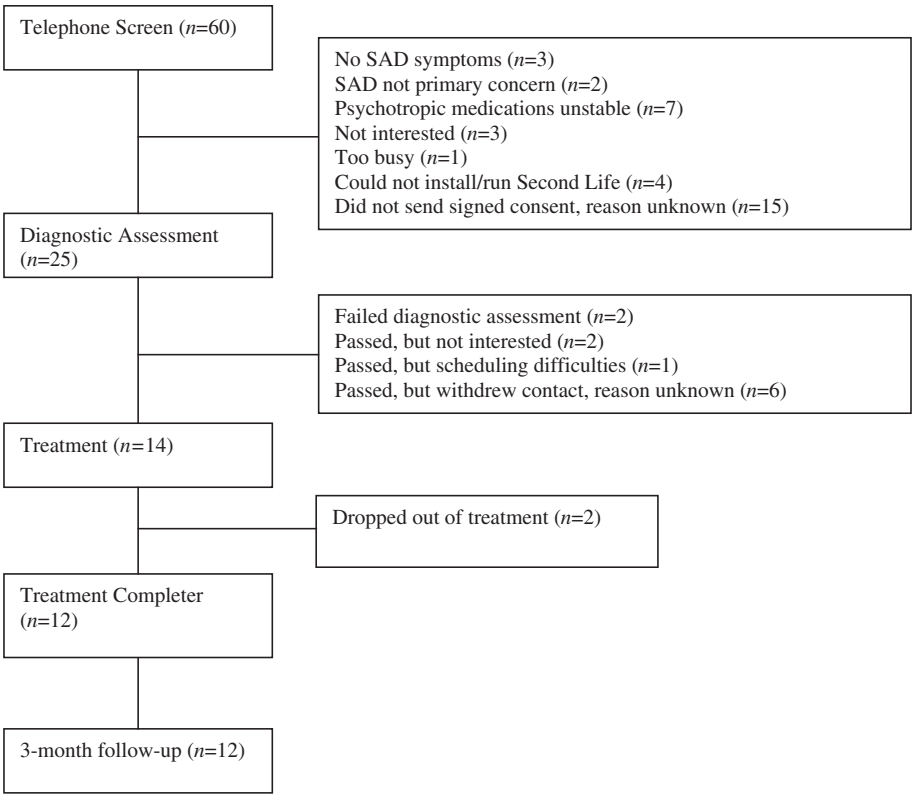

FIGURE 1 Participant flow.

Individual therapy consisted of 12 weekly 1-hour sessions. Therapists and patients met in a private secure virtual room and communicated vocally through headsets and visually with avatars. Typed messages were used concurrently to exchange information, such as listing the goals for in-session behavioral exercises. After each session, therapists recorded whether any technical difficulties occurred and how they impacted the treatment. The therapists were doctoral students in clinical psychology, who were trained and closely supervised by licensed psychologists with expertise in the treatment program (the second and third authors). Sessions were audio recorded, and weekly supervision involved discussion of cases and recordings to check for treatment adherence and quality of treatment delivery. Therapists followed a manualized treatment protocol for ABBT for SAD (Dalrymple & Herbert, 2007; Herbert & Cardaciotto, 2005) that incorporates mindfulness and psychological acceptance principles for anxiety (Eifert & Forsyth, 2005; Hayes, Strosahl, & Wilson, 1999; Hayes, Strosahl, & Wilson, 2011) with the core strategies of other CBT programs for SAD (Clark & Wells, 1995; Heimberg & Becker, 2002), including exposure to feared social situations, outward refocusing of attention, and social skills training.

Beginning with Session 3, in-session exposure exercises were conducted within the virtual world, such as initiating a conversation with a stranger at a virtual bar, or delivering a presentation inside a virtual conference room. Trained clinical staff served as confederate role-players, and utilized a variety of pre-made avatars with varying physical characteristics (gender, age, ethnicity) to interact with the participants. Through discussion and exposure exercises, participants practiced "willingness" (engaging in values-based productive behaviors without attempts to control anxiety). Each session concluded with a homework assignment consisting of in vivo exposure exercises and practice of the strategies addressed in that session. Additional homework assignments required patients to read articles/handouts, complete forms (e.g., homework log, values chart), and email them to the therapist before the start of the session.

Several steps were taken to ensure confidentiality within the Second Life environment. Second Life utilizes encryption technology and secure HTTP connection in the transmission of account information. Access to the virtual environments used in this treatment program (e.g., therapy room, role-playing rooms) were restricted to participants during their therapy sessions. Privacy features were utilized to

ensure that voice and text conversations were private, and that other avatars in the nearby vicinity were unable to eavesdrop.

Results

Both intent-to-treat (ITT) and completer-only analyses were conducted and results were equivalent; therefore, only the former are reported. Two participants who dropped out of treatment completed final assessments at the time of discontinuation. Multiple imputation (Rubin, 1987) using SPSS was conducted to account for missing data. Because this was a pilot study to explore if implementing CBT using Second Life is even feasible, we were mindful of balancing concerns over Type I error with those regarding Type II error; we therefore elected not to adjust alpha to control for experiment-wise error.

ACCEPTABILITY AND FEASIBILITY

All participants, including dropouts, completed a posttreatment patient satisfaction survey, and reported satisfaction with their treatment (93% were very or mostly satisfied) and their therapists (100% were completely or mostly satisfied). Most patients believed that the treatment decreased their fears in social situations (86% strongly agreed or agreed) and decreased their avoidance of social situations (72% strongly agreed or agreed). Ninety-three percent of patients would recommend the treatment to a friend. Most patients reported that receiving treatment through Second Life was easy (79% reported very or fairly easy). The dropout rate was 14%, with 12 out of 14 participants completing treatment. One participant dropped out after the third session to avoid in-session exposure exercises, and the other participant dropped out after the ninth session to avoid in-session exposure exercises and because she was uncomfortable communicating with a therapist she could not see.

All three therapists rated treatment in Second Life as "fairly feasible" (5 = *very feasible*, 4 = *fairly feasible*, 3 = *neutral*, 2 = *fairly unfeasible*, 1 = *very unfeasible*). Therapists reported insignificant (i.e., did not affect quality of treatment session) or no technical difficulties for 61% of sessions, moderate technical difficulties for 27% of sessions, and major to severe technical difficulties for 12% of sessions. Inability to transmit or receive sound through the headset on the part of the patient, therapist, or role-player was the most commonly reported technical problem, occurring in 21% of sessions; sometimes the microphone settings or headset volume was not adjusted properly, and other times the reason for the problem was unknown. Poor sound quality was experienced in 17% of sessions, with voices garbled or cutting out in the middle of conversation, or "echoing," which occurs when one hears the sound of his or her own voice back

Table 2
Means, Standard Deviations, and Effect Sizes for Intent-to-Treat Sample

Measure	*M*	*SD*	Effect Size (Cohen's *d*)
SPAI-SP			
Pre-treatment	134.60	26.45	
Mid-treatment	112.95	26.37	
Post-treatment	96.96	38.93	1.42
Follow-up	94.90	29.35	1.50
LSAS-Total			
Pre-treatment	81.36	23.85	
Mid-treatment	68.57	24.62	
Post-treatment	55.86	27.22	1.07
Follow-up	52.50	24.20	1.21
LSAS-Fear			
Pre-treatment	41.79	11.37	
Mid-treatment	35.93	11.41	
Post-treatment	29.07	12.16	1.12
Follow-up	28.36	10.85	1.18
LSAS-Avoidance			
Pre-treatment	39.57	13.56	
Mid-treatment	32.64	14.01	
Post-treatment	26.79	16.19	0.94
Follow-up	24.14	14.24	1.14
Brief-FNE			
Pre-treatment	48.00	7.71	
Mid-treatment	44.07	9.65	
Post-treatment	38.64	10.79	1.21
Follow-up	38.07	9.24	1.29
BDI			
Pre-treatment	14.29	10.74	
Mid-treatment	8.64	7.41	
Post-treatment	6.64	8.61	0.71
Follow-up	7.29	7.65	0.65
CGI-Severity			
Pre-treatment	5.07	1.14	
Mid-treatment	3.86	1.29	
Post-treatment	3.29	1.64	1.56
Follow-up	2.93	1.49	1.88
QOLI			
Pre-treatment	-0.93	1.93	
Mid-treatment	-0.09	1.41	
Post-treatment	0.72	1.62	0.85
Follow-up	0.64	1.25	0.81
SDS-Total			
Pre-treatment	20.57	5.71	
Mid-treatment	18.21	7.17	
Post-treatment	11.86	6.95	-1.53
Follow-up	13.86	8.47	-1.18
AAQ-II			
Pre-treatment	30.50	10.11	
Mid-treatment	28.00	6.48	
Post-treatment	23.21	6.89	0.72
Follow-up	24.17	7.95	0.63

through the headset. Due to technical difficulties with sound in Second Life, therapists reported using the telephone (concurrently with Second Life) for all or part of the time in 27% of sessions. In 6% of sessions, patients experienced hardware or Internet connection problems, such as being disconnected from Second Life, having a slow Internet connection, having their computer freeze, etc. Therapists reported that the moderate to severe technical difficulties impacted treatment by resulting in less time for discussion and exposure exercises, interrupted flow of the session, and difficulty in hearing what the other party was saying.

The mean presence score was 4.71 ($SD = 1.94$), with 43% reporting a score of 6 or 7. Most patients anecdotally reported feeling anxious during in-session exposures, suggesting a level of psychological presence. However, correlations were small for the relationship between presence and residual change (pretreatment to follow-up) in social anxiety symptoms as measured by the Brief FNE, $r(14) = .17$, $p = .56$, the SPAI-SP, $r(14) = .09$, $p = .76$, and the LSAS-Total, $r(14) = .05$, $p = .86$; note that a validated measure of presence was not used.

TREATMENT OUTCOME MEASURES

Repeated measures ANOVAs were conducted for the primary outcome measures across pretreatment, midtreatment, posttreatment, and 12-week follow-up (see Table 2). The ANOVA results were significant with large effect sizes for all measures of social anxiety: SPAI-SP, Wilks's lambda = 0.32, $F(3, 11) = 7.92$, $p < .01$; LSAS-Fear, Wilks's lambda = 0.28, $F(3, 11) = 9.52$, $p < .01$; LSAS-Avoidance, Wilks's lambda = 0.33, $F(3, 11) = 7.44$, $p < .01$; Brief-FNE, Wilks's lambda = 0.24, $F(3, 11) = 11.49$, $p < .01$; and CGI-Severity, Wilks's lambda = 0.19, $F(3, 11) = 15.22$, $p < .01$. Tukey's post hoc tests showed decreases in social anxiety from pretreatment to follow-up for all social anxiety measures. At follow-up, the majority of participants ($n = 8$; 57%) no longer met DSM-IV criteria for SAD, and clinician ratings on the CGI-Improvement scale were as follows: 21% of participants were given a rating of 1 (*very much improved*), 43% a rating of 2 (*much improved*), and 21% a rating of 3 (*minimally improved*). Using the criteria suggested by Jacobson and Truax (1991), 36% of participants demonstrated clinically significant improvement, having a reliable change index greater than 1.96 and a SPAI-SP score below 106.5 (Osman et al., 1996), which is closer to a non-SAD population. Treatment expectancy after Session 1 was not significantly correlated with residual change in social anxiety symptoms for the SPAI-SP, $r(14) = .44$, $p = .11$, Brief FNE, $r(14) = -.16$, $p = .60$, nor LSAS-Total, $r(14) = .371$, $p = .19$.

The ANOVA on the BDI-II was also significant, with a medium effective size, Wilks's lambda = 0.38, $F(3, 11) = 5.95$, $p = .01$, with post hoc tests revealing decreases in depression from pretreatment to follow-up. Psychosocial functioning and disability also improved, with significant ANOVA results and large effect sizes for the SDS, Wilks's lambda = 0.12, $F(3, 11) = 26.18$, $p < .01$, and the QOLI, Wilks's lambda = 0.18, $F(3, 11) = 17.08$, $p < .01$, with post hoc tests showing improvements from pretreatment to follow-up. Significant results and a medium effect size was found for the AAQ-II, Wilks's lambda = 0.22, $F(3, 11) = 10.62$, $p < .01$, with post hoc tests showing decreases in experiential avoidance from pretreatment to follow-up.

Discussion

This pilot study investigated the efficacy and feasibility of implementing ABBT for SAD through online virtual environments in Second Life, an easily accessible application that can be downloaded and installed on a personal computer. The majority of patients and therapists rated this treatment modality as both acceptable and feasible, and reported that setting up and using Second Life was easy to learn, despite some technical difficulties. Participants had the convenience of receiving long-distance evidence-based treatment while located in their homes, work office, or hotel while traveling. The dropout rate of 14% is comparable to previously reported dropout rates for in-person CBT for SAD (Dalrymple & Herbert, 2007; Davidson et al., 2004; Fedoroff & Taylor, 2001; Otto et al., 2000).

Results demonstrate that treatment in Second Life using acceptance-based exposure therapy in this virtual environment was highly effective in reducing social anxiety symptoms, as well as reducing avoidance and disability, improving depression, and increasing quality of life. Effect sizes for the social anxiety measures ($d = 1.14$ to 1.50) were very large, and comparable to previously reported effect sizes in RCTs delivering in-person treatment for SAD (Davidson, et al., 2004; Fedoroff & Taylor, 2001; Heimberg, et al., 1998; Otto, et al., 2000). It is possible that regression to the mean may have contributed to the high effect sizes, particularly given that participants in the present study had higher baseline social anxiety symptoms compared to many other studies of SAD (Dalrymple & Herbert, 2007; Davidson et al., 2004; Heimberg et al.; Otto, et al.). However, this concern is mitigated somewhat by the large literature documenting little to no improvement for individuals with SAD in wait-list control conditions who have not received treatment (Fedoroff & Taylor). ITT treatment response rate, defined as having a CGI-Improvement score of 1 or 2 (very

much improved, or much improved, respectively), was 64% at follow-up, which is comparable to previously reported treatment response rates for in-person CBT for SAD (Davidson et al.; Heimberg et al.).

The fact that a staggering number of individuals with SAD do not receive effective treatment is especially tragic given its severity yet treatability. The results of this study provide support for the effectiveness of remote treatment and online virtual reality exposure therapy to treat SAD. The online, virtual reality approach is a viable alternative for patients and may be preferable to self-help modalities in some cases because it provides direct therapist contact and fosters adherence. Virtual environments provide an opportunity for flexible and individually tailored in-session exposures. For example, a male patient who was very anxious about dating was able to practice dating situations in virtually constructed bars or restaurants with female role-players represented by attractive avatars. Furthermore, exposures conducted in VRT may be an intermediate step for patients who are reluctant to engage in the exposure in the real world.

A limitation to the treatment delivered through Second Life was that therapists and patients could not see each other's actual faces. Several patients reported feeling uncomfortable with revealing personal details to a therapist whose face they could not see. Therapists reported that conducting therapy was sometimes difficult without being able to view and interpret the patients' body language and facial expressions. In-session exposure exercises through Second Life were also limited in that the patient was not exposed to real-life faces and body language from their conversation partners, nor could they receive feedback from their therapist about their nonverbal social skills, such as eye contact, posture, and facial expression. In general, most patients reported feeling anxious during role-plays, which is necessary for exposure exercises to be effective. However, a number of patients reported that being unable to see actual people made the role-plays sometimes feel less realistic, and thus they were somewhat less engaged than they might have been otherwise.

Potential participants who initially inquired about the study but elected not to participate reported several reasons for their decision, including disinterest and difficulty installing or running Second Life. Future studies should carefully monitor reasons for discontinuing the enrollment process to explore barriers to engaging in online treatment. Whereas remote treatments increase the availability of providers and reduce logistical barriers related to transportation and scheduling, other barriers still exist, such as financial limitations and lack of access to technology and the Internet. However, note that rural and low-income Americans have the largest recent growth in broadband connectivity (Horrigan, 2009).

Based on the therapists' and participants' experiences using Second Life in this study, we offer several recommendations for future therapy programs utilizing an online virtual environment. In-session exposure exercises in this study were limited to controlled social situations with confederate role-player, and patients were aware that the role-players were clinical staff, which may have reduced their anxiety. To increase the impact of exposure, future treatment inside Second Life could involve the patients initiating social interactions with avatars operated by other actual users in public locations within Second Life. This option is particularly practical for therapists who may not have other clinical staff available to practice role-plays with their patients. Another option, in situations where a team of confederate role-players are not available, is to have the therapist control the role-player avatars, or to conduct group therapy sessions within Second Life whereby the patients role-play conversations with each other.

Technical difficulties in any treatment program utilizing technology are inevitable, due to human error (e.g., incorrect headset configurations), software errors, (e.g., programming bug), and hardware issues (e.g., poor Internet connection). Technical problems and their impact can be reduced through several means: (a) training of therapists and patients in the correct usage of the computer application and equipment, as well as how to troubleshoot technical problems; (b) requiring therapists and patients to use specific technology (e.g., headsets, type of Internet connection) that has been proven to work well with the application; (c) encouraging patients to verbalize any technical difficulties experienced so that troubleshooting can occur.

Although psychological presence was not correlated with treatment outcome in this study, a comprehensive and validated measure of presence was not administered, and it is possible that increasing presence may result in even better treatment outcomes. Participants with high presence feel connected to the virtual environment and identify with their avatar, which may result in greater engagement with the in-session exposure exercises. Potential ways to increase presence are to conduct exposure exercises in realistic-looking virtual environments, offer opportunities for the patients and therapists to interact with virtual objects, and tailor the physical appearance of the situation and characteristics of the avatars to the social fears of each

patient. In addition, requiring participants to create avatars that accurately represent themselves (gender, height, body shape, clothing, attractiveness) may also increase presence. For example, participants self-conscious about their weight would have to engage in virtual exposures with an overweight personal avatar that looks like them, which would presumably trigger anxiety related to appearance and increase the transferability of the virtual exposures to real life. In addition, the present study utilized a virtual PowerPoint board to display diagrams and main points to the patients. The use of such educational tools may also increase patient immersion and engagement with the therapy. Finally, faster Internet connections result in less lag time (i.e., the time it takes for the avatar's actions to be displayed subsequent to the user's keyboard command), thereby increasing the feeling of realism.

Due to the visual limitations of Second Life, it is possible that delivering remote treatment through videoconferencing, allowing the exchange of non-verbal communication between patient and therapist, may provide additional benefits over using Second Life. A pilot study conducted by our group found that delivering ABBT through videoconferencing produced reductions in social anxiety symptoms comparable to previously published treatment outcome results from in-person CBT for SAD (Yuen et al., 2010). It is also possible that a combination of VR plus videoconferencing would provide patients with the benefits of both modalities.

As technology continues to develop rapidly and as the public continues to embrace these new technologies, additional opportunities for remote treatment will emerge. For example, treatment delivery through mobile handheld devices is currently being researched, which allows patients to receive therapy in any location within a wi-fi or cellular network. These technological advances may be an important key to increasing dissemination of empirically supported treatments to those in need.

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