OPTIMIZING STRATEGIES FOR IN VIVO EXPOSURE IN THE TRADITIONAL CLINICAL SETTING

by

MARYANN E. OWENS

B.S. University of Georgia, 2008
M.S. University of Central Florida, 2013

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Psychology
in the College of Sciences
at the University of Central Florida
Orlando, Florida

Summer Term
2016

Major Professor: Deborah C. Beidel

ABSTRACT

This study examined the ability of a pre-recorded videoconferencing (VC) audience to elicit the physiological and subjective arousal associated with Social Anxiety Disorder (SAD) when giving a formal presentation. This study had three objectives: (a) to determine whether speaking to the VC audience elicited significant increases in physiological response (e.g., heart rate and electrodermal activity) and subjective distress over baseline resting conditions (b) to determine whether the VC task more closely replicates the physiological and subjective experience of giving a speech to a comparable real-life audience than levels elicited by a Virtual Reality (VR) environment and (c) to determine whether the VC task elicited higher levels of presence and fear of negative evaluation than the VR task, more closely replicating levels elicited by an in vivo speech. All participants gave an impromptu speech under three conditions: in vivo, VC, and VR audience while measures of physiological arousal, self-reported distress, and presence were obtained. Results demonstrated that the VC task elicited significantly greater increases in heart rate, electrodermal activity, and self-reported distress than the VR task and VC responses were not significantly different from in vivo. In addition, participants reported levels of immersion and fear of negative evaluation during the VC task that were significantly greater than during the VR task, and did not differ significantly from in vivo. Clinical implications of these findings including cost effectiveness and the role of VC in the treatment of SAD are discussed.

ACKNOWLEDGMENTS

I would like to show my gratitude to Dr. Lisa Mills and Christopher Williamson of the University of Central Florida's School of Visual Art and Design for their guidance and assistance in developing the videoconferencing task used in this study.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

Social Anxiety Disorder (SAD) is one of the most prevalent and impairing anxiety disorders. With a lifetime prevalence rate of 13% among adults (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012), SAD is characterized by a "marked fear or anxiety about one or more social situations in which the individual is exposed to possible scrutiny by others (American Psychiatric Association, 2013). SAD typically emerges during childhood or mid-to-late adolescence with approximately 50% developing this disorder by age 11 and almost 80% by age 20 (Beidel, Turner, & Morris, 1999; Stein & Stein, 2008). Among the most commonly feared situations (e.g., meeting new people, initiating and maintaining conversations, attending parties, eating or writing in front of others, using public restrooms, and speaking up in class or at meetings), the most ubiquitously distressing is public speaking (Mannuzza et al., 1995; Stein, Walker, & Forde, 1996). Although most individuals fear a variety of situations, a specifier of "performance only" is added if anxiety only occurs during performance situations (APA, 2013).

At their core, individuals with SAD are excessively fearful of doing or saying something to elicit judgment that they are somehow inadequate or otherwise unlikeable. Exposure to feared circumstances is often met with negative cognitions such as "Everyone will think I'm stupid," in addition to significant symptoms of physiological arousal (e.g., increased heart rate, sweating, blushing, and trembling). Although considered an innate and sometimes invaluable reaction to perceived threat, those with SAD fear these reactions will result in further scrutiny if apparent to others (APA, 2013; Roth, Antony, & Swinson, 2001). These individuals often disregard the possibility of alternate, benign interpretations for their behavior and in turn, are dismissive of positive social cues (Veljaca & Rapee, 1998).

Encounters with feared situations almost always provoke anxiety and are avoided or otherwise tolerated with unremitting, intense distress (APA, 2013). Avoidance behaviors can be as basic as avoiding eye contact, speaking softly, and over-preparing for a speech or as extensive as disenrolling from college to avoid requisite public speaking classes. The literature has consistently demonstrated associations between this pattern of distress and behavioral avoidance with significantly reduced quality of life (Stein & Kean, 2000; Wittchen, Fuetsch, Sonntag, Müller, & Liebowitz, 2000) and impairment in occupational, academic, social, and emotional functioning (Acarturk, Cuijpers, Van Straten, & De Graaf, 2009; Davidson, Hughes, George, & Blazer, 1993; Turner, Beidel, Dancu, & Keys, 1986; Wittchen & Beloch, 1996; Zhang, Ross, & Davidson, 2004). Despite intelligence and ability, individuals with SAD are approximately 10% less likely to obtain higher education, are over twice as likely to be unemployed, earn on average 10% less salary, and are less likely to obtain upper-level jobs than those without SAD (Katzelnick et al., 2001; Moitra, Beard, Weisberg, & Keller, 2011; Stein & Kean, 2000). Extensive social isolation and diminished self-esteem can contribute to the development of comorbid conditions such as other anxiety disorders, depression, and substance use disorders (Kessler, Stang, Wittchen, Stein, & Walters, 1999; Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992) . These individuals are also more likely to seek health care services and take prescription medication (Patel, Knapp, Henderson, & Baldwin, 2002). Overall, the annual cost of anxiety disorders including SAD approximates $42.3 billion, or $1,542 per individual (Greenberg et al., 1999).

Despite the burden placed on the individual and the economy, over 80% of individuals with SAD are not receiving treatment (Grant et al., 2005). The most commonly identified

barriers include an inability to afford treatment, uncertainty, fear of negative evaluation, and ironically, the symptoms of SAD themselves (Olfson et al., 2000). Additionally, over 75% of counties in the United States have a paucity of mental health professionals, particularly professionals with training in evidence-based treatments for SAD, leaving a sizeable portion of the population without access (Goisman, Warshaw, & Keller, 1999; Thomas, Ellis, Konrad, Holzer, & Morrissey, 2009; Wang, Berglund, & Kessler, 2000).

Current Treatments

Pharmacological Treatments

Medications such as selective serotonin reuptake inhibitors (SSRIs) and serotonin-norepinephrine reuptake inhibitors (SNRIs) are frequently prescribed for the treatment of SAD (Blanco, Bragdon, Schneier, & Liebowitz, 2013). These newer (second-generation) drugs tend to have large treatment effect sizes, few side effects, the strongest outcomes, the lowest dropout rates and are recommended as the first-line pharmacological treatment for SAD (Blanco et al., 2013; Gould, Buckminster, Pollack, Otto, & Yap, 1997; Katzelnick et al., 1995; van Vliet, den Boer, & Westenberg, 1994). Other commonly prescribed classes of medication include benzodiazepines which have the potential for abuse and side-effects (e.g., sedation and impaired cognition) (Blanco et al., 2013) and β-adrenergic antagonists (β-blockers) which may only temporarily improve the physiological effects of anxiety (Gould et al., 1997). Despite the potential benefits of pharmacological treatments, many potential patients and psychiatrists are deterred by side-effects, withdrawal problems, potential for relapse, and unknown teratogenic effects in pregnant women (Fyer et al., 1987; Gould et al., 1997; Marks et al., 1993).

Cognitive-Behavioral Therapy

Currently, cognitive-behavioral therapy (CBT) is the most established and recommended psychotherapeutic treatment for SAD. Although CBT treatment paradigms may consist of multiple components (e.g., psychoeducation, exposure to feared social stimuli (EXP), homework assignments, cognitive therapy (CT), progressive muscle relaxation (PMR), applied relaxation, and in some cases social skills training (SST). EXP produced the best outcomes when components are compared (Gould et al., 1997). EXP is better suited than CT in addressing the avoidance behaviors believed to maintain and contribute to SAD by replacing maladaptive memory structures through a mechanism known as emotional processing theory (Foa & Kozak, 1986; Gould et al., 1997).

Typically during EXP, patients confront their fears in a safe, controlled environment by exposure to either actual (*in vivo*) or imagined stimuli. Through a process known as habituation or extinction, repeated exposure to feared stimuli without negative consequences yields a natural decrease in the physiological and cognitive aspects of the fear over time. The patient's worst fear is targeted either right away (flooding) or in a gradual (hierarchical) manner. Although extant research has demonstrated that that EXP utilizing *in vivo* stimuli is the most effective approach for treating SAD (Craske et al., 2008), *in vivo* exposures are not always practical, ethical, or are difficult or expensive to recreate or repeat. In addition, the stimuli may elicit such extreme fear that the patient is unwilling to enter or remain in treatment. Although imaginal exposure may be useful in these circumstances, imaginal exposure relies heavily on the patient's cognitive skills and creative abilities to produce complete immersion in the scenario and to prevent avoidance via cognitive distraction.

Virtual Reality Exposure Therapy

Using computer-generated graphics viewed through a head mounted display (HMD) coupled with other sensory stimuli, virtual reality exposure therapy (VRET) was developed as a means to overcome these limitations (Krijn, Emmelkamp, Olafsson, & Biemond, 2004; Rothbaum & Hodges, 1999). The HMD is a visor that allows the individual to view the images on a display screen while blocking potentially distracting stimuli from the outside environment. The HMD utilizes an electromagnetic tracking system that displays different areas of the VRE corresponding with changes in head movements. On a separate screen, the therapist can see the patient's view and manipulate the environment to increase presence by including audio and olfactory stimuli (Krijn et al., 2004; Rothbaum & Hodges, 1999). Although data have consistently demonstrated that VR may in fact be a useful tool for the treatment of specific phobias and SAD, including public speaking anxiety (Anderson, Rothbaum, & Hodges, 2003; Anderson et al., 2013; Anderson, Zimand, Hodges, & Rothbaum, 2005; Harris, Kemmerling, & North, 2002; Klinger et al., 2005; Wiederhold & Wiederhold, 1998), methods of exposure therapy must meet certain requirements and research examining the relationship between those tenants and VRET is sparse.

For example, consistent with emotional processing theory (Foa & Kozak, 1986), (a) the patient must feel immersed in the VRE as opposed to a passive observer, (b) the VRE must also be generalizable to the corresponding real-life situation, and (c) the VRE should elicit physiological arousal, indicating that the core elements of the fear have been activated (Lee, 2004; North et al., 2008; Regenbrecht, Schubert, & Friedmann, 1998; Schubert, Friedmann, & Regenbrecht, 2001; Schuemie et al., 2000). Although extant research has suggested that full

immersion with exposure stimuli may not be necessary when treating specific phobias (Podina, Koster, Philippot, Dethier, & David, 2013), additional research is needed to elucidate the generalizability of these findings to SAD.

Studies to date have yielded promising results, demonstrating the ability of VR environments to elicit physiological arousal (e.g., blood pressure and heart rate), self-reported distress, and a sense of immersion, but conclusions were limited by numerous factors (e.g., small sample sizes, lack of a clinical population and comparable control task) (Hartanto et al., 2014; Kotlyar et al., 2008; Pertaub, Slater, & Barker, 2002; Slater, Pertaub, Baker, & Clark, 2006). Although one trial did demonstrate the ability of a VR conversation task to elicit significant levels of subjective distress and immersion when compared to an *in vivo* task (Powers et al., 2013), this study lacked the inclusion of a clinical population and objective measures of anxiety, thus its relevance to the treatment of a clinical population is unclear.

In an effort to address these limitations, a trial by Owens and Beidel (2015) compared physiological responses elicited by a VR public speaking task and a comparable *in vivo* speech task in individuals with SAD and individuals with no diagnosis. This study expanded upon physiological response data by including measurements of electrodermal activity (EDA), respiratory sinus arrhythmia (RSA), and heart rate (HR) measured continuously before, during and after each of the two tasks. To replicate earlier studies, these objective measures of arousal were compared to self-report measures of anxiety as well as a measure of presence. Results demonstrated that the VR speech task elicited significant increases in these metrics over baseline conditions, but the VR task was less anxiety provoking than the *in vivo* speech task. The findings suggest that although the VR stimuli were sufficiently similar to real-life stimuli to

support its utility as a tool for conducting exposure therapy, the VR was not equivalent to an *in vivo* audience and may be better suited as an intermediate step in a hierarchy or as a means to encourage those more hesitant about *in vivo* exposure to initiate treatment. In addition, participants reported a moderate level of presence in the VR task, but significantly less than in the *in vivo* speech task, particularly when the *in vivo* task was administered first. For example, following the VR speech task, a number of participants remarked, "That wasn't nearly as scary as giving a speech with real people, you know the virtual people aren't thinking negatively about you." These findings indicated that the VR task may not sufficiently address a primary concern of those with SAD – fear of negative evaluation by others (Clark & Wells, 1995; Horley, Williams, Gonsalvez, & Gordon, 2004; Rapee & Heimberg, 1997).

Although research has clearly demonstrated the superiority of *in vivo* exposures, in the case of patients with SAD, the majority of clinicians do not have consistent access to volunteers to serve as audience members for a speech or access to conference rooms/auditoriums large enough to hold an audience. Those that do, face the time-consuming challenge of recruiting and coordinating audience members. The advantages of using VR when *in vivo* exposure proves too troublesome are many. Despite its convenience, VR environments have limitations. Aside from the initial equipment cost (including a computer capable of running the software), there are software licensing fees and the cost of both training staff and maintaining the system. Although prices vary by distributor, VR software and hardware packages can cost thousands, placing this technology out of reach of many clinicians' budgets. Given these shortcomings, it is worthwhile to investigate tools for conducting exposure therapy that are less elaborate and better address fears of negative evaluation.

Capitalizing on the benefits of *in vivo* and VR exposure stimuli, while overcoming many of the associated drawbacks, utilization of a pre-recorded audience may restore the evaluative component lost in VREs while greatly reducing the need for costly VR equipment and eliminating the difficulties encountered when forming *in vivo* public speaking exposures. Viewed on a TV screen, a pre-recorded audience presented to participants as a live audience in a remote location could elicit fears of negative evaluation similar to a "live" audience. The current study sought to expand upon previous work (Owens & Beidel, 2015) by replicating the VR vs. *in vivo* comparison and including a third task, in which participants are instructed to provide a speech in front of a "representational" videoconferencing audience.

Current Study

This study has the following hypotheses:

1. Participants will experience a significant increase in physiological arousal and self-reported distress from baseline levels during the videoconferencing speech task.
2. Participants will have the greatest increase from baseline levels of physiological and self-reported distress during the *in vivo* speech task and the least during the VR speech task.
3. Participants will report the highest levels of presence and fear of negative evaluation in the *in vivo* speech task and the least in the VR speech task.

CHAPTER TWO: METHODOLOGY

Procedure Overview

Participants were recruited via community advertisement and through the university's undergraduate research pool. Participants were admitted into the study if they met diagnostic criteria for SAD and met additional inclusion and exclusion criteria. Specifically, participants were required to have a Clinician Severity Rating (CSR) of at least 4 on the Anxiety Disorders Interview Schedule for the DSM-5 (ADIS-5; Brown & Barlow, 2014). Participants with additional disorders (e.g., depression) were included if they were secondary to their primary diagnosis of SAD. However, presence of a lifetime diagnosis of current bipolar disorder, suicidal ideation, current alcohol or substance abuse, or psychosis was exclusionary. Further, participants were only included if they endorsed frequently experiencing anxiety when speaking in front of at least 5 people. Additional exclusion criteria included any unstable or serious medical conditions or taking any medications that, in the opinion of the researcher, might have interfered with the measures being assessed (e.g., psychoactive medications, anti-hypertensives).

Forty-eight (48) adults responded to recruitment efforts. Five participants met exclusion criteria for comorbid disorders: (2) primary Major Depressive Disorder, (1) primary Generalized Anxiety Disorder, (1) Alcohol Use Disorder, (1) Bipolar Disorder with Psychotic Features. Seven participants did not meet the minimum CSR requirement for study inclusion (e.g., sub-clinical SAD) and one participant did not meet criteria for any diagnosis. An additional 2 participants were removed due to incomplete physiological assessment data. Finally, 3 participants were removed as their HR and SCR data were determined to be outliers, as the values fell above the 3rd quartile. The final sample consisted of 30 adults with SAD (14 males;

16 females) ranging in ages from 18 to 42 years (*M*=21.37). The sample was ethnically varied consisting of 40% Caucasians, 23% African Americans, 20% Hispanics/Latinos, 13% Asian American/Pacific Islanders, and 3% who identified as belonging to the Other category (e.g., of mixed ethnic background). Demographic characteristics, comorbid diagnoses, and clinical severity scores are displayed in Table 1. Two of the participants were currently receiving talk therapy to address anxiety and depression related concerns; however, none of the participants reported prior experience with exposure therapy.

Table 1 Demographic and Clinical Severity Data

Variable	**SAD (N=30)**
Age M(SD)	21.37(5.49)
Gender	
Males	14
Females	16
Race/Ethnicity	
Caucasian	12
African American/Black	7
Hispanic/Latino	6
Asian/Pacific Islander	4
Other	1
Assessment Measures	**M(SD)**
ADIS-5 SAD CSR	5.60(1.19)
SPAI Difference Score	95.55(19.78)
HAMD Total Score	12.57(6.41)
Comorbidity	**(N)**

Variable	SAD (N=30)
MDD	2
Specific Phobia	4
GAD	4
PTSD	1
Unspecified Feeding/Eating	1

ADIS-5 SAD CSR=Anxiety Disorders Interview Schedule for the DSM-V Social Anxiety Disorder Clinician Severity Rating, SPAI=Social Phobia and Anxiety Inventory, HAMD=Hamilton Depression Scale, MDD=Major Depressive Disorder, PTSD=Post-Traumatic Stress Disorder, GAD=Generalized Anxiety Disorder

Diagnostic Measures

Diagnostic Interview

Following the consent process, potential participants were administered the Anxiety and Related Disorders Interview Schedule for the DSM-5 – Adult Version (ADIS-5L; Brown & Barlow, 2014). As part of the ADIS-5, a Clinician Severity Rating (CSR) was assigned to each diagnosis, using a 9-point scale (0-8) where higher numbers are indicative of greater severity. The ADIS-5 was conducted by the first author, a doctoral student at UCF. To calculate inter-rater reliability and agreement, twenty-percent of the interviews were scored by a second blinded evaluator (e.g., a doctoral student within the clinical psychology program). For the diagnosis of SAD, the kappa coefficient was k=1.00. Inter-rater agreements for the CSR intraclass correlation coefficient was ICC(3,2)= 1.00 and the reliability was r=1.00.

In addition to the diagnostic interview, the following measures were included to determine study eligibility and SAD symptom severity:

Participants completed the Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel,

Dancu, & Stanley, 1989) to assess the range and severity of their social fears. The SPAI is a 45 item self-report questionnaire measuring the somatic, cognitive, and behavioral aspects of social phobia. The SPAI consists of 2 subscales, social phobia and agoraphobia. The SPAI total score is calculated as the difference between two subscales, providing a more pure measure of social phobia. The SPAI has high test-retest reliability of .86 and differentiates patients with social phobia from normal controls or from patients with other anxiety disorders (Turner et al., 1989). In addition, the SPAI has good concurrent and external validity (Beidel, Turner, Stanley, & Dancu, 1989; Turner et al., 1989).

To assess potential depressive symptoms and rule out participants who may be suffering from significant depression, the first author administered the 21-item Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960). To calculate inter-rater reliability and agreement, twenty-percent of the interviews were scored by a second blinded evaluator (e.g., a doctoral student within the clinical psychology program). Inter-rater agreement for the HAM-D was ICC(3,2)=.996 and the reliability was r=.990. With mean scores ranging from 3-27 and with depressive symptoms presenting as secondary to SAD, no participants were excluded from the current study based on their HAM-D scores.

Outcome Measures

Participants completed the following battery of self-report measures:

The *Self-Statements During Public Speaking* (SSPS; Hofmann & DiBartolo, 2000) is a 10-item questionnaire designed to assess fearful thoughts experienced during public speaking. The SSPS consists of two 5-item subscales, the “Positive Self-Statements” (SSPS-P) and the

"Negative Self-Statements" subscale (SSPS-N). The SSPS has demonstrated acceptable levels of internal consistency and test-retest reliability and differentiates high and low levels of public speaking anxiety (Hofmann & DiBartolo, 2000).

The *Brief Fear of Negative Evaluation-II* (BFNE-II; Carleton, McCreary, Norton, & Asmundson, 2006) is a revised version of the Brief Fear of Negative Evaluation Scale (BFNE; Leary, 1983). This 12-item scale provides a measurement of worry and distress encountered upon the possibility of negative evaluation or judgment by others. Each item is rated on a 5-point Likert scale between 1 and 4 with higher scores indicating greater fear. This measure has demonstrated good confirmatory single-factor fit and a moderate degree of convergent and discriminate validity with other measures of social anxiety (Carleton, Collimore, & Asmundson, 2007). A total score of 38 is considered the clinical cut-off for differentiating between those with and without SAD (Carleton, Collimore, McCabe, & Antony, 2011). For the purposes of the current study, a modified version was administered following each speech task, referencing the fear of negative evaluation elicited by the task, rather than across all situations.

The *Subjective Units of Distress Scale* (SUDS) asked the participant to rate their own level of anxiety using a 9-point likert type rating scale (0 to 8; no distress to extreme distress).

Two *Visual Analogue Scales* (VAS) were administered after each speech task to assess the degree to which the participant felt engaged/involved with the speech task environment and separately, how strong was their sense of "being there." Participants were asked to indicate their response by drawing a vertical mark on a 100mm line, which is anchored by labels representing the extremes of the continuum (e.g., Not Engaged/Involved At All to Complete

Engaged/Involved and Completely Detached/No Sense of Being There to Complete Sense of "Being There").

Behavioral Measures

The behavioral assessment consisted of (a) an impromptu speech in front of a live 5-person audience, (b) an impromptu speech in front of a 5-person virtual audience, and (c) an impromptu speech in front of a 5-person "representational" videoconferencing audience. The VR speech task utilized the conference room environment from Virtually Better's© software package. In this VRE, the participant viewed a waiting room through a HMD and the researcher guided the participant into a virtual conference room in which a five person audience was seated around a conference table. The audience members consisted of two men and three females of varying ethnicities (3 Caucasians, 1 African American, and 1 Asian) wearing business casual attire.

For the *in vivo* speech task, the virtual conference room was recreated in a conference room in UCF's Psychology Clinic. Four to five undergraduate volunteers, instructed to wear business casual attire, were seated around a conference table, consistent with the virtual task. Participants were told the audience members would not be interacting with them.

The videoconferencing task recreated the virtual conference room by utilizing a pre-recorded audience, consisting of five volunteers wearing business casual attire, seated around a conference table. Participants viewed this recording on a 32" flat screen TV (from a distance of approximately 5ft away) and were told the recording was actually a live-audience in a remote location, being viewed through videoconferencing software. Participants were told that the

audience was able to view their performance through a webcam but would not be interacting with them.

Physiological Measures

During the behavioral assessment, HR and EDA were continuously monitored and recorded using the locally monitored MindWare Mobile Impedance Cardiograph system. Continuous recording allowed for the assessment of physiological arousal over time and in relation to the three speech tasks. MindWare Version 3.1 allowed for the conversion of physiological data into meaningful statistical data to be analyzed using MindWare analysis software version 3.1. HR, a measure of sympathetic and parasympathetic responses to external stimuli was measured via EKG at 30 second intervals. EDA, as measured by skin conductance level (SCL) and response (SCR) provided measures of sympathetic activity of the autonomic nervous system (ANS) and was recorded continuously.

Cost-Effectiveness Measures

Approximate clinician labor cost for conducting an *in vivo* exposure session was determined by recording the approximate time the researcher spent performing recruitment tasks for audience volunteers and multiplied by the average hourly wage for a private practice clinician ($150/hr). Clinician time for conducting an exposure session with each tool was not included as this is expected to be consistent across the three conditions. An expert in the field of virtual reality software development, Josh Spitalnick, Ph.D., provided the average costs to develop a virtual reality speech environment (e.g., audience member recruitment, voiceovers, animation, and programming) and the approximate cost to the clinician in terms of hardware and software

expenses (personal communication, April 20th, 2015). Similarly, an expert in film production, Scott Elias, was consulted for approximate personnel costs to develop the videoconferencing task environment (personal communication, April 24th, 2015). An estimate for clinician costs in terms of hardware was calculated based on current retail prices.

Procedure

Eligible participants were fitted with (2) 1 ½"x 1" disposable foam electrodes containing 0% Chloride wet gel on the palm of the participant's non-dominant hand, (3) 1 ½" disposable foam electrodes containing 7% Chloride wet gel on the participant's torso, and a respiration belt. The electrodes were connected to a mobile recording device that each participant wore on the waistband of his/her pants. Participants were asked to sit quietly during a 10-minute adaptation/baseline period. At the conclusion of the baseline period, participants provided a SUDS rating and were informed that they would participate in three 5-minute speech tasks. Participants were provided with 5 topics (a different set of 5 topics was provided for each task with topic areas including: qualities of a good president, whether school uniforms should be required, the influence of television on children, and the legal drinking age) and were instructed to choose up to 3 topics to use during their first speech. Participants were given 3 minutes to prepare this speech and were allowed to reference their topic cards during the task, but not any notes made during the preparation period. After delivering their speech, participants recorded their SUDS rating and completed the SSPS, VAS, and BFNE-II. The participant then sat quietly for 5 minutes before the next task to allow the participant's physiological response to return to

approximately baseline levels. Participants were then provided with a new set of 5 topics and then the same procedure was repeated for the second and third speech tasks.

Study Design

This study used a within-subjects design (Condition: *In Vivo*, Virtual Realty, and Videoconferencing). To control for order effects and other potential sources of bias, the order of task administration was counterbalanced using a Latin square design in which participants were randomly assigned to one of six different task order combinations. Measures of HR, SCL, SCR, were recorded continuously before and during each task and SUDS ratings were obtained at the end of baseline and each experimental task. Measures of cognitive distortions (SSPS), fear of negative evaluation (BFNE-II), and presence (VAS) were also obtained after each experimental task.

Analytical Strategy

SCRs were counted if the fluctuation exceeded .05μS. HR data were edited for artifact following data collection. The mean of the final 60 seconds of the initial baseline period was used in the calculation of change scores. The mean change score of HR and SCL for each 5-minute speech were calculated and used as the overall task mean change score. The mean number of SCRs was calculated and used as the overall task mean.

One-tailed, paired samples t-tests were used to examine the ability of the videoconferencing speech task to elicit a significant increase in physiological arousal over baseline. A series of 3x6 Mixed Subjects Repeated Measures ANOVAs with planned comparisons of task effects were used to analyze physiological arousal (e.g., HR, SCL, and

SCR), self-reported distress (e.g., SUDS), self-reported perception of task performance (e.g., SSPS), self-reported fear of negative evaluation (e.g., BFNE-II) and degree of engagement with the task environments (e.g.,VAS). A variable representing task order assignment was included as a between-subjects factor to assess for the presence of order effects. Significant F scores for this between-subjects factor were followed up by Bonferroni corrected t-tests to determine where differences occurred.

CHAPTER THREE: FINDINGS

Does the VC Speech Task Produce Feelings of Immersion?

Prior to determining whether the VC speech task elicited physiological arousal and subjective distress, VAS "Engagement" and "Being There" scores were analyzed to determine whether the VC task was a valid manipulation. There were no significant main or interaction effects on the VAS Engagement scale suggesting similar engagement in the VC (*M*(SD)= 60.92(27.74)), *in vivo* (*M*(SD)=58.58(34.78)), and VR (*M*(SD)=55.33(27.62)) speech tasks. In contrast, there was a significant main effect for task on the VAS "Being There" scale ($F(2,48)=5.656$, $p=.006$). Participants had a significantly stronger sense of "being there" during the *in vivo* (*M*(SD)= 61.25(36.41)) and VC (*M*(SD)=60.22(30.76)) tasks than during the VR task (*M*(SD)=45.32(28.51)). The *in* vivo and VC task ratings were not significantly different. The main effect for order and interaction effects were not significant. RMANOVA results and scores for each task are depicted in Table 2.

Does the VC Speech Task Elicit More Cognitive Distortions, Fear of Negative Evaluation, and Subjective Distress than an Equivalent VR Speech Task?

On the SSPS Positive subscale, there were no main or interaction effects; all tasks elicited similar positive self-statements ($M(SD)_{Vivo}=13.13(3.45)$; $M(SD)_{VR}=13.87(2.83)$; $M(SD)_{VC}=13.23(3.52)$). Although there was a significant main effect for task order ($F(5,24)=3.578$, $p=.015$), none of the follow-up pairwise comparisons were significant. Additionally, there were no significant main effects or interactions for the SSPS Negative subscale; all task elicited a similar degree of cognitive distortions ($M(SD)_{Vivo}=13.33(3.18)$;

$M(SD)_{VR}$=12.93(2.79); $M(SD)_{VC}$=13.97(3.20)). RMANOVA results and scores for each task for both scales are depicted in Table 2.

There were significant interactions for both the BFNE-II and SUDS measures (see Task Order Effects). Although main effects are not typically interpreted in presence of a significant interaction, for the goals of the current study results of the significant main effect for Task are important and as follows: With regard to the BFNE-II, Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2)=13.74$, $p=.001$, therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon=.69$). There was a significant main effect for task type on the BFNE-II Total Score ($F(1.379,33.107)=39.015$, $p<.001$). Participants reported a stronger fear of negative evaluation during the *in vivo* ($M(SD)=49.33(6.90)$) and VC speech tasks ($M(SD)=47.83(8.47)$) than during the VR speech task ($M(SD)=33.73(15.96)$). The *in vivo* and VC ratings were not significantly different. Similarly, the main effect for task type on the SUDS (change over baseline) was significant ($F(2,48)=33.891$, $p=<.001$) with participants reporting more subjective distress during the *in vivo* ($M(SD)=4.47(2.05)$) and VC speech tasks ($M(SD)=4.43(1.99)$) than during the VR speech task ($M(SD)=2.50(2.06)$). The *in vivo* and VC ratings were not significantly different. RMANOVA results and scores for each of these tasks are depicted in Table 2. Simple effects associated with the significant interactions are discussed below.

Table 2: RMANOVA Results and Descriptive Statistics for Measures of Self-Reported Distress

	M(SD)					
Variable	**In Vivo**	**VR**	**VC**	**F**	**p**	**Partial η^2**
SUDS (Change Score)						
Main Effect: Task	4.47(2.05)[a]	2.50(2.06)[b]	4.43(1.99)[a]	33.891	**<.001**	.585
Main Effect: Order				.175	.969	.035
TxO Interaction				5.650	**<.001**	.541
BFNE-II Total						
Main Effect: Task	49.33(6.90)[a]	33.73(15.96)[b]	47.83(8.47)[a]	39.015	**<.001**	.619
Main Effect: Order				9.638	**<.001**	.668
TxO Interaction				2.905	**.018**	.377
VAS "Engagement"						
Main Effect: Task	58.58(34.78)	55.33(27.62)	60.92(27.74)	.803	.454	.032
Main Effect: Order				.982	.449	.170
TxO Interaction				1.921	.065	.286
VAS "Being There"						
Main Effect: Task	61.25(36.41)[a]	45.32(28.51)[b]	60.22(30.76)[a]	5.656	**.006**	.191
Main Effect: Order				.816	.550	.145
TxO Interaction				1.561	.148	.245
SSPS Positive Subscale						
Main Effect: Task	13.13(3.45)	13.87(2.83)	13.23(3.52)	1.320	.277	.052
Main Effect: Order				3.578	**.015**	.427
TxO Interaction				1.112	.373	.188
SSPS Negative Subscale						
Main Effect: Task	13.33(3.18)	12.93(2.79)	13.97(3.20)	2.380	.103	.090
Main Effect: Order				.084	.994	.017
TxO Interaction				1.542	.154	.243

SUDS=Subjective Units of Distress Scale, VAS=Visual Analogue Scale, SPSS=Self Statements about Public Speaking Questionnaire, BFNE-II=Brief Fear of Negative Evaluation-II
Means not sharing superscripts are significantly different at $p<.05$

Task Order Effects.

To follow-up on the significant interactions for the BFNE-II ($F(6.897, 33.107)=2.905$, $p=.018$) and SUDS ($F(10,48)=5.650$, $p<.001$) scales, Bonferroni corrected tests of simple effects revealed that unless presented first, VR elicited less self-reported distress (SUDS) and fear of

negative evaluation (BFNE-II) than the *in vivo* and VC exposure tasks. Findings are detailed in Tables 3 and 4 below.

Table 3: Simple Effects for the BFNE-II Total Score

	Speech Task M(SD)		
Task Order	**In Vivo**	**VR**	**VC**
VR:Vivo:VC	53.40(6.54)[a]	46.40(11.15)[a]	54.80(4.97)[a]
VR:VC:Vivo	53.20(4.32)[a]	54.00(5.29)[a]	54.20(5.12)[a]
Vivo:VC:VR	42.20(6.50)[a]	23.80(11.10)[b]	39.40(5.77)[a]
Vivo:VR:VC	50.40(6.50)[a]	21.60(12.36)[b]	43.80(10.66)[a]
VC:Vivo:VR	49.00(8.15)[a]	31.40(13.99)[b]	51.60(4.72)[a]
VC:VR:Vivo	47.80(5.07)[a]	25.20(10.18)[b]	43.20(5.85)[a]

Means not sharing superscripts are significantly different at $p<.05$

Table 4: Simple Effects for SUDS Change Score

	Speech Task M(SD)		
Task Order	**In Vivo**	**VR**	**VC**
VR:Vivo:VC	4.80(1.48)[a]	4.00(1.22)[a]	4.00(2.24)[a]
VR:VC:Vivo	3.00(3.61)[a]	4.00(3.08)[a]	4.20(2.59)[a]
Vivo:VC:VR	5.80(1.30)[a]	1.80(.84)[b]	4.00(1.22)[c]
Vivo:VR:VC	5.60(1.95)[a]	2.00(2.12)[b]	4.40(2.61)[a]
VC:Vivo:VR	4.00(.71)[a]	1.80(1.64)[b]	5.20(1.92)[a]
VC:VR:Vivo	3.60(1.14)[a]	1.40(1.82)[b]	4.80(1.92)[a]

Means not sharing superscripts are significantly different at $p<.05$

Does the VC Speech Task Elicit Physiological Arousal and Subjective Distress?

Participation in the VC speech task produced a significant HR increase of 16.68bpm from baseline (*M*(SD)=75.29(10.09) vs. VC task (*M*(SD)=91.97(10.79); *t*(29)=-17.48, *p*<.001). Participants also had a significant SCL increase of 6.55µS during the VC speech task over baseline (*M*(SD)=5.38(5.63) vs. VC task *M*(SD)=11.93(6.82); *t*(29)=-11.06, *p*<.001). Finally, participants had significantly more SCRs during the VC speech task (*M*(SD)=6.82(3.19)) than during baseline (*M*(SD)=3.07(4.06); *t*(29)=-5.23, *p*<.001). With regard to the ability of the VC task to elicit subjective distress, participation in the VC task produced a significant increase in SUDS scores of 4.43 when compared to baseline levels (*M*(SD)=1.67(1.84) vs. VC task (*M*(SD)=6.10(1.60); *t*(29)=-12.17, *p*<.001), producing a high level of subjective distress.

Does the VC Speech Task Produce a Greater Increase in Physiological Arousal than an Equivalent VR Speech Task?

The main effect for task type on HR was significant (*F*(2,48)=7.847, *p*=.001) with participants exhibiting significantly greater increases in HR during the *in vivo* (*M*(SD)=16.03(6.61)) and VC speech tasks (*M*(SD)=16.68(5.23)) than during the VR speech task (*M*(SD)=13.86(5.65)); however, there was no significant difference between the *in vivo* and VC conditions. There was no significant interaction or main effect for task order. RMANOVA results and scores for each task are depicted in Table 5.

The main effect for task type on SCL was significant (*F*(2,48)=9.610, *p*<.001). Participants exhibited an increase in SCL over baseline during the *in vivo* (*M*(SD)=6.29(3.01)) and VC speech tasks (*M*(SD)=6.55(3.25)), but they were not significantly different. Further,

there was a significantly greater change in SCL from baseline during the *in vivo* and VC speech tasks than during the VR speech task (*M*(SD)=5.39(3.04)). There was no significant interaction or main effect for task order. RMANOVA results and scores for each task are depicted in Table 5.

The main effect for task type on SCR was significant ($F(2,48)=14.290$, $p<.001$) with all participants exhibiting more SCRs during the *in vivo* (*M*(SD)=6.87(3.28)) and VC speech tasks (*M*(SD)=6.82(3.19)) than during the VR speech task (*M*(SD)=5.04(3.02)). The frequency of SCRs elicited during the *in* vivo and VR speech tasks was not significantly different. There was no significant interaction or main effect for task order. Scores for each task are depicted in Table 5.

Table 5: RMANOVA Results and Descriptive Statistics for Physiological Measures

	M(SD)					
Variable	**In Vivo**	**VR**	**VC**	**F**	**p**	**Partial η^2**
HR (Change Score)						
Main Effect: Task	16.03(6.61)[a]	13.86(5.65)[b]	16.68(5.23)[a]	7.847	**.001**	.246
Main Effect: Order				.228	.947	.045
TxO Interaction				1.298	.258	.213
SCL (Change Score)						
Main Effect: Task	6.29(3.01)[a]	5.39(3.04)[b]	6.55(3.25)[a]	9.610	**<.001**	.286
Main Effect: Order				1.370	.270	.222
TxO Interaction				1.124	.364	.190
SCR (Mean Total)						
Main Effect: Task	6.87(3.28)[a]	5.04(3.02)[b]	6.82(3.19)[a]	14.290	**<.001**	.373
Main Effect: Order				.565	.726	.105
TxO Interaction				.901	.539	.158

HR=Heart Rate, SCL=Skin Conductance Level, SCR=Skin Conductance Response
Means not sharing superscripts are significantly different at $p<.05$

Is the VC Speech Task More Cost Effective than VR?

In Vivo Task Costs

Assuming that clinic space and office furniture (e.g., table and 5 chairs) is readily available and free for usage (as in this investigation), the primary costs for conducting the *in vivo* speech task involve costs for the clinician's time to recruit, train, schedule, and manage speech task volunteers. Utilizing an average rate of $150/hr for the typical private practice clinician, the costs for arranging an *in vivo* speech session are estimated to be as follows:

- Volunteer recruitment and training
    - 8 hours of clinician labor (e.g., Advertising for volunteers, reading through volunteer applications, multiple emails with applicants, training, and setting up lab access) = $1,200
- Scheduling and Coordinating Volunteers for Each Task
    - 30 minutes of clinician labor per session (e.g., sending 1-2 email requests to list of volunteers for sign-ups, finding additional staff to supplement audience, responding to volunteer questions and scheduling concerns) = $75/session
- **Total estimated cost for 30 *in vivo* speech task exposure sessions = $3,450**

VR Task Costs

- Estimated cost of software development (e.g., audience member recruitment, voiceovers, animation, and programming) = $40,000-$50,000 (J. Spitalnick; personal communication, April 20th, 2015).

- Estimated cost of purchasing software and necessary hardware for clinic usage = $10,000 (J. Spitalnick; personal communication, April 20th, 2015).
- **Total estimated cost for VR = $50,000-$60,000**

VC Task Costs

- Approximately 5 hours to film speech task and recruit actors
    - Union videographer rate = $100/hr + Fringe benefits (26pprox.. 35%)
        - Total Estimated Cost = $675 (S. Elias; personal communication, April 24th, 2015)
- Approximately 3 hours of video editing
    - Union editor rate = $55/hr + Fringe benefits (26pprox.. 44%)
        - Total Estimated Cost = $238 (S. Elias; personal communication, April 24th, 2015)
- Five actors to film
    - SAG Extra rate = $150/day per person
        - Total Cost = $750 (S. Elias; personal communication, April 24th, 2015)
- Hardware costs to run VC speech task video (e.g., laptop with HDMI port, separate computer monitor or TV screen with HDMI port, webcam, headset, microphone)
    - Estimated $600-$800 (varies widely)
- **Total estimated cost for VC = $2,263-$2,463**

CHAPTER FOUR: DISCUSSION

The current study sought to determine whether VC is a closer approximation of a comparable *in vivo* speech task than VR in terms of its ability to elicit physiological arousal, subjective distress, presence, and fear of negative evaluation in adults with SAD. Physiological data, self-report measures of anxiety as well as a measure of presence were examined. Findings indicated that the VC speech task elicited feelings of immersion and a significant increase in physiological arousal and subjective distress over baseline resting conditions, outperforming the VR task on the majority of variables assessed (VAS "Being There", SUDS, BFNE-II, HR, SCL, and SCR). Further, the effect elicited by the VC task was statistically equivalent to an actual audience. Taken together, these results suggest that statistically, the VC speech task shares more similarities to a real-life audience than the VR speech task environment.

Consistent with the findings of Owens and Beidel (2015) and similar to the findings of Powers et al. (2013), participants described the VR speech task as less realistic and reported a significantly diminished fear of negative evaluation during the VR task that was not attenuated during the VC task. Following the conclusion of study procedures, over half of participants were informally noted to say some variation of "The VR task was the easiest because the audience wasn't real and couldn't judge me" (see APPENDIX B: POST-PARTICIPATION PARTICIPANT COMMENTS). Only three participants described the VR task as the most anxiety provoking and in each of these cases, the VR task was the first task administered. This finding is in line with the work of Vossel and Laux (1978), which demonstrates the protective ability of a prior stressful experience on subsequent novel experiences, an effect not shown to occur when less stressful tasks are encountered first. All participants believed they were video-

conferencing with a live audience and a few were noted to have said, “That wouldn’t have been as bad if I had known it was pre-recorded.” As the VR task utilized an audience with neutral facial expressions, the degree of immersion, realism, and fear of negative evaluation may be increased if the facial expressions were negative or varied in response to the participant. This hypothesis is supported by the work of Pertaub, Slater, and Barker (2002) comparing positive, neutral, and negative virtual audiences which demonstrated that regardless of the participants’ level of fear, all experienced more anxiety when giving a speech in front of the negative audience.

Although statistically, these results may seem to indicate that the VC task is an equivalent replacement for an actual audience, participant comments suggest that that the *in vivo* speech task was the most anxiety provoking. Participants informally indicated that removing the barrier of a TV screen and having the audience in the room induced more anxiety as it enhanced their feelings of being the center of attention and decreased their perceived ability to escape (APPENDIX B: POST-PARTICIPATION PARTICIPANT COMMENTS). This may be indicative of a subtle difference between the tasks, untapped by the current outcome measures. For example, the aforementioned participant comment may reflect a decrease in perceived control, an unmeasured construct associated with increased distress (Mineka & Kihlstrom, 1978; Rachman, 1978).

These results do, however, suggest that not only is the VC speech task a more face valid tool for conducting exposure therapy than the VR task in terms of its ability to replicate the physiological and emotional experience of giving a speech to a real-life audience, but it is vastly more cost effective. At an estimated cost of $2,263-$2,463, the VC task is a small fraction of the

cost of the VR system's estimated $50,000-$60,000. Not only does the VC task cost substantially less to develop (approximately $1,663 vs. $40,000-$50,000 for VR), but the technology required is less advanced, significantly reducing the cost to the clinician. Using equipment likely already at the clinician's disposal such as a laptop and a simple TV or computer monitor to display the video, the VC task does not require the purchase and maintenance of specialized equipment such as a HMD. Although the primary argument for utilizing an HMD is the need for immersion, the VC task produced a significantly greater sense of immersion, anxious arousal, and distress without an HMD than was experienced during the VR task. In support of these findings, extant research suggests an HMD may no longer be necessary. Specifically, an investigation indicated that a researcher-controlled avatar projected on a screen elicited equal distress as when projected through an HMD (Morina, Brinkman, Hartanto, & Emmelkamp, 2014). In addition, researchers have discovered that full immersion may not be needed to achieve the desired outcome (Feinhofer et al., 2014; Podina et al., 2013).

Over time, the VC task is more affordable than the cost of conducting *in vivo* exposure. At an average cost of $150/hr, it is not only costly for a clinician to organize an *in vivo* exposure session, but it is also challenging. The largest obstacle a clinician must overcome to create a realistic public speaking exposure is to form a proper audience. Most community clinicians do not have easy access to numerous quantities of undergraduate psychology majors seeking research experience available to call upon when an audience is needed (as in the university setting of the current study). While some may forge an arrangement with a nearby college or other staff members, recruiting reliable volunteers, providing training, and organizing schedules

can be a burdensome task. Long-term, the costs of *in vivo* exposure may even exceed the cost of the VR task.

Replicating the findings of similar studies (Hartanto et al., 2014; Kotlyar et al., 2008; Owens & Beidel, 2015; Pertaub et al., 2002; Powers et al., 2013; Slater et al., 2006), the VR task does still elicit subjective distress, physiological arousal, and some fear of negative evaluation but, with the exception of cognitive distortions in which values were equivalent to those of socially anxious participants in other tasks (Hofmann & DiBartolo, 2000), to a much attenuated degree than in the VC and *in vivo* speech tasks. As previous research has supported the utility of VR exposure for treating specific phobias and SAD, including public speaking anxiety (Anderson et al., 2003; Anderson et al., 2013; Anderson et al., 2005; Harris et al., 2002; Klinger et al., 2005; Wiederhold & Wiederhold, 1998), these findings emphasize the role of VR as an intermediate step on a hierarchy, as a way to ease those who are otherwise reluctant to engage in *in vivo* exposure (Garcia-Palacios, Botella, Hoffman, & Fabregat, 2007), and for those who have difficulty with imaginal exposure exercises. Given the cost of the VR equipment, future research comparing impact of the VC speech task when participants know it is a pre-recording to the VR environment may further help to alleviate clinician burden and remove issues related to deception.

This study was not without limitations. Although physiological measurements are considered to be objective measures of arousal, they can be influenced by many factors. For example, changes in HR are found to occur just by the act of speaking (Tardy, Thompson, & Allen, 1989), in addition the greater freedom of movement during the *in vivo* and VC speech tasks than during the VR task may also have influenced HR. Furthermore, the physiological,

behavioral, and cognitive components of Lang's (1970) conceptualization of fear are largely considered to function independently of one another and at different rates, making interpretation challenging (Cox, Hallam, O'connor, & Rachman, 1983; Rachman, 1978). Lastly, when comparing the current sample to the treatment-seeking community sample in a study by Beidel et al. (2010), participants in the current study reported a lower average SUDS rating at baseline (*M*(SD)=1.67(1.84) vs. *M*(SD)=3.20(1.80), respectively) and following the *in vivo* speech task (*M*(SD)=6.13(1.48) vs. *M*(SD)=7.00(1.60), respectively). In addition, participants with SAD in the current study reported a lower average SPAI score than the mean SPAI score of participants from the treatment-seeking sample (*M*=95.55 vs. *M*=109.0, respectively). As the current sample was less severe, these differences may affect the ability to replicate findings with treatment-seeking community samples.

In summary, this is the first investigation to use multiple measures of physiology to examine autonomic arousal elicited by an *in vivo* speech task to comparable "representational" videoconferencing and virtual reality speech tasks. Results indicated that the VC speech task audience elicited a degree of physiological arousal, self-reported distress, and fear of negative evaluation that was greater than a VR speech task and statistically equivalent to an *in vivo* speech. The VC speech task is also much more cost-effective than the VR speech task and more cost-effective and efficient over time when compared to the resources needed to recruit a live audience, the difficulty of which varies widely depending on access to sources of volunteers (e.g., undergraduate psychology students, other staff). Therefore, it appears the VC task may potentially alleviate the burden that SAD exposure therapy places on the individual and the clinician but may still not be a perfect substitution for giving a speech in front of a live audience.

APPENDIX A: IRB APPROVAL LETTER

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Maryann Owens**

Date: **November 05, 2014**

Dear Researcher:

On 11/5/2014, the IRB approved the following human participant research until 11/04/2015 inclusive:

Type of Review:	UCF Initial Review Submission Form
Project Title:	Optimizing Strategies for In Vivo Exposure in the Traditional Clinical Setting
Investigator:	Maryann Owens
IRB Number:	SBE-14-10664
Funding Agency:	
Grant Title:	
Research ID:	N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 11/04/2015, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a signed and dated copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 11/05/2014 11:45:24 AM EST

IRB Manager

APPENDIX B: POST-PARTICIPATION PARTICIPANT COMMENTS

Table 6: Post-Participation Participant Comments

Number of Responses	Participant Comments
***In Vivo* Speech Task**	
15	This task was the worst/most difficult/most anxiety provoking
7	More anxiety provoking to have audience in the room
1	Easier than VC because audience seemed more like peers
2	Easier since had practice from VC and VR tasks
VC Speech Task	
5	This task was the worst/most difficult/most anxiety provoking
15	Not as bad as *In Vivo* task but worse than VR task
3	Harder than *In Vivo* because audience seemed older/more authoritative
1	Just as bad as giving a speech in front of the *In Vivo* audience
1	Wouldn't have been as bad if had known it was pre-recorded
1	Felt more comfortable with VC task than VR
2	Would have been more anxiety provoking if audience made eye-contact
30	Believed it was a live videoconference
VR Speech Task	
3	This task was the worst/most difficult/most anxiety provoking
20	The VR Task was the easiest because the audience wasn't real and couldn't judge them
2	Headset was distracting/uncomfortable
1	"They aren't real, are they?"
1	Felt more like a video game
1	Would have been easier if not the first task
Other	
1	All tasks were equally hard
4	Whether it was hard depended more on how much I knew about the topics/Level of preparation

LIST OF REFERENCES

Acarturk, C., Cuijpers, P., Van Straten, A., & De Graaf, R. (2009). Psychological treatment of social anxiety disorder: a meta-analysis. *Psychological Medicine, 39*(02), 241-254.

Anderson, P., Rothbaum, B. O., & Hodges, L. F. (2003). Virtual reality exposure in the treatment of social anxiety. *Cognitive and Behavioral Practice, 10*(3), 240-247.

Anderson, P. L., Price, M., Edwards, S. M., Obasaju, M. A., Schmertz, S. K., Zimand, E., & Calamaras, M. R. (2013). Virtual reality exposure therapy for social anxiety disorder: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 81*(5), 751.

Anderson, P. L., Zimand, E., Hodges, L. F., & Rothbaum, B. O. (2005). Cognitive behavioral therapy for public-speaking anxiety using virtual reality for exposure. *Depress Anxiety, 22*(3), 156-158. doi: 10.1002/da.20090

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Publishing.

Beidel, D. C., Rao, P. A., Scharfstein, L., Wong, N., & Alfano, C. A. (2010). Social skills and social phobia: An investigation of DSM-IV subtypes. *Behaviour Research and Therapy, 48*(10), 992-1001. doi: 10.1016/j.brat.2010.06.005

Beidel, D. C., Turner, S. M., & Morris, T. L. (1999). Psychopathology of childhood social phobia. *Journal of the American Academy of Child & Adolescent Psychiatry, 38*(6), 643-650. doi: 10.1097/00004583-199906000-00010

Beidel, D. C., Turner, S. M., Stanley, M. A., & Dancu, C. V. (1989). The Social Phobia and Anxiety Inventory: Concurrent and external validity. *Behavior Therapy, 20*(3), 417-427. doi: 10.1016/S0005-7894(89)80060-7

Blanco, C., Bragdon, L. B., Schneier, F. R., & Liebowitz, M. R. (2013). The evidence-based pharmacotherapy of social anxiety disorder. *The International Journal of Neuropsychopharmacology, 16*(01), 235-249.

Brown, T., & Barlow, D. (2014). *Anxiety and Related Disorders Interview Schedule for the DSM-5 (ADIS-5L): Lifetime Version*. New York, NY: Oxford University Press.

Carleton, R. N., Collimore, K. C., & Asmundson, G. J. (2007). Social anxiety and fear of negative evaluation: Construct validity of the BFNE-II. *Journal of Anxiety Disorders, 21*(1), 131-141.

Carleton, R. N., Collimore, K. C., McCabe, R. E., & Antony, M. M. (2011). Addressing revisions to the Brief Fear of Negative Evaluation scale: Measuring fear of negative evaluation across anxiety and mood disorders. *Journal of Anxiety Disorders, 25*(6), 822-828.

Carleton, R. N., McCreary, D. R., Norton, P. J., & Asmundson, G. J. (2006). Brief fear of negative evaluation scale—revised. *Depress Anxiety, 23*(5), 297-303.

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope & F. R. Schneier (Eds.), *Social phoba: Diagnosis, assessment, and treatment* (pp. 69-93). New York, NY, US: Guilford Press.

Cox, D., Hallam, R., O'connor, K., & Rachman, S. (1983). An experimental analysis of fearlessness and courage. *British Journal of Psychology, 74*, 107-117.

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy, 46*(1), 5-27.

Davidson, J. R., Hughes, D., George, L. K., & Blazer, D. G. (1993). The epidemiology of social phobia: findings from the Duke Epidemiological Catchment Area Study. *Psychological Medicine, 23*(03), 709-718.

Feinhofer, A., Kothgassner, O. D., Hetterie, T., Beutil, L., Hlavacs, H., & Kryspin-Exner, I. (2014). Afraid to be there? Evaluating the relation between presence, self-reported anxiety, and heart rate in a virtual public speaking task. *Cyberpsychology, Behavior, and Social Betworking, 17*(5), 310-316.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin, 99*(1), 20-35. doi: 10.1037/0033-2909.99.1.20

Fyer, A. J., Liebowitz, M. R., Gorman, J. M., Campeas, R., Levin, A., Davies, S. O., . . . Klein, D. F. (1987). Discontinuation of alprazolam treatment in panic patients. *The American Journal of Psychiatry, 144*(3), 303-308.

Garcia-Palacios, A., Botella, C., Hoffman, H., & Fabregat, S. (2007). Comparing acceptance and refusal rates of virtual reality exposure vs. in vivo exposure by patients with specific phobias. *CyberPsychology & Behavior, 10*(5), 722-724. doi: 10.1089/cpb.2007.9962

Goisman, R. M., Warshaw, M. G., & Keller, M. B. (1999). Psychosocial treatment prescriptions for generalized anxiety disorder, panic disorder, and social phobia, 1991–1996. *American Journal of Psychiatry, 156*(11), 1819-1821.

Gould, R. A., Buckminster, S., Pollack, M. H., Otto, M. W., & Yap, L. (1997). Cognitive-behavioral and pharmacological treatment for social phobia: A meta-analysis. *Clinical Psychology: Science and Practice, 4*(4), 291-306. doi: 10.1111/j.1468-2850.1997.tb00123.x

Grant, B. F., Hasin, D. S., Blanco, C., Stinson, F. S., Chou, S. P., Goldstein, R. B., . . . Huang, B. (2005). The epidemiology of social anxiety disorder in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry*.

Greenberg, P. E., Sisitsky, T., Kessler, R. C., Finkelstein, S. N., Berndt, E. R., Davidson, J. R. T., . . . Fyer, A. J. (1999). The economic burden of anxiety disorders in the 1990s. *Journal of Clinical Psychiatry, 60*(7), 427-435. doi: 10.4088/JCP.v60n0702

Hamilton, M. (1960). A rating scale for depression. *Journal of neurology, neurosurgery, and psychiatry, 23*(1), 56.

Harris, S. R., Kemmerling, R. L., & North, M. M. (2002). Brief virtual reality therapy for public speaking anxiety. *CyberPsychology & Behavior, 5*(6), 543-550. doi: 10.1089/109493102321018187

Hartanto, D., Kampmann, I. L., Morina, N., Emmelkamp, P. G., Neerincx, M. A., & Brinkman, W.-P. (2014). Controlling Social Stress in Virtual Reality Environments. *PloS one, 9*(3), e92804.

Hofmann, S. G., & DiBartolo, P. M. (2000). An instrument to assess self-statements during public speaking: Scale development and preliminary psychometric properties. *Behavior Therapy, 31*(3), 499-515. doi: 10.1016/S0005-7894(00)80027-1

Horley, K., Williams, L. M., Gonsalvez, C., & Gordon, E. (2004). Face to face: visual scanpath evidence for abnormal processing of facial expressions in social phobia. *Psychiatry research, 127*(1), 43-53.

Katzelnick, D. J., Kobak, K. A., DeLeire, T., Henk, H. J., Greist, J. H., Davidson, J. R. T., . . . Helstad, C. P. (2001). Impact of generalized social anxiety disorder in managed care. *The American Journal of Psychiatry, 158*(12), 1999-2007. doi: 10.1176/appi.ajp.158.12.1999

Katzelnick, D. J., Kobak, K. A., Greist, J. H., Jefferson, J. W., Mantle, J. M., & Serlin, R. C. (1995). Sertraline for social phobia: A double-blind, placebo-controlled crossover study. *The American Journal of Psychiatry, 152*(9), 1368-1371.

Kessler, R. C., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Wittchen, H. U. (2012). Twelve-month and lifetime prevalence and lifetime morbid risk of anxiety and mood disorders in the United States. *International journal of methods in psychiatric research, 21*(3), 169-184.

Kessler, R. C., Stang, P., Wittchen, H. U., Stein, M., & Walters, E. E. (1999). Lifetime comorbidities between social phobia and mood disorders in the US National Comorbidity Survey. *Psychological Medicine, 29*(3), 555-567. doi: 10.1017/S0033291799008375

Klinger, E., Bouchard, S., Légeron, P., Roy, S., Lauer, F., Chemin, I., & Nugues, P. (2005). Virtual Reality Therapy Versus Cognitive Behavior Therapy for Social Phobia: A Preliminary Controlled Study. *CyberPsychology & Behavior, 8*(1), 76-88. doi: 10.1089/cpb.2005.8.76

Kotlyar, M., Donahue, C., Thuras, P., Kushner, M. G., O'Gorman, N., Smith, E. A., & Adson, D. E. (2008). Physiological response to a speech stressor presented in a virtual reality environment. *Psychophysiology, 45*(6), 1034-1037. doi: 10.1111/j.1469-8986.2008.00690.x

Krijn, M., Emmelkamp, P. M. G., Olafsson, R. P., & Biemond, R. (2004). Virtual reality exposure therapy of anxiety disorders: A review. *Clinical Psychology Review, 24*(3), 259-281. doi: 10.1016/j.cpr.2004.04.001

Lang, P. (1970). Stimulus control, response control and desensitisation of fear. In D. Levis (Ed.), *Learning approaches to therapeutic behavior change*. Chicago: Aldine Press.

Leary, M. R. (1983). A brief version of the Fear of Negative Evaluation Scale. *Personality and Social Psychology Bulletin, 9*(3), 371-375.

Lee, K. M. (2004). Presence, Explicated. *Communication Theory, 14*(1), 27-50. doi: 10.1111/j.1468-2885.2004.tb00302.x

Mannuzza, S., Schneier, F. R., Chapman, T. F., Liebowitz, M. R., Klein, D. F., & Fyer, A. J. (1995). Generalized social phobia: Reliability and validity. *Archives of General Psychiatry, 52*(3), 230-237. doi: 10.1001/archpsyc.1995.03950150062011

Marks, I. M., Swinson, R. P., Başoğlu, M., Kuch, K., Noshirvani, H., O'Sullivan, G., . . . Sengun, S. (1993). Alprazolam and exposure alone and combined in panic disorder with agoraphobia: A controlled study in London and Toronto. *The British Journal of Psychiatry, 162*, 776-787.

Mineka, S., & Kihlstrom, J. (1978). Unpredictable and uncontrollable events. *Journal of Abnormal Psychology, 87*, 256-264.

Moitra, E., Beard, C., Weisberg, R. B., & Keller, M. B. (2011). Occupational impairment and social anxiety disorder in a sample of primary care patients. *Journal of Affective Disorders, 130*(1), 209-212.

Morina, N., Brinkman, W.-P., Hartanto, D., & Emmelkamp, P. M. G. (2014). Sense of presence and anxiety during virtual social interactions between a human and virtual humans. *PeerJ, 2*(e337). doi: DOI 10.7717/peerj.337

North, M. M., North, S. M., Coble, J. R., Botella, C., Quero, S., Perpina, C., . . . Rey, A. (2008). Virtual reality therapy: an effective treatment for the fear of public speaking. *The International Journal of Virtual Reality 3 (1998), 1, 6.*

Olfson, M., Guardino, M., Struening, E., Schneier, F. R., Hellman, F., & Klein, D. F. (2000). Barriers to the treatment of social anxiety. *The American Journal of Psychiatry, 157*(4), 521-527. doi: 10.1176/appi.ajp.157.4.521

Owens, M. E., & Beidel, D. C. (2015). Can Virtual Reality Effectively Elicit Distress Associated with Social Anxiety Disorder? *J Psychopathol Behav Assess, 37*(2), 296-305. doi: 10.1007/s10862-014-9454-x

Patel, A., Knapp, M., Henderson, J., & Baldwin, D. (2002). The economic consequences of social phobia. *Journal of Affective Disorders, 68*(2-3), 221-233. doi: 10.1016/S0165-0327(00)00323-2

Pertaub, D.-P., Slater, M., & Barker, C. (2002). An experiment on public speaking anxiety in response to three different types of virtual audience. *Presence: Teleoperators and virtual environments, 11*(1), 68-78.

Podina, I. R., Koster, E. H., Philippot, P., Dethier, V., & David, D. O. (2013). Optimal attentional focus during exposure in specific phobia: a meta-analysis. *Clin Psychol Rev, 33*(8), 1172-1183. doi: 10.1016/j.cpr.2013.10.002

Powers, M. B., Briceno, N. F., Gresham, R., Jouriles, E. N., Emmelkamp, P. M., & Smits, J. A. (2013). Do conversations with virtual avatars increase feelings of social anxiety? *Journal of Anxiety Disorders, 27*(4), 398-403.

Rachman, S. (1978). *Fear and courage*. San Francisco: Freeman.

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35*(8), 741-756.

Regenbrecht, H. T., Schubert, T. W., & Friedmann, F. (1998). Measuring the sense of presence and its relations to fear of heights in virtual environments. *International Journal of Human-Computer Interaction, 10*(3), 233-249. doi: 10.1207/s15327590ijhc1003_2

Roth, D., Antony, M. M., & Swinson, R. P. (2001). Interpretations for anxiety symptoms in social phobia. *Behaviour Research and Therapy, 39*(2), 129-138.

Rothbaum, B. O., & Hodges, L. F. (1999). The use of virtual reality exposure in the treatment of anxiety disorders. *Behavior Modification, 23*(4), 507-525. doi: 10.1177/0145445599234001

Schneier, F. R., Johnson, J., Hornig, C. D., Liebowitz, M. R., & Weissman, M. M. (1992). Social phobia: Comorbidity and morbidity in an epidemiologic sample. *Archives of General Psychiatry, 49*(4), 282-288. doi: 10.1001/archpsyc.1992.01820040034004

Schubert, T., Friedmann, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators and virtual environments, 10*(3), 266-281.

Schuemie, M., Bruynzeel, M., Drost, L., Brinckman, M., De Haan, G., Emmelkamp, P., & Van der Mast, C. (2000). *Treatment of acrophobia in virtual reality: A pilot study.* Paper presented at the Conference Proceedings Euromedia.

Slater, M., Pertaub, D.-P., Baker, C., & Clark, D. M. (2006). An Experimental Study on Fear of Public Speaking Using a Virtual Environment. *CyberPsychology & Behavior, 9*(5), 627-633. doi: 10.1089/cpb.2006.9.627

Stein, M. B., & Kean, Y. M. (2000). Disability and quality of life in social phobia: epidemiologic findings. *American Journal of Psychiatry, 157*(10), 1606-1613.

Stein, M. B., & Stein, D. J. (2008). Social anxiety disorder. *The Lancet, 371*(9618), 1115-1125.

Stein, M. B., Walker, J. R., & Forde, D. R. (1996). Public speaking fears in a community sample: Prevalence, impact on functioning, and diagnostic classification. *Archives of General Psychiatry, 53*(2), 169-174. doi: 10.1001/archpsyc.1996.01830020087010

Tardy, C. H., Thompson, W. R., & Allen, M. T. (1989). Cardiovascular responses during speech: Does social support mediate the effects of talking on blood pressure? *Journal of Language and Social Psychology, 8*(3-4), 271-285. doi: 10.1177/0261927X8983007

Thomas, K., Ellis, A., Konrad, T., Holzer, C., & Morrissey, J. (2009). County-level estimates of mental health professional shortage in the United States. *Psychiatric Services, 60*(10), 1323-1328.

Turner, S. M., Beidel, D. C., Dancu, C. V., & Keys, D. J. (1986). Psychopathology of social phobia and comparison to avoidant personality disorder. *Journal of Abnormal Psychology, 95*(4), 389-394. doi: 10.1037/0021-843X.95.4.389

Turner, S. M., Beidel, D. C., Dancu, C. V., & Stanley, M. A. (1989). An empirically derived inventory to measure social fears and anxiety: The Social Phobia and Anxiety Inventory. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 1*(1), 35-40. doi: 10.1037/1040-3590.1.1.35

van Vliet, I. M., den Boer, J. A., & Westenberg, H. G. M. (1994). Psychopharmacological treatment of social phobia: A double blind placebo controlled study with fluvoxamine. *Psychopharmacology, 115*(1-2), 128-134. doi: 10.1007/BF02244762

Veljaca, K.-A., & Rapee, R. M. (1998). Detection of negative and positive audience behaviours by socially anxious subjects. *Behaviour Research and Therapy, 36*(3), 311-321.

Vossel, G., & Laux, L. (1978). The impact of stress experience on heart rate and task performance in the presence of a novel stressor. *Biological Psychology, 6*, 193-201.

Wang, P. S., Berglund, P., & Kessler, R. C. (2000). Recent care of common mental disorders in the United States. *Journal of General Internal Medicine, 15*(5), 284-292.

Wiederhold, B. K., & Wiederhold, M. D. (1998). A review of virtual reality as a psychotherapeutic tool. *CyberPsychology & Behavior, 1*(1), 45-52. doi: 10.1089/cpb.1998.1.45

Wittchen, H.-U., Fuetsch, M., Sonntag, H., Müller, N., & Liebowitz, M. (2000). Disability and quality of life in pure and comorbid social phobia. Findings from a controlled study. *European Psychiatry, 15*(1), 46-58.

Wittchen, H. U., & Beloch, E. (1996). The impact of social phobia on quality of life. *International Clinical Psychopharmacology, 11*(Suppl 3), 15-23. doi: 10.1097/00004850-199606003-00004

Zhang, W., Ross, J., & Davidson, J. R. T. (2004). Social Anxiety Disorder in Callers to the Anxiety Disorders Association of America. *Depress Anxiety, 20*(3), 101-106. doi: 10.1002/da.20020