

A Comparison of Virtual Reality vs. Imaginal Exposure for Aviophobia
on Measures of Anxiety and Presence.

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ABSTRACT

Aviophobia affects an individual's personal life, business opportunities, and overall quality of life. It may prevent individuals from visiting distant family or friends, traveling for enjoyment, and obtaining jobs that require travel. Previous literature estimates that 10 to 50% of the population is affected by Aviophobia, or fear of flying (Agras, Sylvester, & Oliveau, 1969; Magee, Eaton, Wittchen, McGonagle, & Kessler, 1996; Van Gerwen & Diekstra, 2000). Both past and current literature strongly supports exposure-based methods for treating flying phobia. Due to cost, time, and security measures in airports, conducting in-vivo exposure therapy is not always possible or accessible. Imaginal exposure therapy can be implemented, but has several limitations. For instance, some patients are unable, due to poor imagination, inability to suspend disbelief or poor concentration abilities, or unwilling, to go through the imaginal procedure. Furthermore, therapists require training to become skilled at conducting the imagery scenes. As an alternative to imaginal exposure therapy, researchers have developed simulated computer flight experiences, incorporating the use of virtual reality technology.

Advanced computer technology provides a new medium to conduct exposure therapy. The Virtual Reality (VR) head-mounted display and other high tech equipment allow patients to experience a virtual airport and airport-related scenes using as many as five human senses. VR exposure attempts to create a sense of presence within a three dimensional computer-generated world thus having "the subjective experience of being in one place or environment, even when one is physically situated in another" (Witmer & Singer, 1998, p. 225). While the concept of presence is suggested to be an important part

of the VR experience, it has been inconsistently measured, resulting in conflicting findings. This is particularly applicable to the extent to which the concept of presence is similar to, or different from, anxiety during a VR session.

The purpose of the current study was to compare VR exposure versus imaginal exposure on measures of flight related anxiety. Additionally, the current researcher explored whether sitting in an actual airplane chair had an effect on the level of anxiety reported by participants compared to sitting in a regular office chair. Finally, the extent to which anxiety was correlated with presence was examined.

Sixty undergraduate students were recruited from Hofstra University. Qualification requirements were a total score of 56 or higher on the Flight Anxiety Situations Questionnaire, and answering “yes” to the experimenter’s question, “Are you afraid of flying” (Nousi, Van Gerwen, & Spinoven, 2009). The study was a 2x2 randomized between subjects’ design, with the independent variables being type of exposure (Virtual Reality or Imaginal) and type of chair (airplane or regular). The dependent variables were defined as the average level of anxiety as measured by a Subjective Units of Distress Scale (Wolpe, 1969; SUDs) taken during multiple points throughout the exposure sessions, and number of objective behavioral observations obtained through a behavioral coding system (Hoffman, 2009). The relationship between anxiety and presence was assessed through a correlation.

Results suggest that imaginal exposure therapy led participants to rate a higher average subjective level of anxiety, and to engage in more observed fidgeting behavior than did those in the VR exposure condition. No significant differences were found for other observed anxiety behaviors. Furthermore, significant differences were not

identified between groups for type of chair on either average SUDs or observed anxiety behaviors. Anxiety, as measured by average SUDs, was correlated with Spatial Presence, Engagement, and Ecological/ Naturalness Presence. A relationship between Ecological/Naturalness Presence and observed fidgeting was found. Furthermore, verbalized anxiety was correlated with Spatial Presence. Implications for the treatment of aviophobia are discussed.

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CHAPTER I

Introduction

Aviophobia, or as it is more commonly referred to, flying phobia, can have a major impact on individuals' functioning. For example, many individuals either cannot visit family members who live far away, work at jobs that require travel, or take vacations due to their inability to fly or do these things with marked anxiety and discomfort. Many individuals who endure flying will do so with dread and a high level of anticipatory anxiety. Past researchers estimate that 10 to 50% of the population maybe affected by Aviophobia (Agras, Sylvester, & Oliveau, 1969; Magee et al., 1996; Van Gerwen & Diekstra, 2000). This high prevalence rate can be attributed to the lack of consistency in the definitions used, variety of populations surveyed, and increases in the prevalence over time due to instances such as September 11th and other air disasters. Although there are many types of treatments for Aviophobia, exposure-based methodologies are strongly supported. Traditionally, imaginal and in-vivo exposure has been implemented with individuals with a fear of flying. Recently, Virtual Reality Exposure Therapy (VRET), a medium through which a head-mounted display and other high tech equipment allow patients to observe an airport and airport related scenes using up to five human senses, is being used in treatment. This environment attempts to create a sense of presence within a three dimensional computer generated world.

The intent in this study was to compare a VR exposure procedure with an imaginal exposure procedure on levels of anxiety. Furthermore, the researcher explored whether sitting in an airplane chair lead participants to feel a greater or lesser level of

anxiety than sitting in a regular chair. Finally, the extent to which anxiety was correlated with presence was examined.

Specific Phobias

According to the current Diagnostic and Statistical Manual for Mental Disorders (DSM-IV-TR), the essential feature to the diagnosis of a specific phobia is a “marked and persistent fear that is excessive or unreasonable, cued by the presence or anticipation of a specific object or situation” (American Psychiatric Association, 2000, p. 449).

Additionally, exposure to the feared stimulus must almost always elicit the anxiety response. The individual with a specific phobia must have insight that the fear is excessive or unreasonable. However, the phobic stimulus or situation is avoided or endured with intense distress and anxiety, which causes significant impairment in the individuals’ personal, occupational, and social relationships (APA, 2000).

The American Psychiatric Association (2000) categorized specific phobias into five subtypes. These subtypes are used to specify an individual’s avoidance or focus of fear. The five subtypes include: 1) Animal Type (e.g., dogs, insects, snakes); 2) Natural Environment Type (e.g. heights, storms, water); 3) Blood-Injection –Injury Type (e.g., seeing blood, getting an injection); 4) Situational Type (e.g., airplanes, elevators, enclosed places); and 5) Other Type (e.g., fear of choking, vomiting, or contracting an illness). The five subtypes of phobias are distinguished based on their differences in age of onset, sex ratio, focus of fear and physiological response differences.

Aviophobia is considered to be a situationally specific phobia. It is described by Wiederhold, Gevirtz, & Wiederhold (1998), as being characterized by an unreasonable or excessive fear cued by flying or the anticipation of flying, which is a detailed version of

the situation type specific phobia description found in the DSM-IV (APA, 2000).

Individuals with this phobia either avoid the situation or endure it with extreme anxiety or distress. Many individuals with Aviophobia ingest alcohol or sedatives in an attempt to self-medicate. According to Greist & Greist (1981), approximately 20% of aviophobics who do fly use alcohol or sedatives during flights (as cited in Rothbaum, Hodges, Anderson, Price, & Smith, 2002). Despite these statistics, it is estimated that only 25% of such individuals seek treatment (Agras et al, 1969; Ekeberg, Seeberg, & Ellersten, 1989).

According to Van Gerwen et al. (1999), individuals who are fearful of flying do not make up a homogeneous group. Individuals can be divided into several subgroups: 1) those that do not fly at all; 2) those that restrict flying to an absolute minimum and experience considerable discomfort on each flight; and 3) those who have continuous mild or moderate apprehension about flying but who do not avoid it. Additionally, according to Van Gerwen, Spinhoven, Diekstra, & Van Dyck (2002), flying phobia can be a manifestation of one or more other phobias; such as claustrophobia or social phobia. For instance, an individual's fear may solely be focused on being in a closed space or appearing anxious around unfamiliar people and not the flying experience. Furthermore, it can be the effect of generalization of one or more natural environment type specific phobias, such as fear of heights, falling, storms, water, instability, etc. Therefore, an individual may not be afraid of flying but instead afraid of a specific component of the flying experience, such as being at a high altitude.

Research and clinical practice suggest that individuals who are fearful can focus their anxiety during different parts of the flying experience. For instance, individuals rate their anticipatory anxiety, in-flight anxiety and generalized anxiety with different severity

levels (Van Gerwen et al, 1999). Furthermore, bad weather, air turbulence, mechanical failure, takeoff and landing impact reported anxiety levels. According to Howard, Murphy, and Clarke (1983), a fear of flying can be comprised of underlying fears which can include, crashing, heights, confinement, stability and social situations.

Onset and Course

The mean age of onset varies depending on the type of specific phobia. According to the DSM-IV-TR (APA, 2000), initial symptoms of specific phobias usually originate in childhood or early adolescence. It has been reported that individuals with animal type phobia and blood-injection-injury type phobia tend to begin in childhood, while situational type phobia and natural environment type phobias begin in early childhood and late adolescence. Furthermore, research has shown that situational type phobias have a second peak during the mid-20's (Anthony, Brown, & Barlow, 1997; APA, 2000). Wilhelm & Roth (1997) sought to determine the clinical characteristic of flight phobia by sampling 66 subjects, 37 of whom were diagnosed by meeting the DSM-IV criteria with "simple phobia of flying." The average onset age of intense fear for this sample was 24.8 years. Furthermore, the researchers found that the average number of flights prior to fear onset was 17.1.

Caution is suggested when interpreting data regarding age of onset. Most research is retrospective in nature, and thus is subject to recall biases. For most individuals, fear of a stimulus is present for a significant length of time before causing significant impairment in functioning to be considered a specific phobia. Additionally, differences in the interpretation of the DSM criteria can skew data.

The DSM-IV-TR cites predisposing factors such as traumatic events, unexpected panic attacks, observation, and modeling as being associated with the acquisition of phobias. Feared objects are also seen as having an evolutionary basis. This means that the experience or a component of the experience is feared due to its historical risk. Phobias that continue through adulthood have approximately a 20% chance of remitting (APA, 2000).

Rachman (1977) identified three main pathways through which fears develop: conditioning, vicarious acquisition and information/instruction. Conditioning refers to the association of events. For instance, an individual who experiences a negative flying experience will associate this experience with flying in general. In vicarious acquisition, an individual learns a fear of flying through the observation of others that are fearful flyers and internalizing the fear. Information/instruction deals with the acquisition of a phobia through media and culture. For example, an individual who reads various stories about plane crashes may develop a fear of flying. Aviophobia can be linked to these theoretical models of fear acquisition (Wilhelm & Roth, 1997).

Gender Differences

The ratio of women to men with specific phobias is approximately two to one across the lifespan (APA, 2000; Bourdon, Boyd, Rae, Burns, Thompson, Locke, 1988; Hartung & Widiger, 1998; Kessler, McGonagle, Zhao, Nelson, Hughes, Eshleman, Wittchen, & Kendler, 1994). Specifically, Kessler et al. (1994), found gender differences for specific phobia indicating that women have a higher lifetime prevalence rate of 15.7% compared to males at 6.7%. However, it must be noted that gender difference varies across the different subtypes of phobias. For example, 75-95% of individuals with

animal type, natural environment type, and situational type phobias are female, with the exception of fear of heights, while only 55-70% of Blood-Injection-Injury type phobias are females (APA, 2000).

Gender prevalence rates for fear of flying specifically could not be found. However, Bourdon et al. (1988), found a 2.9:1 female to male ratio for having a phobia related to being on any public transportation, including airplanes. This statistic differs from the estimated percentage of females with situational phobias presented above.

Prevalence

According to the research, the National Comorbidity Survey (Kessler et al, 1994) and Epidemiological Catchment Area (Eaton, Kramer, Anthony, Dryman, Shapiro, & Locke, 1989) are the two largest prevalence surveys to date. The National Comorbidity Survey is a congressionally mandated survey designed to study the prevalence and comorbidity rates in the United States, using a structured psychiatric interview. According to Kessler et al. (1994), the results of the National Comorbidity Survey suggest a lifetime prevalence of specific phobias of 11.3% and a twelve month prevalence rate of 8.8% in adults. Similarly, The Epidemiological Catchment Area Study conducted by Eaton, Kramer, Anthony, Dryman, Shapiro, & Locke (1989) estimates the one year prevalence of phobic disorders between 6 and 16%. The Epidemiological Catchment Area consisted of collaborative community surveys carried out by five university-based teams in different locations in the United States. The limitations associated with this study include the definition of phobic disorder, which combined agoraphobia with specific phobias. Therefore, teasing these results apart to get more precise estimates of specific phobia prevalence is not possible.

Phobia Acquisition and Maintenance

There are several different theories on the acquisition and maintenance of phobic behavior. The following section is a review of the literature from an evolutionary, information processing, and learning perspective.

Evolutionary

According to Darwin (1859), more individuals of a species are born than can survive; and as a result there is a struggle for existence. Through the process of natural selection, the less well adapted forms of life become extinct. This is known as survival of the fittest. Complex relations to others as well as to the environment are inherited by offspring for the purpose of preservation of the individual. Through this theory, it can be surmised that many human fears observed today have their origins in evolutionary history. This fear and avoidance of dangerous stimuli increased the likelihood of survival, which was then passed down through genes. As a result, these fears are represented in future generations.

In 1971, Seligman wrote about humans having evolutionary predispositions, labeled “preparedness,” which states that humans tend to avoid or be fearful of items or experiences that were once threatening to the survival of prehistoric man. According to Davey (1995), prepared phobias refer to a small number of fear inducing stimuli that can be traced back to biological predispositions, such as a fear of spiders. An acquired phobia refers to a phobia that originates from a cognitive bias, which consists of a heightened expectation of aversive outcomes following fear relevant stimuli.

According to Mineka & Ohman (2002), heights and open spaces provided threats to survival for our ancestors. Therefore, we are more likely to develop fears in these

areas than with modern objects and situations such as guns or cars, which can also lead to traumatic and dangerous situations. Evolutionary theories of specific phobias are well supported by the literature, however, not all phobias are evolutionarily relevant.

Evolutionary theories can be related to the components of Aviophobia in various ways. For example, the claustrophobia component of fear of flying, can be linked to the danger associated with being trapped in a small space by a predator, which can be life threatening. Therefore to ensure survival, it is adaptive to avoid small and closed spaces. Additionally, moving at high speeds, which is part of the flying experience, can be dangerous and lead to injury. Furthermore, the feeling of fast acceleration can cause discomfort in one's stomach or inner ears. These types of sensations are the body's way of signaling distress. In general, all painful and uncomfortable situations are avoided by most humans. Furthermore, Wilhelm & Roth (1997) propose that looking out of the window of a plane is similar to the visual cliff in experiments performed with both toddlers and animals. According to Gibson and Walk (1960, as cited in Rader, Bausano, & Richards, 1980), the animal species' response toward depth is avoidance of an apparent drop-off. Moreover, toddlers instinctively avoid crossing over the "visual cliff" (a glass bridge) . This evidence suggests avoidance of a "visual cliff" is adaptive due to the inherent dangers of falling from a high place.

Information Processing

According to Rego, Muller, and Sanderson (2009), the information processing of individuals with a specific phobia contains two main biases: bias in attention and bias in memory. It has been proposed that a bias in attention may aid an individual in escaping from danger. However, according to Barlow (2002; as cited in Rego, Muller, and

Sanderson, 2009) the relationship between bias in attention and specific phobias has been weak and unreliable. However, individuals with a fear of flying may attend more to plane crashes in the media than a non-phobic population. Bias in judgment is said to impact the maintenance of specific phobias. Individuals with a specific phobia tend to be inaccurate when reporting their expected fear level prior to encountering a feared stimulus, and are more likely to attribute negative consequences to a feared stimulus. For example, an Aviophobic may rate his/her expected flying anxiety level higher than the actual number reported during the flying experience. He/she may also, view flying as more dangerous than non-phobic individuals due to attributing negative consequences to the flying experience. The perceived risk can also be impacted by the media. Plane crashes are often highly publicized, despite their low frequency of occurrence.

Rego, Muller, and Sanderson (2009) propose that “given the existence of distorted information processing, it seems logical to assume that feared objects or situations would increase anxious apprehension that could ultimately trigger a false alarm reaction in response to an encounter with the phobic situation...(p. 161).” Since Aviophobia has many components that are consistent with a prepared phobia, it follows that individuals with a fear of flying have distorted information processing that causes anxiety and triggers the false alarm reaction when confronted with a flying experience.

Learning

Classical Conditioning. Classical or respondent conditioning was demonstrated by Ivan Pavlov in the well-known experiment involving the salivation of dogs(Pavlov, 1928). This type of learning occurs when an unconditioned stimulus (US) automatically produces an unconditioned response (UR). Furthermore, as a result of pairing the US

with a neutral stimulus (NS), the NS elicits a response similar to the UR, and is then entitled the conditioned stimulus (CS) (Pavlov, 1928).

John B. Watson applied Pavlov's theory of classical conditioning to the human emotional response with his Little Albert experiment. Watson and Rayner (1920) found that Albert produced a fear response to loud noise, and a neutral response to a white rat. Through repeated pairings of the loud noise and white rat, the experimenters evoked a conditioned fear response to the white rat. The fear response was characterized by Albert falling over, crying, and crawling away from the rat, which was interpreted as his method of escaping from the adverse conditioned stimulus. The conditioned fear response generalized to other objects. This demonstrated how a fear response is conditioned, and how avoidance learning begins to occur.

According to Wilhelm & Roth (1997), conditioning can be involved in flying phobia in three ways. First, stimuli occurring during flying can be unconditioned stimuli for classical conditioning. These stimuli include: sudden loss of support (airplane drops during turbulence), loud noise (take-off), and pain (middle ear pain from air pressure). Second, the authors' state that some stimuli in the flying situation may be prepared stimuli easily linked to a fear response, such as fear of heights or closed spaces. Last, panic attacks in the airplane can lead to conditioned avoidance. Panic attacks can be a result of the cramped space, reminders that one is far from land, lack of control, and/or knowledge of the extended time period remaining in the flight (pg. 243).

Operant Conditioning. In contrast to classical conditioning, Skinner (1938) stated, "there is a large body of behavior that does not seem to be elicited" (p.453), which he believes is ignored due to fear of "spontaneity" and its implications of freedom. Skinner

is referring to individuals being fearful of behaviors that have no apparent or direct cause. His theory of operant conditioning starts with the premise that some behaviors are not correlated with a stimulus that can be detected. Their strength of occurrence is associated with drive or motivation, and dependent upon the contingencies that follow a response (Skinner, 1938; Skinner, 1966). Skinner (1938) postulated that when a behavior is followed by reinforcement, the frequency of that behavior to occur in the future will increase. In contrast, when a behavior is not followed by reinforcement the frequency of that behavior in the future will decrease.

In an article by Skinner (1948), "Superstition in the Pigeon," he discussed how accidental pairing of an operant behavior with either a positive or negative reinforcer can produce superstitious behavior. Skinner states, "the conditioning process is usually obvious. The Pigeon happens to be executing some response as the hopper (device that distributes food) appears; as a result it (the pigeon) tends to repeat this response" (pp. 168). These pigeons developed superstitious behavior, such as turning in their cage, head thrusts, and a "tossing" response because they were accidentally paired with receiving food. This type of learning can be compared to the acquisition of anxiety, specifically phobias. For example, if an individual is sick prior to flying, he/she may attribute the sickness to the flight. The sickness, in this example, would act as a punisher, and the behavior of flying would decrease. However, operant conditioning better explains the maintenance of fear, which is further discussed in the following section.

Mowrer's Two Factor Theory. In general, according to Mowrer and Lamoreaux (1947), there is a basic defect in a purely associative interpretation of conditioning. Classical conditioning cannot occur without motivation. Experimentation demonstrates

that the unconditioned response and conditioned response are not the same, and may differ both quantitatively and qualitatively. Classical conditioning alone cannot account for this finding. A two factor theory was developed, which postulated that behaviors are acquired through classical conditioning and maintained through operant conditioning. The model would suggest that an individual with a fear of flying may have initially developed this fear due to a highly emotional negative experience on a plane. Next, this fear of flying became maintained through motivation to avoid other anxiety provoking experiences.

In a later publication, Mowrer (1950) describes the two factor theory as two distinct learning processes. The first learning process is problem solving, effect, and reward. He defines these as “habits” which originate from the central nervous system and skeletal musculature. These are the results of voluntary responses patterns, which are solution learning based and part of operant conditioning.

The second learning process was classical conditioning or emotional learning. Autonomic nervous system and visceral vascular tissues produce involuntary reactions, which are called “feelings.” Secondary drives such as emotions are explained by the second learning process.

While applying this theory to psychotherapy techniques, Mowrer (1950) states “the neurotic continues to have emotions he doesn’t want to have and feelings he cannot control because he continues to engage in behavior that produces consequences, which are actively reinforcing these emotions” (p.117). Therefore, therapists can help patients by not reinforcing inappropriate behaviors, which is considered to lead to extinction of the maladaptive behaviors. The therapist should provide a suitable identification model

that the patient can acquire. The new behaviors will then elicit positive responses from the environment. This results in new attitudinal learning or reconditioning. In this model, the biological drive does not change. Instead, the voluntary behaviors change along with the emotions. In the example of fear of flying, a therapist would encourage the patient to engage in flying behaviors. This would provide opportunities for the patient to be positively reinforced and therefore develop new learning.

According to Mowrer (1950), “a two factor theory of learning suggests that therapy may lead to either (a) a new and better solution to old problems or (b) a modification in the nature of the problems themselves” (pp. 119). Therefore, in therapy individuals may modify their habitual behavior, but there is no possibility of modifying biological drives. However, emotional change can occur during therapy that may bring about personality changes.

Phobia Treatment

The learning models of classical conditioning, operant conditioning, and Mowrer’s two factor theory became the basis for many phobia intervention strategies. Once a phobia has been learned, the associations between stimuli and maladaptive responses must be weakened to reduce or eliminate the phobic behaviors. This can be accomplished through the use of habituation and extinction principles. The following section will review learning based treatment approaches such as systematic desensitization and exposure.

Systematic Desensitization.

Systematic desensitization is a technique developed by Salter and Wolpe, and is based on principals of counter conditioning (as cited in Goldfried & Davison, 1976). According to Wolpe (1969), systematic desensitization requires patients to be trained in relaxation. Jacobson (1938, developed deep muscle relaxation training. Using Wolpe's model, patients would be given approximately six session of relaxation training. During relaxation training sessions, patients are asked to list several fear-inducing situations, which they will place in rank order. This is done according to how disturbing the experiences would be to the patient, and is called a "hierarchy." A hierarchy is constructed in descending order according to the situations anxiety arousing effect. Once the relaxation training and hierarchy construction is complete, the patient is ready for systematic desensitization.

In this model, the therapist requests that the patient remain comfortably seated while he/she is presented with scenes, beginning with the least anxiety inducing, from his/her hierarchy. The patient is instructed to gesture to the therapist when a scene is disturbing. When this occurs, the therapist immediately presents a relaxation image. Wolpe (1969) explains, "The therapist makes his way up the hierarchy and there is an almost complete transfer of the deconditioning of the anxiety from the imaginary situation to the corresponding situation in reality" (pp. 11).

The principle behind this type of treatment suggests that "if a response antagonistic to anxiety can be made to occur in the presence of anxiety-evoking stimuli, so that it is accompanied by a complete or partial suppression of the anxiety response, the bond between those stimuli and the anxiety responses will be weakened" (Wolpe, 1969,

pp. 71). Systematic desensitization has demonstrated its efficacy in the treatment of Aviophobia (Howard, Murphy, & Clarke, 1983; Sank, 1976; Timm, 1977).

Exposure.

The principle behind exposure is based on classical conditioning. According to Levis (1980), “The repeated presentation of the conditioned stimuli in the absence of the unconditioned stimuli will lead to the unlearning of the learned response” (pp. 93). Exposure therapy is a modern re-conceptualization of two earlier related but distinct behavioral therapies: flooding and implosive therapy. Both techniques are united in the desire to promote behavioral change through extinction principles and in their use of imaginal methods.

Flooding. Flooding is a type of exposure, in which feared stimuli are presented either through imagery and in-vivo (real life) for prolonged periods of time. The cues that are presented are symptom contingent, meaning they are related specifically to the patient’s anxiety provoking stimuli (Marks, 1972). The purpose of flooding is to maximize anxiety until extinction occurs. Baum (1970) reported that flooding is a treatment administered after an avoidance response has been learned, which can effectively eliminate the behavior. In Baum’s words, this technique can be described as “flooding the animal with the full strength fear stimulus on first presentation, and continuing this for a protracted period of time” (p.277). Response prevention is another integral part of exposure, and prevents a patient from performing an avoidance response.

Siegeltuch and Baum (1971) attempted to determine if flooding was effective in eliminating well-established avoidance behavior in rats. The researchers presented aversive stimuli in short presentations, before response prevention can occur, and found

that increased durations of response prevention was needed for extinction of the avoidance response. In contrast, when the presentation of aversive stimuli was done in a long presentation, the avoidance response was learned at a slower rate. The researchers indicated that longer exposure led to a greater reduction of fear responses in rats.

Solomon, Kamin and Wynne (1953) placed dogs in a shuttle box and conditioned them to jump from one chamber to another when a light (CS) was presented. In order to obtain this response, the light (CS) was paired with sub-tantalizing electrical shock (UCS), which produced a jump response (CR). The jump response was first an escape to stop the shock, but later became an avoidance technique to not receive the shock. Extinction did not occur when the UCS was removed, and only the CS was presented for hundreds of trials. The experimenters then raised the height of the divider between chambers preventing the dogs from jumping. Initially, the dogs exhibited a fear response when the CS was presented and the dogs were unable to jump (CR). However, after a few presentations, the dogs' fear response was decreased.

Solomon and Wynne (1954) analyzed their findings using assumptions from Mowrer's two factor theory, Pavlov's classical conditioning, and Thorndike or Hullian's instrumental conditioning in an effort to apply their work to therapy. They state that anxiety can never be fully removed but can be reduced to a functional level, which will not interfere with patient's daily lives. Solomon and Wynne (1954) reported that re-experiencing the anxiety producing situation in a supportive setting will reduce the emotion. Therefore, exposure is the key component of this model.

Marks (1972) concludes that "patients need to be well motivated and to understand what is required of them in flooding treatment, otherwise they might

terminate treatment prematurely and enhance future tendencies to escape” (p. 136). The premature termination of treatment is a problem in clinical practice. Techniques to build rapport and enhance understanding of treatment can facilitate an improved therapeutic relationship. Despite the aversive nature of treatment, results of flooding, specifically on symptoms of fear of flying, have demonstrated this technique to be efficacious (Bryant, Mould, Guthrie, Dang, & Nixon, 2003; Dadds, Bovbjerg, Redd, & Cutmore, 1997; Howard, Murphy, & Clarke, 1983).

Implosion. Similar to flooding, implosion involves presenting patients with anxiety provoking scenes through imagery. Stampfl and Levis (1967) stated, “the fundamental hypothesis is that a sufficient condition for the extinction of anxiety is to re-present, reinstate, or symbolically reproduce the stimuli (cues) to which the anxiety response has been conditioned, in the absence of primary reinforcement” (p.498). The therapist attempts to obtain the maximal level of anxiety for the patients and hold them at this level until the anxiety reduces. This treatment can only be performed in an imaginal environment because it goes beyond feared situations that are symptom contingent, and presents feared consequences, which individuals form as a greater stimulus gradient around their original conditioned stimulus (Schare, personal communication, 2010). This component is unique to implosive therapy. According to Morganstern (1973), the therapist embellishes scenes with the “most horrifying and unrealistic images” in order to attain the maximum level of anxiety. However, these scenes are based upon the consequential thoughts and avoidance behaviors that reinforce their occurrence (Schare, personal communication, 2010). Currently the literature suggests that implosive therapy

can be effective in the treatment of phobias (Howard et al., 1983; Levis, 1974; Morganstern, 1973).

Modality. Practitioners of exposure today have developed several different modalities in which to present anxiety provoking stimuli. These include imaginal, in-vivo, and VR mediums.

Imaginal. When performing exposure therapy, the scene can be presented to patients verbally. They would be instructed to close their eyes and imagine themselves in the described scene. According to Dadds et al. (1997), images are “considered to be mental content that possess sensory qualities in the absence of external stimuli which provoke relevant senses or brain states like those that arise during perception but occur in the absence of appropriate immediate sensory input” (pp. 89). Visual imagery is used in this type of modality, and is said to rely on the expertise of the therapist in creating an imaginal scene and the ability of the patients to create the described scene in their mind. This is typically done by filling in gaps based upon their life experience. As noted earlier in the implosive therapy section, imagery allows for the creation of exposure content not simply based on realistic occurrences in daily life, but also on the irrational extreme fears expressed by phobic patients.

In-Vivo. The modality of in-vivo presentation for conducting exposure therapy means that the patient will be exposed to real life anxiety provoking stimuli. For example, a spider phobic might be shown an actual spider in a jar, asked to hold the jar, and eventually to touch it. An individual fearful of bridges would be taken to view a bridge and then asked to cross a bridge. A patient with a fear of flying would be brought to the airport, asked to board a plane, and eventually to take a flight. This modality of

treatment is often inconvenient and perhaps unrealistic. Additionally, in-vivo exposure does not allow a therapist to go beyond symptom contingencies to imaginal or hypothesized consequences. For example, during an in-vivo therapy session patients would not be able to experience a plane crash.

Virtual Reality. VR is a new medium that uses technology to create a simulated three-dimensional environment. According to Rothbaum, Hodges, Smith, Lee, & Price (2000), “VR offers a new human-computer interaction paradigm in which users are no longer simply external observers of images on a computer screen, but are active participants within a computer-generated three-dimensional virtual world” (pg. 1020). The authors further state that the newer “virtual environments differ from traditional displays in that computer graphics and various display and input technologies are integrated to give the user a sense of presence and immersion in the virtual environment” (pg. 1020). This is accomplished using a head mounted display, which consists of two display screens for each eye, display optics, stereo earphones, and a head tracking device. The computer generated virtual world changes in a “natural way” with the user’s body and head motion.

Patients can be presented with their feared stimulus through visual, auditory, and olfactory senses using computer generated images. Tactile stimulation can also be provided. For example, a vibrating platform can be used to simulate turbulence or engines, an airplane seat can be used to simulate buckling up or using the buttons on the chair, and a fan can be used to simulate the air conditioning blowing directly in ones face. Olfactory sensations are also available (Krijn, Emmelkamp, Olaffson & Biemond, 2004).

For example, the smell of burning electrical wires can be used in exposure to simulate a problem with the engine.

There are several advantages of using VR when conducting exposure therapy for Aviophobics. According to Krijn, Emmelkamp, Olafsson, and Biemond (2004), it provides a visual for individuals who have trouble with mental imagery, it decreases the risk of breaking confidentiality when conducting in-vivo exposure, it decreases external distracting stimuli, and it is more time efficient than in-vivo exposure, which requires the therapist to travel. Due to VR's several advantages, many researchers have sought to determine the efficacy of VRET for Aviophobics.

Exposure Therapy for Aviophobia

Several researchers have used exposure techniques for the treatment of Aviophobia (e.g. Doctor, Mc Varish, & Boone, 1990; Ost, Brandberg & Alm, 1997; Timm, 1977); Walder, McCracken, Herbert, James, & Brewitt, 1987).

Case Studies

Timm (1977) described a case study in which systematic desensitization was performed on a 27-year-old male with a fear of helicopters. The methodology described included four weeks of relaxation training, the compilation of a 32 item hierarchy, and ten sessions of graded exposure. Four months after treatment, the patient flew on a helicopter for 40 minutes with a reported manageable level of anxiety. Another case study was performed by Sank (1976) with a 26-year-old male with a fear of flying. Using a similar procedure of relaxation training, building a hierarchy and performing exposure, the patients was able to fly for business. Due to the limited time available for

treatment, video recorded relaxation and Valium were also used by the patient. At the end of treatment, he reported to “look forward” to upcoming trips.

Group Studies

Doctor, McVarish, & Boone (1990) conducted a study using 23 adult participants who requested psychological treatment for flying anxiety. Participants took part in a one and a half hour “freedom to fly program,” which consisted of six group meetings that focused on anxiety management skills and in-vivo gradual exposure using a commercial flying situation, such as being shown the functional aspects of an airplane. Twenty one of the participants took a graduation flight following the course. At follow-up, 83% of participants had taken a flight and 73 percent reported a decreased level of anxiety.

Ost, Brandberg, & Alm (1997) compared five sessions of exposure and cognitive restructuring with one session of exposure and cognitive restructuring on 28 patients who met the current diagnostic criteria for specific phobia, flying. The five session condition consisted of four one hour sessions and one two hour session. The first two sessions were conducted in the therapist’s office and centered on the participant’s idiosyncratic thoughts about flying. The third and fourth sessions were spent in an airport and then on a mock plane. The last session consisted of an actual flight. The one session treatment condition consisted of a three hour massed exposure at the airport and cognitive restructuring throughout session. Ninety three percent of the one session condition participants flew post-treatment, and 64 percent at the 12-month follow-up. Seventy nine percent of the five session condition participants flew post-treatment, and 64 percent flew at follow-up.

Walder, McCracken, Herbert, James, & Brewitt (1987) conducted a three session treatment protocol on individuals with a fear of flying. During the sessions, participants were given psycho-education about flying, graded exposure, and group support. The authors concluded that exposure reduced participants reported anxiety. At a one-year-follow-up, 40 percent of the participants had flown. At the three-year-follow-up, 60 percent of the participants had flown. Additionally, 84 percent of the participants reported less anxiety than prior to treatment at the three-year-follow-up.

Virtual Reality Exposure Therapy for Aviophobia

VR exposure therapy (VRET) has been shown to be an effective treatment technique for Aviophobia, and is quickly becoming a popular tool for the treatment of phobias in general (Krijn, Emmelkamp, Olfasson, Biemond, 2004).

Virtual Reality Treatment Studies.

According to a review article by Krijn et al. (2004), VRET can be an effective component of treatment for fear of flying. There have been several case studies and experimental investigations of the efficacy of VRET for fear of flying.

Case Studies

North, North, and Coble (1997) performed “virtual environment desensitization” on a 42-year-old male. The VR therapy consisted of five sessions “flying” on a helicopter simulation. The patient was exposed to anxiety producing stimuli in increasingly challenging situations, which can be labeled as graduated exposure. A vibration apparatus was placed under the physical helicopter to enhance tactile stimulation. The authors concluded that there was a significant reduction in anxiety

symptoms, as measured by subjective self-rating scales. Additionally, the authors report that the subject's ability to face the phobic situation in the real world was increased.

Another case study was performed by Wiederhold, Gevirtz, & Wiederhold (1998), who examined the differences in physiological symptoms between an individual suffering from fear of flying and a person without a fear of flying. Specifically, heart rate, peripheral skin temperature, respiration rate, sweat gland activity, and brain wave activity were measured during a baseline, 20 minute VR exposure session, and a recovery period. "The twenty minute VR exposure session consisted of the patient wearing an HMD and viewing a three dimensional computer generated image of several flying scenes, including sitting in a plane with the engines on, pushing back to taxi down the runway, takeoff, flying in good weather, flying in turbulent weather, and landing" (p. 99). The authors concluded that four sessions of VR exposure therapy reduced skin conductance for the individual with a fear of flying, suggesting a decrease in anxiety. No data was presented for the other types of physiological symptoms.

Another case study conducted by Rothbaum, Hodges, Watson, Kessler, & Opdyke (1996) involved a 42-year-old female patient who met criteria for a specific phobia (Aviophobia). The treatment consisted of seven sessions of Anxiety Management, and six sessions of VR exposure, which consisted of sitting on a plane with engines on, taxiing, taking off, normal flying, landing, turbulent flying, and rough taking off. Each treatment component on its own was found to be effective on reducing measures of anxiety, behavioral avoidance, depression, and "general improvement."

Controlled Studies

A between subject multiple baseline design was used by Botella, Osma, Garcia-Palacios, Querno, and Banos (2004) to examine the short- and long-term efficacy of VRET for the treatment of flying phobia. Nine participants who met criteria for Aviophobia were given six sessions of VRET, which consisted of different virtual scenes progressing from easiest to most difficult situations. The main goal of these sessions was to stay in the situation until the patient experienced a significant decrease in anxiety. Patients also received one session of psycho-education. The VR environment was said to activate participants' anxiety levels at a moderate to high level, therefore making the exposure effective. The authors report an improvement in their participants' fear and avoidance. All participants flew within five months after treatment. Results were maintained by participants in a one year follow-up study.

Kahan, Tanzer, Darwin, Borer (2000), investigated a multidimensional treatment program for 31 patients with a fear of flying. The treatment included several components, such as psycho-education, relaxation, cognitive strategies, and VRET. During the VR exposure, patients were gradually introduced to flight scenarios, using anxiety management strategies to reduce fear before moving on to the next scenario. The criterion for improvement was behavioral, if the patient flew or not. Sixty-eight percent of patients flew after treatment. Due to the methodology used in the study, it is impossible to identify which component of the treatment plan was efficacious. Additionally, the varied number of sessions across subjects, the dropout rate, and the different medication regimens of subjects, made it difficult to draw general conclusions from this study.

Relaxation training and VRET were compared in a study conducted by Muhlberger, Herrmann, Wiedemann, Ellgring, and Pauli (2001). Thirty participants who met criteria for simple phobia (Aviophobia) received psycho-education and then were randomly assigned to either a relaxation condition or VR exposure condition. The conditions consisted of either four 16-minute VR exposure flights, or two 32-minute relaxation exercises. Investigators concluded that the VR exposure was more effective in fear reduction than relaxation. Fear of flying was reported to have decreased in both conditions; however, the physiological measures of heart rate and skin conductance indicated greater anxiety reduction in the VR exposure condition.

According to Maltby, Kirsch, Mayers, and Allen (2002), VRET was more efficacious than an attention placebo group on four out of five measures of post treatment self-reported flight anxiety. Specifically, there was significantly more improvement on the In-Flight Anxiety Scale, Anticipatory Flight Anxiety scale, Somatic Anxiety Scale, and Cognitive Anxiety Scale for the VR condition compared to the placebo group. The researchers randomly assigned 45 patients to five sessions of one of the two treatment groups: VR exposure or attention placebo group. The VR exposure group consisted of five sessions over three weeks. The first session included an introduction to the VR equipment, explanation of the rationale and anxiety management skills. The remaining four sessions lasted 50 minutes, and consisted of graded exposure to flying in virtual environments, which was similar to the exposure scenes of the previous articles. The attention placebo group participated in psycho-education, sharing personal experiences, and engagement in group processes. Although the VRET group seemed to be more

efficacious at post-treatment, a six month follow-up study indicated that most group differences had disappeared, but some treatment gains remained.

Bibliotherapy, VRET, and cognitive behavior therapy were compared in an investigation conducted by Krijn, Emmelkamp, Olafsson, Bouwman, Van Gerwen, Spinhoven, Schuemie, & Van Der Mast (2007). Thirty five participants, who met the current criteria for specific phobia (Aviophobia), were randomly assigned to one of the three conditions. However, complete data were analyzed for only 29 subjects due to attrition, incomplete data, and medical issues. Participants in the bibliotherapy condition were given a book on flying, aircrafts, relaxation, cognitive and behavioral coping strategies, and self-help. The VR exposure condition consisted of four sessions of exposure in a virtual environment of flying. Lastly, the cognitive-behavioral group was given two to four sessions of cognitive techniques and relaxation. The researchers concluded that both VR and cognitive behavioral therapy, when pooled together, were more effective than bibliotherapy. However, there was no statistically significant difference between VR and cognitive behavioral therapy on the dependent variables of the Igroup Presence Questionnaire and Subjective Units of Distress.

Virtual Reality vs. In-vivo Exposure.

In-vivo exposure therapy has demonstrated its efficacy in the treatment of phobias as reviewed earlier. Despite the positive treatment outcomes, this type of exposure is rejected by 20 to 25% of individuals due to the aversive nature of confronting feared stimuli (Garcia-Palacios et al., 2001; Botella et al., 2004). Furthermore, according to Botella, et al. (2004), “the lack of control over the real situation, the lack of confidentiality, as well as the high economical cost and the amount of time that this

therapeutic strategy represents, makes in-vivo exposure less accessible for clinicians who treat fear of flying” (pp.312). This is especially true following the increased airport security after the September 11th attacks.

In contrast, VRET is conducted in the safety of the treatment facility and allows the therapist to remain in control. Additionally, VR is more accessible to patients and therapists who are now unable to go through the airport gates without purchasing a ticket due to security constraints. Scheduling difficulties and time constraints are also minimized with the convenience of the VR system. Maltby et al. (2002) state that VR can isolate the focal concerns in a more efficient manner than in-vivo exposure. Specifically, when treating fear of flying, if the take-off is the most anxiety producing component of the flight, it can be repeated quickly and frequently without having to experience the other components of a flight. The VR system in its current form presents some barriers to treatment. These include the expense of hardware and software, the possibility of motion sickness, the limitations of the software, and lack of complete active participation in the VR environments (Maltby, et al., 2002). Additionally, a weakness of VR is that the feared object is not actually present during exposure. It is logical to assume that the reaction will be different when confronting your actual feared stimulus versus a VR feared stimulus.

Rothbaum, Hodges, Smith, Lee, & Price (2000) conducted a comparison study to determine the differences in treatment outcome of participants randomly assigned to VR exposure, in-vivo exposure, or a waitlist control. Treatment consisted of four sessions of “anxiety management training” followed by either VR exposure or in-vivo exposure at an airport on a real airplane. The VR exposure and in-vivo exposure sessions were identical

for the first four sessions and lasted approximately one hour. The first five sessions consisted of information gathering, treatment planning, an explanation of the rationale, teaching of anxiety management techniques, and the learning of cognitive strategies. Sessions five through eight focused on exposure. The VR exposure was equivalent to the procedures listed in previous studies. The in-vivo exposure consisted of two combined double session at the airport, which exposed participants to pre-flight stimuli (ticketing, trains, parking, etc.) and in-flight stimuli (sitting on a stationary plane while imagining take-offs, cruising, and landing). The dependent variables included standardized questionnaires related to flying anxiety symptoms and a behavioral measure of the number of participants who actually flew on a real plane after treatment. The authors reported VR exposure and in-vivo exposure to be significantly better than a waitlist control on all measures. However, there were no reported significant differences between VR exposure and in-vivo exposure. Furthermore, at a six month follow-up, 93% of participants in both the VR exposure and in-vivo exposure conditions had flown (Rothman, et al., 2000).

A twelve month follow-up study was conducted by Rothman et al. (2002) to determine if treatment gains were maintained. Eighty percent of the original participants in the VR exposure condition and in-vivo exposure condition participated in this follow-up study. According to the authors, 92% of VR exposure participants and 91% of in-vivo participants maintained their treatment gains and had flown on an airplane since treatment. However, it was reported that the participants in the VR exposure condition consumed more alcohol and drugs while flying after treatment than did the participants in the in-vivo exposure condition.

Virtual Reality vs. Imaginal Exposure.

Imagery is another medium used to confront anxiety arousing stimuli. Imaginal exposure therapy has been considered an efficacious alternative to in-vivo exposure. Imaginal exposure therapy has similar advantages to VR exposure, including time, money, confidentiality, and control over the stimuli. However, exposure through imagery has distinct disadvantages compared to VR exposure.

First, the ability of individuals to visualize images varies. Moreover, some individuals are considered to be incapable of forming images (Ayres & Hopf, 1987; Botella et al., 2004; Cuthbert, Lang, Strauss, Drobles, Patrick, & Bradley, 2003; Dadds et al. 1997; Kosslyn, 1987). Lang, Levin, Miller, and Kozak (1983), investigated the relationship between behavioral report, verbal report, and physiological responses in human fear. The researchers reported that different types of fear stimuli elicit inconsistent physiological, verbal, and behavioral data. However, through their “imagery pre-training program,” participants were able to increase their concordance rate between multiple response formats. Individuals with difficulty forming images may therefore benefit not only from training programs, but also from a treatment such as VR exposure, which does not demand that individuals form mental representations.

According to Kosslyn (1987), images are generated on the basis of stored information and require memory recognition. Therefore, there is a retrieval process involved with mental imagery. This suggests that individuals who have never flown would be inappropriate candidates for imaginal exposure, as they have no experiences in flying environments. Additionally, individuals with working memory deficits would also encounter difficulties in their imagery abilities (Cuthbert et al., 2003; Dadds, Hawes,

Schaefer, & Vaka, 2004). The ability to create mental representations seems to be dependent on a variety of factors. VR exposure can be an alternative treatment modality, which does not require the skills associated with imagery.

A second major disadvantage of imaginal exposure is the possibility of cognitive avoidance or escape while patients are confronting the feared situation (Botella et al., 2004; Dadds et al., 1997). For example, during imaginal exposure, individuals can stop focusing on the anxiety provoking image in an attempt to escape the aversive experience. This provides relief from the image and reduces the efficacy of treatment, which is based on extinction principles. Since individuals have their eyes closed, it is difficult to determine what they are actually imaging or thinking. However, during VR exposure, the therapist is able to monitor the individuals escape attempts. The therapist is able to watch and listen to the VR program and redirect individuals who are focusing on non-anxiety provoking stimuli. For example, if an individual is staring at the floor of the plane in order to avoid the experience, the therapist can redirect his/her attention to the window.

Wiederhold and Wiederhold (2003) conducted an investigation comparing three different Aviophobia treatment modalities. The first group of participants received VR exposure, physiological monitoring (learning diaphragmatic breathing) and visual feedback (participant viewed visual feedback of physiology). The second group received VR exposure and physiological monitoring. Finally, the third group received imaginal exposure, which progressed based on SUDS levels, and was conducted based on a graded hierarchy with physiological monitoring. The VR exposure consisted of six, 20 minute sessions, in the three dimensional computer stimulated world. No further detail related to the specific details of the VR exposure was given. The authors reported that

after three months, 100% of participants in the first group, 80% of participants in the second group, and 10% of participants in the third group flew without medication or alcohol. A three year follow-up study was conducted. The authors report some of the post-treatment gains had been maintained. Furthermore, many participants related that the treatment program changed their anxiety and stress in general everyday life situations. In general, the authors concluded that VR exposure was more efficacious than imaginal exposure, and that adding a physiological feedback can further benefit individuals. This study should be interpreted with caution due to its limited detail of the methods.

Definitions of Presence

The construct of presence has been added to the research on virtual reality therapy, but was not previously found in literature on either imaginal or in-vivo exposure. Several authors (e.g. Botella, Osma, Garcia-Palacios, Quero, & Baños, 2004; Maltby, Kirsch, Mayers, & Allen, 2002; Rothbaum & Hodges, 1999; Wiederhold, Gevritz, & Spira, 2001) who have conducted studies of VRET have indicated that a sense of presence within the technology is necessary for the treatment to be successful.

The VR technology came out of the computer science field. VR was being used to improve video game technology. Some “gamers” wanted to feel more “immersed” in their game than they had previously. For example, instead of looking at a television or computer screen that showed a figure going through a corridor in preparation for battle, some gamers wanted to feel that they were *actually walking* through that corridor rather than watching a figure they controlled. To accomplish this, VR generally involved a person wearing a head mounted display (HMD) that tracked his/her head movements. That is, every time someone wearing an HMD moved his/her head, s/he was looking at

something different, just as in real life. In addition, others watching the person play the video game could observe everything s/he saw through his/her HMD on a separate monitor or TV screen. It appears that VR has been successful in creating more immersive video games than existed previously (Slater & Wilbur, 1997; Wiederhold & Wiederhold, 2005).

According to Schuemie, Van Der Straaten, Krijn, & Van Der Mast (2001), the term presence is related to a wide field of research with several different definitions. Lombard & Ditton (as cited in Schuemie et al., 2001), recognize six different clarifications of presence. These include social richness (the extent to which the medium is perceived as social and warm), realism (the extent to which the medium is perceived as realistic), transportation (the sense 'you are there'), immersion (the extent to which the senses are engaged), social actor within medium (the extent to which the user responds socially to a representation of a person through a medium), and medium as a social actor (the extent to which the medium itself is perceived as a social actor) (p. 184). According to the author, the common usage of presence by most researchers is equivalent to transportation presence, and is most related to the immersive VR environment. Further distinctions of the term presence are made between one's individual experience in the VR world, one's social interactions in the VR world, and one's interactions with the environment in the VR world. Additionally, the authors discuss different distinctions between the subjective ratings of an individual on their level of presence with an objective measure of presence being the completion of a task. The research varies on which constructs are distinct from presence or characteristics of the overall term.

Current literature suggests that several components are involved in creating an overall sense of presence. However, the specific components that make up presence vary depending on the definition of presence used by the investigators. Common components across authors seem to include naturalness (realism), engagement (the ability to interact with the environment), and involvement (the amount of attention devoted). However, different terms for each appear in the literature (Lessiter, Freeman, Keogh, & Davidoff, 2001; Regenbrecht, et al., 2008; Witmer & Singer, 1998).

Murray, Fox, and Pettifer (2007) explored the relationship between presence and the psychological variables of absorption, dissociation, locus of control, and immersion. Sixty-four individuals were administered self-report questionnaires after being placed in a VR environment and instructed to navigate around a cityscape for 15 minutes. After the VR experience, participants completed a presence questionnaire. The investigators reported a positive relationship between presence and both dissociation ('a disruption in the normally integrated functions of consciousness, memory, identity, or perception of the environment') and locus of control ('a person's attribution style about events which happen to themselves or others and can range from internal to external causes'). However, they indicated that there was no relationship between presence and absorption ('the ability to get lost in the task at hand'). In addition, positive significant correlations were found between absorption and dissociation, absorption and immersive tendencies ('perceiving oneself to be enveloped by, included in, and interacting with, an environment that provides a continuous stream of stimuli and experiences') (Witmer & Singer, 1998, p. 227), dissociation and locus of control, and dissociation and immersive tendencies. In contrast, no significant relationship was found between presence and

immersive tendencies. These findings suggest that there may be a more complex interrelationship between psychological variables and presence (Murray, Fox, & Pettifer, 2007).

Relationships between Phobia, Presence, & Anxiety.

Since it has been established that exposure therapy is an effective treatment of phobias, it is important to examine the relationship between phobia, presence, and anxiety. When treating phobias using the VR technology, variables examined generally include the construct of presence, which is often measured through subjective self-report questionnaires or objective physiological measures, such as heart rate. However, fewer researchers examined the role anxiety in VR exposure, and most use self-report questionnaires. The relationship between these two variables appears to be inconsistent throughout the literature.

Regenbrecht et al. (1998) found that although there was a non-significant relationship between presence and anxiety, presence was the most reliable factor in predicting anxiety. In this study, participants were asked to fill out questionnaires related to their fears of heights and avoidance behaviors. Next, participants were immersed in a virtual environment that they could discontinue at any time and asked to perform a simple task. Participants' average length of time in the virtual environment was 20 minutes. Directly following the immersion, participants were asked to complete questions relating to their anxiety. Schuemie et al. (2001) concluded a literature review and determined that currently there was not enough data to support a relationship between presence and anxiety.

Krijn et al. (2004) report that heart rate can be used to measure both anxiety and presence. Therefore, the authors question the distinguishing characteristics of these constructs. It is difficult to use objective measures and tease apart these variables. In contrast, Price and Anderson (2007) found a positive relationship between self-reported presence and in-session anxiety. In this study, participants completed eight individual sessions of treatment: four anxiety management/ skills training, and four VR exposure therapies. The VR exposure consisted of a virtual plane that included many aspects of flying, such as sitting on a plane with engines on and off, taxiing, flying in good weather, flying in bad weather, and landing. These were individualized in accordance with the individual's hierarchy. Throughout the exposure session, SUDs ratings were taken in five minute intervals to obtain an anxiety rating. The authors report that despite the positive relationship between presence and anxiety, presence was not directly related to treatment outcomes.

Robillard et al. (2003) conducted a study exposing phobic and non phobic participants to PC computer games with phobogenic stimuli. Through this investigation, the authors found that anxiety could be induced in phobic patients through the PC computer game. Through the use of group differences, correlation, and regression analyses, the authors report a "synergistic" relationship between presence and anxiety. Thus, the authors believe that anxiety predicts presence, and that presence predicts anxiety. Overall, results of the literature review on the relationship between anxiety and presence is inconclusive.

Summary of the study

The literature suggests that exposure is an effective treatment procedure for fear of flying. However, since VR is a new medium for conducting exposure, there are few studies directly comparing VR and imaginal exposure. Additionally, the impact of adding more sensory cues to increase presence to either the VR or imaginal exposure has not been addressed, especially those which address ecological validity.

Traditionally, anxiety has been the key variable in determine treatment efficacy for exposure, as well as behavioral in-vivo measures. However, Regenbrecht et al., (1998) found no relationship between presence and anxiety, and Price and Anderson (2007) found a positive relationship between presence and anxiety. Thus, the relationship between anxiety and presence is currently inconclusive. This could be a consequence of the use of different definitions, theories, and measures of presence.

The current study was a comparison of VRET with imaginal exposure therapy to determine which has greater efficacy for Aviophobia treatment. Additionally, to examine the presence or absence of an ecologically valid, a sensory cue was manipulated in the therapy environment in the form of an actual airplane chair. Lastly, the study aimed to further examine the relationship between presence and anxiety. In order to accomplish this, multiple measures of presence were administered and compared to one another.

Hypotheses

For the following hypotheses, anxiety was measured through the participant's self-report of his/her Subjective Units of Distress (SUDs; Wolpe, 1969) and objective recordings of anxiety-related physiological arousal, which included breathing, crying, fidgeting, rocking, and verbalized anxiety (Hoffman, 2009). Presence was measured using the Independent Television Commission-Sense of Presence Inventory (ITC-SOPI; Lessiter et al., 2001). Fear of flying was measured using the Flight Anxiety Situations Questionnaire (FAS): Quantification of Fear in Various Flight Situations (Van Gerwen et al., 1999).

Hypothesis 1. A main effect of type of exposure was predicted.

- a) Higher SUDs reports were expected in the VR exposure condition compared to in the imaginal exposure condition.
- b) A greater number of objective behavioral observations were expected in the VR condition compared to in the imaginal condition.

Hypothesis 2. A main effect of type of chair was predicted.

- a) Higher SUDs reports were expected in the airplane chair condition compared to in the regular chair condition.
- b) A greater number of objective behavioral observations were expected in the airplane chair condition compared to in the regular chair condition.

Hypothesis 3. Anxiety and presence were expected to be significantly correlated.

CHAPTER II

Method

Participants

Sixty undergraduate students were recruited from the undergraduate population at Hofstra University. According to Nousi, Van Gerwen, & Spinhoven (2008), the Flight Anxiety Situations Questionnaire (FAS; Van Gerwen, Spinhoven, Van Dyck, & Diekstra, 1999), a measure used to determine if sufficient flight anxiety is present in potential participants, can differentiate between patients and non-patient populations. According to the research conducted by Nousi, et al. (2008), individuals who score 56 or higher are in the 90th percentile or higher and in the clinical range for fear of flying. Therefore, this study used a 56 or higher FAS rating as a qualification requirement.

Additionally, participants needed to answer yes to a question asking “are you afraid of flying” to qualify. Those who have never flown were also excluded from the study. A previous study to investigate the prevalence of Aviophobia was conducted by Strilcic, Grove, Schare, and Kairy (2008). It was found that 39% of introductory psychology students reported a considerable fear on at least one item of the FAS ($n = 136$). Grove (2009) reported that during online electronic testing, 54 out of 206 introductory psychology students had endorsed considerable fear of flying for at least one item on the FAS. The subsequent recruitment of these students by Grove (2009) resulted in the participation of 31 students that endorsed a considerable fear of flying.

A power analysis suggested that 60 participants would be sufficient to detect potential significant differences between the groups with at least a moderate amount of power (Lenth, 2006). Students received two credits toward their research requirement for

introductory psychology, received extra credit through their psychology instructor, or were paid ten dollars for their participation.

Design

The study is a 2 X 2 randomized between subjects design. The independent variables are type of exposure (Virtual Reality or Imaginal) and type of chair (airplane or regular). The dependent variable is defined as the mean level of anxiety during the 20 minutes exposure period as measured by a Subjective Units of Distress Scale (SUDs; Wolpe, 1969). Scoring on a Behavioral Coding System, which measures objective behavioral observations, will also be used as another measure of anxiety (BCS; Hoffman, 2009). The relationship of anxiety and presence was assessed using a correlation.

Students completed the FAS during either an online electronic testing or an in class paper and pencil version. Individuals who scored a 56 or higher on the FAS qualified, and were randomly assigned to one of four conditions: 1) Imaginal Exposure / Regular Chair 2) Imaginal Exposure / Airplane Chair 3) Virtual Reality Exposure / Airplane Chair, or 4) Virtual Reality Exposure / Regular Chair.

Measures

Pre-screener

Flight Anxiety Situations Questionnaire (FAS): Quantification of Fear in Various Flight Situations (Van Gerwen et al., 1999). In this study, the FAS, a 32-item questionnaire that measures anxiety produced by different flying situations, was used as a screening measure to qualify participants for this study. Using a scree test, Van Gerwen et al. formulated three factors that explained 64% of the variance. The three subscales include: 1) The Anticipatory Anxiety scale, which consists of 12 items that pertain to

before-flight anxiety, 2) In-Flight Anxiety scale, which consists of 10 items that pertain to anxiety experience during the flight, and 3) Generalized Flight Anxiety scale, which consists of seven items that pertain to anxiety generally experienced in connection with airplanes. The researchers report a Cronbach's alpha level for the three scales of .88, .95, and .97, respectively. This scale was examined in a sample of 726 individuals with a fear of flying, and revealed the internal consistency and test-retest reliability were "good to excellent." Additionally, the authors report strong correlations between subscales, which indicates "sufficient factorial specificity and convergent validity (Nousi, Van Gerwen, & Spinhoven, 2008). Please see Appendix A.

Behavioral Measures

Subjective Units of Distress Scale (SUDs; Wolpe, 1969). On eight specific occasions throughout the exposure session, participants were asked for a number between zero and 100 by which to rate their anxiety level. Grove (2009) formulated nine points throughout the exposure session, which include: "arrival to the airport," "just before the plane gets called," "in jet way," "as plane taxies on the runway," "during takeoff," "mid-flight during good weather," "mid-flight during bad weather," "mid-flight during good weather a second time," and "during landing." The SUD rating point titled "mid-flight during good weather a second time" was removed from the SUD measure. This is due to the experimenter's belief that one measure of each flying point is more consistent. Descriptions of the extremes of this scale were given as follows: "zero means absolutely no anxiety and 100 means as much anxiety as you've ever experienced or could possible imagine" (Grove, 2009). Please see Appendix B.

Behavioral Coding System (BCS; Hoffman, 2009). A replication of the behavioral coding system used in Hoffman (2009) was performed to gain a behavioral measure of anxiety. Four, one-minute interval samples were analyzed per participant on a DVD following the exposure session. Below is a detailed description of the procedures and reliability that were used in the dissertation by Hoffman. The same procedures and reliability checks were performed in this study (See Appendix C for examples and training forms).

The observed behaviors consisted of overt symptoms of anxiety-related physiological arousal, and included breathing, crying, fidgeting, rocking, and verbalized anxiety. The presence or absence of each behavior was coded for each interval. Due to the complexity of five categories of anxiety-related behavior, and the potentially continuous nature of most of the behavioral variables, a frequency count would have been difficult.

Accuracy of the behavioral rating was improved by having the undergraduate raters watch three mock videos (Arrington, 1932b). They received feedback and had supervision during the practice sessions (Kent et. al 1974). Explicit, operational definitions of target behaviors and behaviors to exclude were made and printed for reference. The raters were trained together as a group to reduce drift and increase convergence validity (Foster & Cone, 1986).

The mock therapy DVD's were 10-minutes long, and actors were advanced graduate students in Hofstra University's PhD program in clinical and school psychology. They were instructed to exhibit the kinds of behaviors that would be observed in the actual data. The undergraduate coders were trained with a lecture about behavioral coding given by the research assistant, detailing theory and techniques. Then they analyzed each minute of the 10-minute mock therapy video along with the research assistant. Then the researcher and trainees coded behavior independently each of the remaining three videos with discussion in between each video.

When discrepancies were found between the raters, the point of contention was reviewed and discussed, to help discriminate between true behavior and ambiguous behavior. If an agreement could not be reached, or if inference was involved, the behavior was not counted. After training for 3.5 hours, there was high agreement among the research assistant and trainees (Hoffman, 2009, pg.64-65).

Self-Report Measures

Independent Television Commission-Sense of Presence Inventory (ITC-SOPI; Lessiter et al., 2001). The ITC-SOPI is a 43-item questionnaire that measures a sense of

presence within a virtual reality environment. Lessiter et al. used a principal axis factoring analysis of the ITC-SOPI to determine four subscales: 1) Sense of Physical Space, which consists of 19 items pertaining to “a sense of physical placement in the mediated environment, and interaction with and control over parts of the mediated environment,” 2) Engagement, which consists of 13 items pertaining to a “tendency to feel psychologically involved and to enjoy the content,” 3) Ecological Validity, which consists of five items that pertain to a “tendency to perceive the mediated environment as lifelike and real,” and 4) Negative Effects, which consists of six items that pertain to “adverse physiological reactions” (p.290). The researchers reported 14.2, 11.1, 7.6, and 5.4 percent of the variance was accounted for by the four subscales, respectively. Additionally, authors reported .94, .89, .76, and .77, internal reliability coefficients via the Cronbach’s alpha for the four subscales, respectively. The ITC-SOPI also included basic demographic questions, such as age, sex, occupation, education, self-rated experience with computers, frequency of computer games played, self-rated knowledge of VR, etc. The authors reported good internal reliability co-efficient for the four factors with alphas ranging between .94 and .77. The validity of the scale was investigated by comparing mean scale scores computed for each factor across different media formats. The authors are currently collecting data to gather information on norms. Please see Appendix D.

Apparatus

Virtual reality exposure was conducted using a Dell Precision PWS390 Intel® Core™ 2 Central Processing Unit (CPU) 6300 computer system consisting of a 1.86 gigahertz (GHz) ACPI Multiprocessor PC with four gigabytes (GB) of Random Access

Memory (RAID 0 hard drive configuration). Other components included an NVIDIA GeForce 7900 GS display adapter with two computer monitors and a Human Interface Device-Compliant Game Controller for movement within the virtual airport. A Creative SB XFi with a VFX-3D Head-Mounted Display (HMD) from Interactive Imaging Systems (www.iisvr.com) was used to provide both visual and auditory stimuli to participants (VFX-3D, 2000). Participants in the Virtual Reality group were seated on a platform containing two 100-watt subwoofers powered by an R3100 AM/FM stereo receiver from KLH Audio Systems this provided tactile stimuli that coincides with the Virtual Reality airplane program, version #2, being used in this study. The virtual reality airplane software was created by Virtually Better, Inc.” (Atlanta, GA; www.virtuallybetter.com).

Participants were recorded using a Sony DVD Recorder RDR GX330, which is mounted to the wall. This system is equipped with a Delvcam color TFT LCD monitor TV to ensure proper focus and alignment. Additionally, an innocuous security ProVideo camera and microphone were placed strategically in the corner of the room and focused on the participant.

Participants in the airplane chair condition for either Virtual Reality or Imaginal exposure were asked to sit in a real airplane chair provided by Delta Airlines. This chair is equipped with a seat belt, cigarette ashtray slot, and non-functioning radio buttons. This chair was situated on the platform described above which is carpeted for both Virtual Reality and Imaginal exposure. Both exposure conditions were performed in the same room.

Procedure

Students completed an online screening measure during a mass testing session as part of their requirement for certain undergraduate level psychology courses, or completed the screening measure in class and contacted to set up an appointment for extra credit. Those who scored a 56 or higher on the fear of flying measure and responded that they were afraid of flying were contacted via email, phone, or through an online system, and asked to participate for either two credits toward their research requirement, extra credit in their psychology course, or ten dollars. During the initial contact, participants were asked if they had ever flown. Those who had never flown were excluded from the study. Once an appointment was arranged, participants were asked to meet at the Hofstra Psychological Evaluation and Research Counseling Clinic (PERCC).

They were met by the experimenter or research assistant in the waiting room and escorted to the Virtual Reality Laboratory room. Participants were randomly assigned to sit in either an airplane or regular chair. Next, the informed consent was briefly discussed, and the participants were asked to read the information and sign the form. Please see Appendix E.

Next, the exposure session began. The DVR recording system was turned on to video record the session. All therapy sessions were recorded with a nonintrusive audiovisual recording system, stored on DVD+RW's. The DVD's were stored in a locked metal container within the laboratory room. Participants either took an imaginal or VR trip to Boston that lasted approximately 20 minutes. Those in the imaginal condition were asked to close their eyes. Participants in the virtual reality condition were assisted in putting on the HMD and positioning themselves comfortably in the

environment. Exposure conditions paralleled each other, and were performed using an identical script written by Grove (2009). Please see Appendix F.

Participants were evaluated and monitored for simulator sickness throughout the exposure protocol. After the exposure protocol, participants were instructed to complete the ITC-SOPI questionnaire. Participants were then debriefed. The debriefing included an explanation of what to expect concerning the participants' anxiety immediately following the study, as well as in the upcoming weeks. Additionally, participants received information regarding future treatment options. All participants' anxiety was assessed through self-report before leaving the study to ensure it had returned to a typical level. A follow-up study would be interesting to determine longer term effects of this research protocol.

Experimenters

The primary investigator and a research assistant conducted the exposure therapy sessions. The researcher is an advanced doctoral student with three years of training with the virtual reality software and exposure techniques, both imaginal and virtual reality. She has conducted over 50 clinical hours of exposure therapy and participated in an experimental protocol that included implementing 20 sessions of exposure. The research assistant was a first year doctoral student trained in both imaginal and virtual reality exposure for the purpose of this study. She previously obtained a master's degree in psychology and worked with anxiety patients during her master's training. The researchers were supervised by an expert therapist who has been actively practicing and researching exposure for the past 30 years.

CHAPTER III

Results

Demographics of Sample

The sample was comprised of 60 participants, with 15 participants assigned to each of four groups (Virtual Reality / Airplane Chair, Virtual Reality / Regular Chair, Imaginal / Airplane Chair, and Imaginal / Regular Chair). Table 1 shows the breakdown of the sample by gender and age. Significant differences were not found between the groups on gender, $\chi^2(3) = 1.12$ ($p = .77$). To determine whether the groups differed on age, a 2x2 between subjects ANOVA was performed. Significant differences were not identified by age for the main effects of type of chair $F(1, 56) = 2.96$ ($p = .09$), type of exposure, $F(1, 56) = 0.12$ ($p = .73$), or the interaction between type of chair and type of exposure, $F(1, 56) = .43$ ($p = .51$).

Frequencies of the sample were calculated for type of compensation. Twenty-eight participants received research credit (46.7%), 22 received extra credit in a undergraduate course (36.7%), and 10 received ten dollars compensation (16.7%).

Cronbach's Coefficient Alphas (α) for Measures

Table 2 shows the results for Cronbach's Coefficient Alphas (α) for all measures analyzed in the study. Using the standard that an alpha of .70 represents good reliability (Cronbach, 1951), for the Independent Television Commission Sense of Presence Inventory (ITC-SOPI) subscales, Spatial Presence demonstrated excellent reliability ($\alpha = .85$), while Engagement ($\alpha = .62$), Ecological Validity/Naturalness ($\alpha = .66$), and Negative Effects ($\alpha = .66$) demonstrated moderate reliability. Thus, results involving these subscales may be less reliable and interpreted with caution. The Flight Anxiety

Situations Questionnaire demonstrated excellent reliability ($\alpha = .95$).

Table 1

<i>Demographics of Sample</i>		
Group	Gender ^a (Frequencies)	Age ^a <i>M (SD)</i>
Virtual Reality / Airplane Chair	Male (3)	21.80
	Female (12)	(6.52)
Virtual Reality / Regular Chair	Male (3)	19.27
	Female (12)	(1.33)
Imaginal / Airplane Chair	Male (5)	20.73
	Female (10)	(4.61)
Imaginal / Regular Chair	Male (3)	19.60
	Female (12)	(1.64)
Sample as a Whole	Male (14)	20.35
	Female (46)	(4.14)

a = No significant differences between the groups on these variable

Table 2
Sample Cronbach's Coefficient Alphas (α) for the ITC-SOPI^a and FAS^b

Measure	Cronbach's Coefficient Alpha (α)
ITC SOPI ^a	
Spatial Presence	.85
Engagement	.62
Validity/Naturalness	.66
Negative Effects	.66
FAS ^b	.95

a = Independent Television Commission Sense of Presence Inventory

b = Flight Anxiety Situations Questionnaire

Sample Pre-test Data on Fear of Flying and Flying Behavior

Table 3 shows FAS means and standard deviations for the extent of participants' fear of flying by condition. No significant differences were identified between groups on fear of flying, as measured by the FAS, for type of chair, $F(1, 56) = .87$ ($p = .36$), type of exposure, $F(1, 56) = 3.22$ ($p = .08$), or the interaction between type of chair and type of exposure, $F(1, 56) = .09$ ($p = .77$). The mean FAS total for the whole sample was 94.37, with a minimum score of 58.00 and a maximum score of 150.00.

Significant differences were not found between the groups on the extent to which they reported avoiding flying, $\chi^2(12) = 19.70$ ($p = .07$). It is noteworthy that almost half of the sample (47%) reported that they never avoided flying. Of the remaining sample, 25% reported that they occasionally avoided flying, 12% reported that they sometimes avoided flying, eight percent reported that they often avoided flying, and eight percent reported that they always avoided flying on an airplane. As in the DSM-IV-TR diagnosis, the participants are not all avoiding flying, but according to their high scores on the FAS, they are enduring flights with intense distress and anxiety.

The means were not significantly different between groups on the amount of time since they reported having last flown on an airplane, $\chi^2(9) = 11.69$ ($p = .23$). Almost half of the sample (45%) reported that they had last flown less than six months ago, 18% reported that they had last flown between six and 12 months ago, 27% reported that they had last flown between one and three years ago, and 10% reported that they had last flown over three years ago.

Table 3
Sample Pre-test Data on Extent of Fear of Flying & Flying Behavior

Group	FAS ^a M (SD)	Avoidance of Aircraft ^b (Frequencies ^c)	Time Since Last Flight ^b (Frequencies ^c)	Age of Onset M (SD)	# of flights since fear of flying began M (SD)
Virtual Reality / Airplane Chair	101.33 (27.57)	8 = Never 2 = Occasionally 3 = Sometimes 0 = Often 2 = Always	3 = <6 mths ago 4 = 6-12 mths ago 5 = 1-3 yrs ago 3 = >3 yrs ago	11.93 (7.37)	12.03 (12.59)
Virtual Reality / Regular Chair	97.67 (20.00)	4 = Never 7 = Occasionally 2 = Sometimes 0 = Often 2 = Always	5 = <6 mths ago 3 = 6-12 mths ago 6 = 1-3 yrs ago 1 = >3 yrs ago	12.07 (3.17)	8.67 (12.94)
Imaginal / Airplane Chair	92.73 (21.33)	10 = Never 2 = Occasionally 1 = Sometimes 1 = Often 1 = Always	10 = <6 mths ago 2 = 6-12 mths ago 3 = 1-3 yrs ago 0 = >3 yrs ago	10.07 (2.22)	13.40 (10.28)
Imaginal / Regular Chair	85.73 (18.68)	6 = Never 4 = Occasionally 1 = Sometimes 4 = Often 0 = Always	9 = <6 mths ago 2 = 6-12 mths ago 2 = 1-3 yrs ago 2 = >3 yrs ago	10.53 (5.26)	15.47 (24.69)
Sample as a Whole	94.37 (22.38)	28 = Never 15 = Occasionally 7 = Sometimes 5 = Often 5 = Always	27 = <6 mths ago 11 = 6-12 mths ago 16 = 1-3 yrs ago 6 = >3 yrs ago	11.15 (4.88)	12.39 (15.91)

a = Flight Anxiety Situations Questionnaire: Quantification of Fear in Various Flight Situations

b = No significant differences between the groups on this variable

c = number of subjects who avoid flying

Significant differences were not found between groups on age of onset of fear of flying for type of chair, $F(1, 56) = .06$ ($p = .81$), type of exposure, $F(1, 56) = 1.79$ ($p = .19$) and interaction between type of chair and type of exposure, $F(1, 56) = .02$ ($p = .90$). Groups did not differ significantly on number of flights taken since fear of flying began for type of chair, $F(1, 56) = .02$ ($p = .88$), type of exposure, $F(1, 56) = .96$ ($p = .33$) nor was there a significant interaction between type of chair and type of exposure, $F(1, 56) = .43$ ($p = .52$). Across conditions, the sample was similar on the age of onset of fear of flying and number of flights taken since fear began, as obtained through self-report.

Means were not significantly different between groups regarding whether participants always feel frightened when confronted with flying, $\chi^2(3) = 2.33$ ($p = .51$). Over half of the sample (61%) reported always being frightened when confronted with flying, while 39% reported not always feeling frightened when confronted with flying. No significant differences were found between the groups regarding whether participants' believe that they are more afraid of flying than one should be or that makes sense, $\chi^2(3) = 1.84$ ($p = .61$). Over half of the sample (63%) reported being "more afraid of flying than they should be or makes sense", while 37% reported that they are "not more afraid of flying than they should be or that makes sense". Lastly, significant differences were not found between groups on whether participants go out of their way avoiding flying, $\chi^2(3) = 2.26$ ($p = .52$). Over half of the sample (75%) reported that they did not avoid flying, while only 25% reported that they did.

Overall, the groups were equal on most characteristics of fear of flying. However, it would be prudent to use the FAS as a covariate in subsequent analyses, due to non-significant but moderate variation between groups.

Inter-rater reliability

Inter-rater reliability was analyzed for the three raters who scored items on the behavior observation coding system. The percentage agreement between raters on observed breathing was 84.85%, with a Kappa of .77. The percentage agreement between raters on verbalized anxiety was 90.91%, with a Kappa of .85, which is also considered good reliability. The percentage agreement for observed fidgeting was 60.6%, with a Kappa of .50. The percentage agreement between raters on crying and rocking were 100%, as no raters observed crying or rocking behavior. Therefore, these last two behaviors will not be further analyzed.

Hypotheses

Hypotheses 1 and 2, which refer to anxiety as measured by average SUDs and observed anxiety by two raters, were analyzed using two-way between subjects analyses of covariance (ANCOVA) with anxiety (average SUDs and observed behavioral anxiety for breathing, fidgeting, and verbalized anxiety) as the dependent variables, type of exposure and type of chair as the independent variables, and level of fear of flying (as measured by the total score of the FAS) as the covariate.

Hypothesis 1 - A main effect of type of exposure is predicted. 1a - Higher SUDs reports are expected in the VR exposure condition in comparison to the imaginal exposure condition. 1b - A greater number of objective behavioral observations are expected in the VR condition in comparison to the imaginal condition.

Imaginal exposure led to mean SUDs level of 54.64, which was significantly greater than the mean SUDs level of 40.95 for virtual reality ($F(1, 55) = 7.47$ ($p = .01$)), when controlling for pre-study fear of flying. Therefore, Hypothesis 1a, which stated that average SUDs would be significantly higher in the virtual reality condition as compared to the imaginal exposure condition, was not supported. Original and adjusted means and standard deviations are provided by condition for average SUDs in Table 4.

Separate analyses were conducted for each type of behavioral observation. Imaginal exposure led to a total observed fidgeting of 4.88, while virtual reality led to total observed fidgeting of 1.92, when controlling for pre-study fear of flying. Significant difference was identified between groups on total observed fidgeting for type of exposure, $F(1, 55) = 19.98$ ($p < .01$). Original and adjusted means and standard deviations are provided by condition for observed fidgeting in Table 5.

No significant differences were found between groups on total observed heavy breathing for type of exposure, $F(1, 55) = .49$ ($p = .49$), nor were they found between groups on total observed verbalized anxiety statements for type of exposure, $F(1, 55) = .36$ ($p = .55$). Therefore, Hypothesis 1b, which stated that a higher number of behavioral anxiety observations would be obtained for the virtual reality condition versus the imaginal condition, was not supported for all observed anxiety characteristics. Original and adjusted means and standard deviations are provided by condition for observed heavy breathing and verbalized anxiety in Tables 6 and 7, respectively.

Table 4

Comparison of Original and Adjusted Means & Standard Deviations for Average SUDs

Group	Original Average SUDs <i>M (SD)</i>	Adjusted Average SUDs <i>M (SD)</i>
Virtual Reality / Airplane Chair	40.51 (23.45)	37.73 (4.94)
Virtual Reality / Regular Chair	45.49 (23.04)	44.18 (4.89)
Imaginal / Airplane Chair	53.63 (17.30)	54.29 (4.88)
Imaginal / Regular Chair	51.56 (18.22)	55.00 (4.97)

a = Means and standard deviations adjusted for total score of FAS
n = 60; 15 participants in each group

Table 5

Comparison of Original and Adjusted Means & Standard Deviations for Observed Fidgeting

Group	Original Observed Fidgeting <i>M (SD)</i>	Adjusted Observed Fidgeting <i>M (SD)</i>
Virtual Reality / Airplane Chair	2.00 (2.14)	1.75 (0.65)
Virtual Reality / Regular Chair	2.20 (2.34)	2.08 (0.66)
Imaginal / Airplane Chair	4.93 (2.91)	4.99 (0.65)
Imaginal / Regular Chair	4.47 (2.92)	4.78 (0.66)

a = Means and standard deviations adjusted for total score of FAS
n = 60; 15 participants in each group

Table 6

Comparison of Original and Adjusted Means & Standard Deviations for Observed Heavy Breathing

Group	Original Observed Heavy Breathing <i>M (SD)</i>	Adjusted Observed Heavy Breathing <i>M (SD)</i>
Virtual Reality / Airplane Chair	.67 (2.06)	.61 (0.30)
Virtual Reality / Regular Chair	.60 (0.83)	.61 (0.30)
Imaginal / Airplane Chair	.00 (0.00)	-.03 (0.30)
Imaginal / Regular Chair	.33 (0.62)	.40 (0.30)

a = Means and standard deviations adjusted for total score of FAS
 n = 60; 15 participants in each group

Table 7

Comparison of Original and Adjusted Means & Standard Deviations for verbalized anxiety

Group	Original Verbalized Anxiety <i>M (SD)</i>	Adjusted Verbalized Anxiety <i>M (SD)</i>
Virtual Reality / Airplane Chair	0.20 (0.56)	0.19 (0.13)
Virtual Reality / Regular Chair	0.00 (0.00)	0.00 (0.13)
Imaginal / Airplane Chair	0.20 (0.56)	0.19 (0.13)
Imaginal / Regular Chair	0.20 (0.56)	0.22 (0.13)

a = Means and standard deviations adjusted for total score of FAS
n = 60; 15 participants in each group

Hypothesis 2 - A main effect of type of chair is predicted. 2a - Higher SUDs reports are expected in the airplane chair condition in comparison to the regular chair condition. 2b - A greater number of objective behavioral observations are expected in the airplane chair condition in comparison to the regular chair condition.

Significant differences were not found between groups on mean SUDs by type of chair, $F(1, 55) = .53$ ($p = .47$). Therefore, Hypothesis 2a was not supported. Please refer back to Table 4 for original and adjusted means and standard deviations by condition for average SUDs.

Separate analyses were conducted for each type of behavioral observation. No significant differences were identified between groups on total observed fidgeting for type of chair, $F(1, 55) = .01$ ($p = .93$), total observed heavy breathing by type of chair, $F(1, 55) = 2.02$ ($p = .16$) and total observed verbalized anxiety statements by type of chair, $F(1, 55) = .77$ ($p = .38$). Hypothesis 2b was not supported for any measurement total observed anxiety. Refer back to Tables 5, 6, and 7 for original and adjusted means and standard deviations by condition for total fidgeting, heavy breathing, and verbalized anxiety, respectively.

Interactions between factors

Significant differences were not found between groups for the interactions between type of chair and type of exposure for any dependent variables.

No significant differences were found between groups on mean SUDs for the interaction between type of chair and type of exposure, $F(1, 55) = .35$ ($p = .56$). Additionally, the means were not significantly different between groups for total observed breathing for the interaction between type of chair and type of exposure, $F(1,$

55) = .52 ($p = .48$), total observed verbalized anxiety statements for the interaction between type of chair and type of exposure, $F(1, 55) = .68$ ($p = .42$), or for total observed fidgeting for the interaction between type of chair and type of exposure, $F(1, 55) = .18$ ($p = .67$).

Hypothesis 3 - Anxiety and presence will be significantly correlated.

Table 8 shows correlations between ITC SOPI sense of presence subscales, average SUDs, total observed breathing, total observed fidgeting, and total verbalized anxiety.

Three of four subscales of the ITC SOPI were highly correlated with one another. Spatial Presence, Engagement, and Ecological/Naturalness were all positively correlated with one another at $p < .01$. Specifically, Spatial Presence and Engagement were correlated at a $r = .60$, Spatial Presence and Ecological/Naturalness at a $r = .63$, and Engagement and Ecological/naturalness at a $r = .53$. Negative Effects was not significantly correlated with any other subscale on the ITC SOPI. Refer to Table 8.

Correlations between average SUD levels and the presence subscales were as follows: mean SUDs was positively correlated with Spatial Presence ($r = .41$), Engagement ($r = .35$), and Ecological/Naturalness ($r = .43$) at $p < .01$, while mean SUDs score was not significantly correlated with Negative Effects ($r = .14$). Refer to Table 8.

There was a significant correlation between Ecological/Naturalness (a subscale of the presence measure) and observed fidgeting (a behavioral measure), $r = .27$. Observed heavy breathing (another behavioral measure) was not significantly correlated with any self reported presence measure (Spatial Presence, Engagement, Ecological/Naturalness

Table 8

Correlations between Presence and Anxiety

Group	Engagement <i>r</i> (<i>p</i>)	Ecological/ Naturalness <i>r</i> (<i>p</i>)	Negative Effects <i>r</i> (<i>p</i>)	Mean SUDS <i>r</i> (<i>p</i>)	Breathing <i>r</i> (<i>p</i>)	Fidgeting <i>r</i> (<i>p</i>)	Verbalized Anxiety <i>r</i> (<i>p</i>)
ITC SOPI ^a							
Spatial Presence	.60** ($<.01$)	.63** ($<.01$)	.15 (.27)	.41** ($<.01$)	.19 (.16)	.24 (.07)	.38** ($<.01$)
Engagement		.53** ($<.01$)	.17 (.19)	.35** (.01)	-.00 (.99)	-.02 (.90)	.10 (.45)
Ecological/Naturalness			-.06 (.68)	.43** ($<.01$)	-.00 (.98)	.27* (.04)	.12 (.38)
Negative Effects				.14 (.28)	.12 (.36)	-.13 (.31)	.18 (.18)
Average SUDS ^b					.04 (.78)	.24 (.07)	.28* (.03)
Breathing ^c						.18 (.18)	.53** ($<.01$)
Fidgeting ^d							-.01 (.95)
Verbalized ^e							

a = Independent Television Commission Sense of Presence Inventory, b = Subjective Units of Distress, c = Total Observed Breathing, d = Total Observed Fidgeting, e = Total verbalized anxiety
 *Correlation is significant at the .05 level (2-tailed), **Correlation is significant at the .01 level (2-tailed)
 n=59

and Negative Effects), self-reported anxiety (average SUDs), or observed behavior (fidgeting). In contrast, observed verbalized anxiety was significantly correlated with spatial presence ($r=.38$), average SUDs ($r=.28$), and observed heavy breathing ($r=.53$). Refer to Table 8.

Additional Analyses

Post-hoc analyses of sense of presence measures were employed using two-way between subjects' analyses of variance with presence (Spatial Presence, Engagement, Ecological/Naturalness, and Negative Effects) as the dependent variables, and type of exposure and type of chair as the independent variables. Since four ANOVAs were conducted post-hoc, a Bonferroni adjustment was employed to control for family-wise Type I error. Therefore, the alpha level was set at .0125 (.05 divided by 4 analyses).

Significant differences were not found between groups on Spatial Presence for type of exposure, $F(1, 56) < .00$ ($p = .99$), type of chair, $F(1, 56) = 1.01$ ($p = .32$), or the interaction between type of chair and type of exposure, $F(1, 56) = .15$ ($p = .70$).

Additionally, significant differences were not found between groups on Ecological/Naturalness for type of exposure, $F(1, 56) = 3.45$ ($p = .07$), type of chair, $F(1, 56) = 1.09$ ($p = .30$) or the interaction between type of chair and type of exposure, $F(1, 56) = .17$ ($p = .69$).

Significant differences were also not identified between groups on Engagement for type of exposure, $F(1, 55) = 1.04$ ($p = .31$), type of chair, $F(1, 55) = 1.89$ ($p = .17$) or the interaction between type of chair and type of exposure, $F(1, 55) = 6.49$ ($p = .014$). Similarly, significant differences were not found between groups on Negative Effects for type of exposure, $F(1, 56) = 3.62$ ($p = .06$), type of chair, $F(1, 56) = .004$ ($p = .95$) or the

interaction between type of chair and type of exposure, $F(1, 56) = 6.65$ ($p = .013$).

However, it should be noted that the interaction between type of chair and type of exposure for Engagement and Negative Effects are approaching significance. Means and standard deviations for the four subscales of presence are displayed in Table 9.

Table 9
Sample Data on Sense of Presence

Group	ITC SOPI ^{ab} Spatial Presence <i>M (SD)</i>	ITC SOPI Engagement <i>M (SD)</i>	ITC SOPI Ecological Validity / Naturalness <i>M (SD)</i>	ITC SOPI Negative Effects <i>M (SD)</i>
Virtual Reality / Airplane Chair	3.12 (0.49)	2.96 (0.42)	3.25 (0.57)	2.80 (0.61)
Virtual Reality / Regular Chair	3.03 (0.64)	3.08 (0.39)	3.47 (0.68)	3.28 (.69)
Imaginal / Airplane Chair	3.17 (0.55)	3.32 (0.41)	3.59 (0.47)	2.92 (0.80)
Imaginal / Regular Chair	2.97 (0.49)	2.92 (0.39)	3.68 (0.53)	2.47 (0.69)
Sample as a Whole	3.07 (0.54)	3.07 (0.41)	3.50 (0.58)	2.87 (0.74)

a = Independent Television Commission-Sense of Presence Inventory

b = Scale of all subscales of ITC-SOPI is 1-5 with high numbers representing higher sense of presence than low numbers with the exception of Negative Effects, where low numbers represent higher sense of presence than high numbers

CHAPTER IV

Discussion

The purpose of this study was to compare the effect of virtual reality exposure versus imaginal exposure on flight anxiety. Additionally, the use of an airplane chair versus a regular chair during an exposure procedure was explored. The relationship between anxiety and presence was also investigated.

As described earlier in the literature review, this group meets criteria for flying with dread, due to their high scores on a fear of flying inventory. The group obtained a mean score of 94.37 on the FAS, for which participants reported moderate to overwhelming anxiety for the majority of items on the questionnaire. Thus, even though their anxiety appears to meet some criteria for clinical significance, many participants are still able to fly (over half of the participants reported to not avoid flying), which may make them more likely to participate in an exposure exercise. Nevertheless, they still experience flying with marked distress and qualify as Aviophobics according to the research conducted by Nousi et al. (2008).

Furthermore, over half of the sample (61%) reported always being frightened when confronted with flying, while 39% reported not always feeling frightened when confronted with flying. Although the remaining 39% reported to not always be frightened when confronted with flying, they characterize themselves as afraid of flying. Additionally, these participants were not given the opportunity to clarify their answer to specify the percentage of time they are frightened when confronted with flying.

Further questioning revealed that more than half of the participants reported that their fear was unsubstantiated by evidence, meaning that they knew their fear was

unreasonable. However, in conversation with the examiner, several participants shared the ways in which having a fear of flying impacts their lives. For example, although participants are not avoiding flying entirely, it was reported that the anxiety impacts their ability to look forward to a vacation, sleep well on the nights leading up to the flight, and book trips in advance. It was also reported the anxiety can be embarrassing while flying with friends and family. Other participants noted that they fly only when necessary, and take other means of transportation if possible, thus missing out on recreational flying. Participants also stated that they refrain from travel sports, going on academic excursions that involve flying, and choose a school close to home to avoid the commute home by plane. Thus, despite participants' reports of a lack of evidence to support their fear of flying, participants avoid flying or fly with distress.

Hypothesis 1

It was hypothesized that a VR exposure procedure would lead to a greater average SUDs and observed behavioral anxiety. This hypothesis was not supported by the findings. In fact, the opposite was found for average SUDs and observed fidgeting; participants in the imaginal exposure procedure reported a greater level of average SUDs and observed fidgeting.

The findings of this study may have several implications for exposure therapy. Despite research inferring that individuals may have difficulty forming mental images (e.g. Ayres & Hopf, 1987; Botella et al., 2004; Cuthbert et al., 2003), and may be aided by a visual representation of the phobic scenario, it appears that participants in the imaginal exposure condition were able to construct visual images. Furthermore, the

mental images produced by these participants apparently caused a greater level of anxiety than did VR presented scenarios. A possible explanation for this finding could be that individuals are able to personalize the images in imaginal exposure, as opposed to the general images presented in the VR exposure. This means people are more likely to incorporate their own phobic images in imaginal exposure. In VR, the image is standardized, and does not elicit the same anxiety response as a personalized image. The discrepancy between an individual's memories and beliefs about flying situations and the VR image presented could have resulted in a less realistic display.

Additionally, individuals may have personalized their experience while in imaginal exposure during periods of silence by the researchers. In contrast, individuals in the VR exposure condition may have been more stimulated by their VR surroundings and unable to personalize their experience or concentrate on their cognitions.

It is important to note that many actions were taken to control for extraneous variables that could potentially impact results, and threaten the validity of the study. Thus, the only distinction between groups in this study was the type of exposure implemented. The scripts used were identical for both the VR and imaginal exposure procedures. Since both mean SUDs and observed fidgeting were found to be higher in the imaginal groups, it would follow that the equipment used in VR did not cause interference in observing the anxiety behaviors. The discussion focuses on observed behaviors that participants displayed. Behaviors such as rocking and crying were not observed in any participants.

Moreover, the same room was used in all exposure sessions. This was done to ensure that the participants' experiences in the room were identical. The VR room differs

from a typical treatment room, in that it has multiple monitors, a platform, and several exposed wires. It can be concluded that the VR equipment did not serve as a distraction for the VR group, since the same room was used for the imaginal condition. Furthermore, there were no significant differences between groups on characteristics of fear of flying. For example, the length of times since last flight, the number of flights taken since fear began, and age of onset of fear.

For this particular study, VR appears to be less effective in eliciting anxiety than imaginal exposure. Caution must be taken when generalizing these results to the treatment of Aviophobia due to many variables. First, one twenty minute exposure session was conducted with undergraduate students who were not seeking treatment. A typical Aviophobia treatment program would include longer exposure sessions over the course of several sessions. Additionally, individuals in treatment are often motivated for change due to the impairment in functioning caused by the phobia. Further replication and research needs to be conducted to investigate these findings. There is currently a dearth of literature comparing VRET with imaginal exposure; especially for studies using anxiety as the dependent variable. Thus, treatment studies comparing these two exposure modalities using anxiety as the dependent variable could expand the research.

Hypothesis 2

It was hypothesized that the airplane chair would lead to a greater average SUDs and observed behavioral anxiety. This hypothesis was not supported by the findings. Therefore, it should be noted that the addition of this cue did not add to the procedure's ability to increase anxiety. Many participants in the airplane-chair condition noted this cue while entering the experimental room. Therefore, the presence of an airplane chair

may have increased the face validity of the exposure experience. No data were kept on this observation, but future studies may benefit from keeping track of participants' awareness of the presence of a cue. It would also be interesting to draw attention to the additional detail at the beginning of the exposure session. Consequently, all participants would be cognizant that they were seated in a real airplane chair and make note of the additional sensory experience.

Limited research has been conducted on the addition of sensory cues to an exposure session. However, in one study, Grove (2009) found no difference in reported sense of presence between participants sitting in an airplane chair vs. those sitting in a regular chair. Post-hoc analyses examined presence as a dependent variable and also found no significant differences between the type of chair, type of exposure, or the interaction between type of chair and type of exposure (Grove, 2009). Research is currently being conducted by DiScalfani (personal communication, April 2010) examining the addition of olfactory cues during an exposure session.

Hypothesis 3

It was hypothesized that presence and anxiety would be positively correlated. Average SUDs were found to positively correlate with all presence subscales, except Negative Effects (physical discomfort). This means that as average SUDs increased, Spatial Presence, Engagement, and Ecological Validity/Naturalness all increased and supports the hypothesis that anxiety and presence are correlated. Feeling physically present in an environment, involved in the story, and that the story was real, were all related to participants self-reported anxiety. This finding is in contrast to a study by Regenbrecht et al. (1998), in which a non-significant relationship was found between

presence and anxiety. However, findings are consistent with the relationship between presence and anxiety found in Price and Anderson's research (2003).

It should be noted that Negative Effects were not correlated with average SUDs. This means physiological pain and reported anxiety were not found to be related. Specifically, feeling dizzy, nauseous, or experiencing eye strain were not related to an individual's anxiety during the exposure session and did not appear to differ across conditions, which means that individuals in the imaginal condition also did not experience a relationship between negative effects and anxiety.

Further exploration of the relationship between presence and anxiety was conducted. It is interesting to note that all behavioral observations of anxiety and self-reported anxiety (average SUDs) were not necessarily related. For example, average SUDs was only significantly correlated with total verbalized anxiety. These two variables were both obtained via participants' self-report. Observed fidgeting and observed heavy breathing were both not significantly correlated with self-reported anxiety. This may indicate that self-report may be different from observed anxiety behaviors.

These findings are similar to findings by Morell (2010), indicating that fearful flyers' subjective level of fear did not correlate with their physiological response to fear stimuli. Morell (2010) explained her findings using the research on desynchronous response systems conducted by Craske, Sanderson, and Barlow (1987). Desynchronous responses occur when the level of anxiety of the cognitive, behavioral, and physiological elements of phobia do not match in intensity. The cognitive, behavioral, and physiological components interact in complex and varied ways. This suggests that all

three components are not equal in their intensity level. This research may account for the discrepancy between cognitive (self-report) and behavioral (observed) anxiety behaviors found in this study.

Hoffman (2009) conducted a single subject treatment study comparing VRET and imaginal exposure therapy. He also found a discrepancy between cognition, behavior, and physiological components. All eight of his subjects flew within two months posttreatment. However, during treatment, subjective report, physiological measures and observed behavior did not uniformly indicate reduced anxiety toward flying.

The lack of correlation between observed and self-reported anxiety behaviors could also suggest that the observed behaviors did not result from anxiety. For example, individuals may have fidgeted from boredom or discomfort. Additionally, given that the imaginal exposure produced higher average SUDs, it is likely that the fidgeting did not result from boredom, but rather from discomfort. Furthermore, there was one positive relationship between an observed behavior and verbalized behavior. Specifically, observed heavy breathing and verbalized anxiety were positively related. This means that as individuals were observed to be breathing heavily, their number of verbalized anxiety statements also increased.

Total verbalized anxiety was significantly correlated to spatial presence. This means that the sense of physically feeling present in an environment was related to the verbal expression of anxiety. When an individual feels engulfed in an environment physically, he/she is more likely to verbalize his/her anxiety. This may indicate that individuals are more in touch with their physical experiences, than their internal experiences such as emotions.

Total observed fidgeting was significantly correlated with ecological validity/naturalness. This indicates that the sense of feeling involved in the environment was related to the observed fidgeting, though it does not explain whether or not the fidgeting was a result of anxiety or of another aspect of being present in the environment. Perhaps the more active display of anxiety was due to the perceived involvement with the environment. It can be inferred that the more mentally involved one is with the anxiety-provoking scenario, the more physical agitation one displays. Due to the various theories of presence and multiple methods of assessing anxiety, this specific relationship has not been found in the literature.

It is important to note that presence is a difficult concept to discuss due to its various theories and measures. Therefore, I have referred to the definitions of the four subscales used often throughout the writing. However, it is difficult to relate these findings to previous studies that used different self-report measures.

According to Schuemie, Van Der Straaten, Krijn, and Van Der Mast (2001), there are several theories of presence, and these distinctions lead to different assessment measures. The first theory, presence as non-mediation, originates from the idea that an individual's perception fails to accurately acknowledge the role of technology in the experience. This results in the person feeling at "some level" as if technology was not part of the experience. This theory may account for the difference between participants' ratings of presence in the imaginal environment versus the VR environment.

Limitations

One potential limitation of this study is use of a standardized script. Though it was necessary to use a script to maintain internal validity, in clinical practice, scripts are

not used to conduct exposure sessions. This suggests that the script may not have been personally relevant for all participants. Furthermore, the results may not generalize to clinical treatment programs where treatment sessions are tailored to the individual.

Another limitation could be the use of the behavioral coding system that was originally created by Hoffman (2009). In this study, neither crying nor rocking was observed in any participants. Furthermore, the observation of heavy breathing was difficult to record due to the quality of the DVD, distance of the camera, and equipment used in VR. Therefore, more heavy breathing could have been exhibited than was caught by the raters. Additionally, fidgeting could be accounted for by other emotions besides anxiety. Therefore, another physiological or behavioral measure could have enhanced this study. However, in Morell (2010), the use of galvanic skin response (GSR) and heart rate (BPM) were not effective in discerning varying levels of anxiety in participants undergoing either general or specific virtual reality exposure procedures. Therefore, it is unclear what type of behavioral indices would be most effective in identifying anxiety during an exposure session.

Additionally, the lack of certain demographic information may be another limitation to this study. For instance, the ethnicity of participants could not be analyzed. Participants completed a self-report measure asking about the ethnicity with which they identify. However, due to the varied responses that identified race, ethnicity, nationality, and religion, this data could not be examined statistically. Furthermore, all students were undergraduates at a suburban private university. Additionally, participants were not questioned on their psychological treatment history, nor were they asked about their

current desire to obtain treatment for fear of flying. Therefore, it is unclear to what population the results can generalize.

Another limitation of the study may include the concern of being videotaped. Following this line of thought, participants may have been reserved in their self-reported anxiety to the fear of being judged by the examiner, or feeling discomfort in disclosing their true level of anxiety. However, this is unlikely because participants did report high levels of anxiety, as evidenced by their SUDs.

The use of self-report measures can also be seen as a limitation of the study. Self-report measures give participants an opportunity to fabricate responses. However, this is the reason behind the use of the behavioral coding system. Specifically, SUDs (a self-report) and observed fidgeting (a behavioral observation) were both higher in the imaginal exposure condition than in the virtual reality condition, suggesting that the use of self-report did not limit the study.

The entry criteria used in this study was a score of 56 or higher on the FAS and the self acknowledgment that the participant had a fear of flying. However, fear of flying has several components. For example, the FAS can be further broken down into three subscales: anticipatory, in-flight, and general anxiety (Van Gerwen, Spinhoven, Van Dyck, & Diekstra, 1999). Furthermore, clinical practice and research suggest that fear of flying may include several other components such as fear of heights, fear of closed spaces, panic disorder components and social phobia. Perhaps a more stringent entry criterion would have impacted the results of the study.

Another limitation of the study is that flying phobics are not all afraid of the same aspects of the flying experience. Thus, specific treatment programs involving virtual

reality exposure or imaginal exposure sessions based on anticipatory, in-flight, or generalized flight anxiety may be more effective than current general flying programs. Furthermore, differences in the cognitions and behaviors manifested by those presenting with varying subsets of flight anxiety may exist, which could inform treatment planning.

Furthermore, it is important to recognize that this is not a treatment study.

Therefore, this sample cannot be generalized to a treatment-seeking sample.

Additionally, these participants were given one 20-minute exposure session, which is not standard for treatment. Therefore, there is limited generalizability from this research to treatment programs. However, this is an important line of research that can be further investigated with a treatment seeking population. Specifically, replication of the finding that imaginal exposure was found to increase anxiety more than VRET under these specific conditions could result in important treatment implications.

Conclusions

This study adds to our knowledge regarding exposure therapy in several ways, despite the limitations. First, it used both self-report and behavioral indices of anxiety as dependent variables while comparing imaginal and virtual reality exposure. Second, it investigated the addition of cues in the virtual and imaginal environment. Third, it explored the relationship between presence and anxiety. Fourth, it contributes to the dearth of literature on the comparison of virtual reality and imaginal exposure for flying anxiety.

Imaginal exposure appeared to be better at eliciting higher levels of anxiety than VR. Perhaps VR should be more personalized for better results. This was recently

studied by Morell (2010), who found that participants reported a higher level of self-reported SUDs during a specific virtual flight geared toward their underlying fear of acrophobia, claustrophobia, or social phobia versus a general virtual flight. Participants in this study reported a medium level of fear in the general virtual flight, whereas the specific virtual flight elicited a high subjective level of fear.

Perhaps future studies should include a more stringent entry criterion for Aviophobia, or use a sample that is more homogeneous in their fear of flying. Future research could also investigate VR versus imaginal exposure for other types of phobias. The efficacy of additional cues in exposure sessions should also be further investigated. Due to the vast amount of literature on imagery and speculation regarding one's ability to mentally visualize stimuli, it would follow that selecting a sample based on imagery abilities would aid in the investigation of virtual reality versus imaginal exposure methodology.

Additionally, multiple exposure sessions could be used in future research to allow participants to habituate to the virtual reality equipment. It is possible that individuals were focused on the novelty of the headset, virtual program, and controller that immersion was difficult. Therefore, a research design utilizing several exposure sessions would eliminate this factor. Another avenue to investigate this hypothesis would be to allow individuals to verbalize their thoughts during the process (e.g. Davison, Vogel, & Coffman, 1997). This would enable investigators to monitor participants' thoughts, and determine if the thoughts are about the equipment or the flying-related scene being presented.

This study serves as a first step in exploring the relationship between different modalities of exposure treatment. Specifically, it investigated the addition of technology to a technique (exposure) that has been in use as an effective treatment method for decades. There is a new world of technology available to use in the context of therapy, and new technologies will only continue to grow. The challenge is to keep research current with the new technologies to ensure that therapy techniques are evidence-based.

REFERENCES

- Agras, S., Sylvester, D., & Oliveau, D. (1969). The epidemiology of common fears and phobia. *Comprehensive Psychiatry*, *10*, 151-156.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders, Fourth Edition, Text Revision*. Washington, DC: Author.
- Anthony, M. M., Brown, T. A., & Barlow, D. H. (1997). Heterogeneity among specific phobia types in DSM-IV. *Behavioral Research and Therapy*, *35*, 1089-1100.
- Ayres, J. & Hopf, T. S. (1987). Visualization, systematic desensitization, and rational emotive therapy: A comparative evaluation. *Communication Education*, *36*, 236-240.
- Baños, R. M., Botella, C., Garcia-Palacios, A., Villa, H., Perpiña, C., & Alcañiz, M. (2000). Presence and reality judgment in virtual environments: A unitary construct? *CyberPsychology and Behavior*, *3*, 327-335.
- Baum, M. (1970). Extinction of avoidance responding through response prevention (flooding). *Psychological Bulletin*. *74* 1970. 276-284.
- Botella, C., Osma, J., Garcia-Palacios, A., Quero, S., & Baños, R. M. (2004). Treatment of flying phobia using virtual reality: Data from a 1-year follow-up using a multiple baseline design. *Clinical Psychology and Psychotherapy*, *11*, 311-323.
- Bourdon, K. H., Boyd, J. H., Rae D. S., Burns, B. J., Thompson, J. W., Locke, B. Z. (1988). Gender Differences in Phobias: Results of the ECA Community Survey. *Journal of Anxiety Disorders*, *2*, 227-241.
- Bryant, R. A., Moulds, M. L., Guthrie, R. M., Dang, S. T., & Nixon, R. D. V. (2003). Imaginal exposure alone and imaginal exposure with cognitive restructuring in

- treatment of posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology, 71*, 706-712.
- Craske, M. G., Sanderson, W. C., & Barlow, D. H. (1987). How do desynchronous response systems relate to the treatment of agoraphobia: A follow-up evaluation. *Behaviour Research and Therapy, 25*, 2, 117-122.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.
- Cuthbert, B. N., Lang, P. J., Strauss, C., Drobles, D., Patrick, C. J., & Bradley, M. M. (2003). The psychophysiology of anxiety disorder: Fear memory imagery. *Psychophysiology, 40*, 407-422.
- Dadds, M. R., Bovbjerg, D. H., Redd, W. H., & Cutmore, T. R. H. (1997). Imagery in human classical conditioning. *Psychological Bulletin, 122*, 89-103.
- Dadds, M. R., Hawes, D., Schaefer, B., & Vaka, K. (2004). Individual differences in imagery and reports of aversions. *Memory, 12*, 462-466.
- Darwin, C. (1859). *On the origin of species by means of natural selection*. New York: D. Appleton. 1892, 207218
- Davey, G. C. L. (1995). Preparedness and phobias: Specific evolved associations or a generalized expectancy bias? *Behavioral and Brain Sciences, 18*, 2, 289-325.
- Davison, G. C., Vogel, R. S., & Coffman, S. G. (1997). Think-Aloud Approaches to Cognitive Assessment and the Articulated Thoughts in Simulated Situations Paradigm. *Journal of Consulting and Clinical Psychology, 65*, 6, 950-958.
- Eaton, W. W., Kramer, M., Anthony, J. C., Dryman, A., Shapiro, S., & Locke, B. Z. (1989). The incidence of specific DIS/DSM-III mental disorders: data from the

- NIMH Epidemiological Catchment Area Program. *Acta Psychiatrica Scandinavica*, 79, 2, 163-178.
- Ekeberg, O., Seeberg, I., & Ellersten, B. B. (1989). The prevalence of flight anxiety in Norway. *Nordic Journal of Psychiatry*, 43, 443-448.
- Garcia-Palacios, A., Hoffman, H., Kwong, See, S., Tsai, A., & Botella, C. (2001). Redefining therapeutic success with virtual reality exposure therapy. *Cyber Psychology and Behavior*, 4, 341-348.
- Goldfried, M. R., & Davison, G. C. (1976). *Clinical Behavior Therapy*. New York: Wiley- Interscience Publication.
- Grove, A. B. (2009). Virtual Reality vs. Imaginal Exposure Procedures on the Sense of Presence within Aviophobics. *Dissertation Abstracts International*.
- Hartung, C. M., & Widiger, T. A. (1998). Gender differences in the diagnosis of mental disorders: conclusions and controversies of the DSM-IV. *Psychological Bulletin*, 123, 3, 260-278.
- Hoffman (2009). Comparative Effects of Virtual Reality Exposure and Imaginal Exposure Therapy on reduction of Fear of Flying Symptoms. *Dissertation Abstracts International*.
- Howard, W. A., Murphy, S. M., & Clarke, J. C. (1983). The nature and treatment of fear of flying: A controlled investigation. *Behavior Therapy*, 14, 557-567.
- Jacobson, E. (1938). *Progressive relaxation*. Chicago, IL: University of Chicago Press.
- Jones, M. C. (1924). The elimination of children's fears. *Journal of Experimental Psychology*, 7, 383-390.

- Kahan, M., Tanzer, J., Darvin, D., & Borer, F. (2000). Virtual reality-assisted cognitive-behavioral treatment for fear of flying: Acute treatment and follow-up. *CyberPsychology and Behavior, 3*, 387-392.
- Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S., Wittchen, H. U., & Kendler, K. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the National Comorbidity Study. *Archives of General Psychiatry, 51*, 8-19.
- Kosslyn, S. M. (1987). Seeing and imagining in the cerebral hemispheres: A computational approach. *Psychological Review, 94*, 148-175.
- Krijn, M., Emmelkamp, P. M. G., Ólafsson, R. P., & Biemond, R. (2004). Virtual reality exposure therapy of anxiety disorders: A review. *Clinical Psychology Review, 24*, 259-281.
- Krijn, M., Emmelkamp, P. M. G., Ólafsson, R. P., Bouwman, Van Gerwen, L. J., Spinhoven, P., Schuemie, M. J., & Van Der Mast, C. A. P. G. (2007). Fear of flying treatment methods: Virtual reality exposure vs. cognitive behavioral therapy. *Aviation, Space, and Environmental Medicine, 78*, 121-128.
- Lang, P. J., Levin, D. N., Miller, G. A., & Kozak, M. J. (1983). Fear behavior, fear imagery, and the psychophysiology of emotion: The problem of affective response integration. *Journal of Abnormal Psychology, 92*, 276-306.
- Lenth, R. V. (2006). Java Applets for Power and Sample Size [Computer software]. Retrieved March 2, 2009 from <http://www.stat.uiowa.edu/~rlenth/Power>.
- Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *Presence, 10*, 282-297.

- Levis, D. J. (1980). Implementing the Technique of Implosive Therapy. In Goldfried, A. J. & Foa, E. B. (Eds). *Handbook of Behavioural Interventions*. (pp.92-149) New York: Wiley-Interscience-Publication.
- Levis, D. J. (1974). Implosive therapy: A critical analysis of Morganstern's review. *Psychological Bulletin*, *81*, 155-158.
- Magee, W. J., Eaton, W. W., Wittchen, H.-U., McGonagle, K. A., & Kessler, R. C. (1996). Agoraphobia, simple phobia, and social phobia in the national Comorbidity survey. *Archives of General Psychiatry*, *53*, 159-168.
- Maltby, N., Kirsch, I., Mayers, M., & Allen, G. J. (2002). Virtual reality exposure therapy for the treatment of fear of flying: A controlled investigation. *Journal of Consulting and Clinical Psychology*, *70*, 1112-1118.
- Marks, I. (1972). Perspectives on flooding. *Seminars in Psychiatry*, *4*, 129-138.
- Mineka, S., & Ohman, A. (2002). Learning and Unlearning Fears: Preparedness, Neutral Pathways, and Patients. *Society of Biological Psychiatry*. *52*, 927-937,
- Morell, E. A. (2010) Self-report and physiological measurement of Aviophobia: A Comparison of General and Specific Virtual Reality Exposure. *Dissertation Abstracts International*.
- Morganstern, K. P. (1973). Implosive therapy and flooding procedures: A critical review. *Psychological Bulletin*, *79*, 318-334.
- Mowrer, O. H., Lamoreaux, R. R. (1947). Fear as an intervening variable in avoidance conditioning. *Journal of Comparative Psychology*, *39*, 29-50.
- Mowrer, O. H. (1950). Implications of a two-factor learning theory. *Psychological Service Center Journal*, *2*, 116-120.

- Mühlberger, A., Herrmann, M. J., Wiedemann, G., Ellgring, H., & Pauli, P. (2001). Repeated exposure of flight phobics to flights in virtual reality. *Behaviour Research and Therapy*, 39, 1033-1050.
- Murray, C., Fox, J., & Pettifer, S. (2007). Absorption, dissociation, locus of control, and presence in virtual reality. *Computers in Human Behavior*, 23, 1347-1354.
- North, M. M., North, S. M., & Coble, J. R. (1997). Virtual reality therapy for fear of flying. *American Journal of Psychiatry*, 154, 130.
- Nousi, A., Van Gerwen, L., & Spinhoven, P. (2008). The Flight Anxiety Situations Questionnaire and the Flight Anxiety Modality Questionnaire: Norms for people with fear of flying. *Travel Medicine and Infectious Diseases*, 6, 305-310.
- Pavlov, I. P., (1928). The psychical secretion of the salivary glands (complex nervous phenomena in the work of the salivary glands). In lectures on conditioned reflexes: Twenty-five years of objective study of the higher nervous activity (behavior) of animals. New York: NY, Liverwright Publishing Corporation.
- Price, M., & Anderson, P. (2007). The role of presence in virtual reality exposure therapy. *Journal of Anxiety Disorders*, 21, 742-751.
- Rachman, S. (1977). The conditioning theory of fear acquisition: A critical examination. *Behavior Research and Therapy*, 15, 375-387.
- Rader, N., Bausano, M., & Richards, J. E., (1980). On the Nature of the Visual-Cliff Avoidance Response in Human Infants. *Child Development*, 51, 61-68.
- 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, 233-249.

- Rego, S. A., Muller, K. L., & Sanderson, W. C. (2009). Psychopathological Mechanisms Across Anxiety Disorders. In Salzinger, K., & Serper, M. (Eds.), *Behavioral Mechanisms and Psychopathology: Advancing the Explanation of Its Nature, Cause and Treatment* (1st ed., pp. 141-173). Washington, D.C.; American Psychological Association.
- Regenbrecht, H., Schubert, T. W., Friedmann, F. (2008). IGROUP Presence Questionnaire. Retrieved March 2, 2009 from <http://igroup.org/projects/ipq/>.
- Robillard, G., Bouchard, S., Fournier, T., & Renaud, P. (2003). Anxiety and presence during VR immersion: A comparative study of the reactions of phobic and non-phobic participants in therapeutic virtual environments derived from computer games. *CyberPsychology and Behavior*, 6, 467-476.
- Rothbaum, B. O., & Hodges, L. (1999). The use of Virtual Reality Exposure in the treatment of Anxiety Disorders. *Behavior Modification*, 23, 4, 507-525.
- Rothbaum, B. O., Hodges, L., Anderson, P. L., Price, L., & Smith, S., (2002). Twelve-Month Follow-Up of Virtual Reality and Standard Exposure Therapies for the Fear of Flying. *Journal of Counseling and Clinical Psychology*, 70, 2, 428-432.
- Rothbaum, B. O., Hodges, L., Smith, S., Lee, J. H., & Price, L. (2000). A controlled study of virtual reality exposure therapy for the fear of flying. *Journal of Consulting and Clinical Psychology*, 68, 1020-1026.
- Rothbaum, B. O., Hodges, L., Watson, B. A., Kessler, G., & Opdyke, D. (1996). Virtual reality exposure therapy in the treatment of fear of flying: A case report. *Behaviour Research and Therapy*, 34, 477-481.

- Sank, L. I. (1976). Counterconditioning for a flight phobia, *Social Work Journal*, 21, 318-319.
- Schubert, T., Friedmann, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence*, 10, 266-281.
- Schuemie, M. J., Van Der Straaten, P., Krijn, M., & Van Der Mast, C. (2001). Research on Presence in Virtual Reality: A Survey. *Cyber Psychology & Behavior*, 4, 183-201.
- Skinner, B. F. (1938). A system of behavior. In L.T. Benjamin (Ed.), *A History of Psychology*. (Pp. 452-457). New York: McGraw Hill.
- Skinner, B. F. (1948). "Superstition" in pigeon. *Journal of Experimental Psychology*, 38, 168-172.
- Skinner, B. F. (1966). What is the experimental analysis of behavior? *Journal of the experimental analysis of behavior*, 9, 3, 213-218. Reprinted 1973, A Warner Modular Publication, 1-6.
- Siegelman, M. B. & Baum, M. (1971). Extinction of well-established avoidance responses through response prevention (flooding). *Behavior Research and Therapy*, 9, 103-108.
- Slater, M., Usoh, M., & Steed, A. (1994). Depth of presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, 1, 130-144.
- Solomon, R. L., Kamin, L. J., & Wynne, L. C. (1953). Traumatic Avoidance Learning: The Outcomes of Several Extinction Procedures with Dogs, *The Journal of Abnormal and Social Psychology*, 48, 2, 291-302.

- Solomon, R. L., & Wynne, L. C. (1954). Traumatic avoidance learning: The principles of anxiety conservation and partial irreversibility. *Psychological Bulletin*, *61*, 353-385.
- Stampfl, T. G., & Levis, D. J. (1967). Essentials of implosive therapy: A learning-theory-based psychodynamic behavioral therapy. *Journal of Abnormal Psychology*, *72*, 496-503.
- Strilcic, M. A., Grove, A. B., Kairy, T. J., & Schare, M. L. *Anxiety severity and symptomatology expression within aviophobics*. (2008, November). Poster session to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Orlando, FL.
- Timm, S.A. (1977). Systematic Desensitization of a Phobia for Flying with the use of Suggestion. *Aviation, Space, and Environmental Medicine*, *48*, 4, 370-372.
- Usoh, M., Catena, E., Arman, S., & Slater, M. (2000). Using presence questionnaires in reality. *Presence*, *9*, 497-503.
- Van Gerwen, L. J. & Diekstra, R. F. (2000). Fear of flying treatment programs for passengers: *An international review*. *Aviation, Space, and Environmental Medicine*, *71*, 430-437.
- Van Gerwen, L.J., Spinhoven, P., Diekstra, R. F., & Van Dyck, R. (2002). Multicomponent Standardization Treatment Programs for Fear of Flying: Description and Effectiveness. *Cognitive and Behavioral practice*, *9*, 138-149.
- Van Gerwen, L. J., Spinhoven, P., Van Dyck, R., & Diekstra, R. F. W. (1999). Construction and psychometric characteristics of two self-report questionnaires for the assessment of fear of flying. *Psychological Assessment*, *11*, 146-158.

- VFX-3D. (2000). Rochester, NY, USA: Interactive Imaging Inc.
- Watson, J. B., Rayner, R. (1920). Conditioned Emotional Responses. *Journal of Experimental Psychology*, 3, 1-14.
- Wiederhold, B. K., Gevirtz, R. N., & Spira, J. L. (2001). Virtual Reality exposure therapy vs. imagery desensitization therapy in the treatment of flying phobia. *Towards Cyberpsychology: Mind, cognition, and society in the internet age*, 253-272, Amsterdam, Netherlands: IOS Press.
- Wiederhold, B. K., Gevirtz, R., & Wiederhold, M. D. (1998). Fear of flying: A case report using virtual reality therapy with physiological monitoring. *CyberPsychology and Behavior*, 1, 97-103.
- Wiederhold, B. K. & Wiederhold, M. D. (2003). Three-year follow-up for virtual reality exposure for fear of flying. *CyberPsychology and Behavior*, 6, 441-445.
- Wilhelm, F. H. & Roth, W. T. (1997). Clinical characteristics of flight phobias. *Journal of Anxiety Disorders*, 11, 241-261.
- Witmer, B. G. & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence*, 7, 225-240.
- Wolpe, J. (1969). Conditioning: the basis of modern psychotherapy. In L. D. Eron & R. Callahan (Eds.). *The relation of theory to Practice in psychotherapies*. Chicago: Aldine Publishing.
- Wolpe, J. (1969) *The practice of behavior therapy*. Pergamon Press, New York.
- Woythaler, K. A. (2007). Corrective information increases the efficacy of virtual reality exposure therapy for flight phobia. *Dissertation Abstracts International*.

#: _____

Appendix A
Flight Anxiety Situations Questionnaire (FAS):
Quantification of Fear in Various Flight Situations

Mark the number which corresponds to your level of anxiety in the situations mentioned. The numbers range from 1 to 5, where 1= no anxiety, 2=slight anxiety, 3= moderate anxiety, 4= considerable anxiety, and 5= overwhelming anxiety.

Item	1	2	3	4	5
1. You see an airplane.					
2. You hear the sounds of planes.					
3. You read a report about a flight.					
4. You bring someone to the airport.					
5. Friends tell you about a flight.					
6. You decide to take a plane.					
7. You buy a ticket.					
8. You are on the way to the airport.					
9. You enter the departure hall.					
10. You are going through customs for a passport check.					
11. You are waiting for the boarding call.					
12. You see planes taking off and landing.					
13. You hear the sound/noise of jet engines.					
14. You are walking in the direction of the gate.					
15. You are going through the security check.					
16. You are going through the gate.					
17. You enter the flight cabin.					
18. The doors are being closed.					
19. You are informed of the flight safety regulations by the cabin crew.					
20. The takeoff is announced.					
21. The engines give full power before takeoff.					
22. You are pushed back into your seat.					
23. You hear some noises during the flight.					
24. The airplane banks left or right.					
25. The wings of the plane are moving, shaking.					
26. The cockpit informs you of the actual altitude or flight level.					
27. The sound of the engines decreases.					
28. The plane starts the descent.					
29. Air turbulence is announced.					
30. You are shaken.					
31. The sound of the engine gets louder again.					
32. The landing is announced.					

Appendix B
Subjective Units of Distress Scale (SUDs; Wolpe, 1969).

Flight Situation during Session	SUDs Rating (0-100)
1) Arrival to airport	
2) Just before plane gets "called"	
3) In jet way	
4) As plane taxis on the runway	
5) During takeoff	
6) Mid-flight during good weather	
7) Mid-flight during bad weather	
8) During landing	

Questions about Flying Behavior

To what extent do you avoid flying on an airplane?	Never	Occasionally	Sometimes	Often	Always
When was the last time you took a plane flight?	Never	<6 months ago	6-12 months ago	1-3 years ago	>3 years ago
What was the age of onset of your fear of flying?					
How many flights have you taken since your fear began?					

Appendix C

Appendix C-1: Observed anxious behavior definitions & examples

Target Behavior	Definition	Examples	Non-Examples
Rocking	<ul style="list-style-type: none"> Upper body movement back and forth 	<ul style="list-style-type: none"> Rhythmic torso movement back and forth in chair 	<ul style="list-style-type: none"> Stretching reaching forward for a drink fidgeting with limbs shifting body position leaning in any direction
Crying	<ul style="list-style-type: none"> tears falling from eyes, often accompanied by wiping eyes and cheeks and verbal sobbing 	<ul style="list-style-type: none"> Tearing Sniffing Sobbing Slowly wiping cheeks or under eyes 	<ul style="list-style-type: none"> Scratching an itch Rubbing eyes quickly
Breathing changes	<ul style="list-style-type: none"> Increase or decrease in breathing frequency or volume 	<ul style="list-style-type: none"> Hyperventilating sucking in breath sighing rapid in-out chest or stomach movements 	<ul style="list-style-type: none"> Yawning Coughing Sneezing
Verbalized anxiety	<ul style="list-style-type: none"> verbally expressing a negative affective state or cognitive worry agreeing with therapist's negative statements 	<ul style="list-style-type: none"> I'm nervous, worried, scared get me out of here I can't take it anymore I'm uncomfortable I'm going to die when are we going to land already!? I hope we make it through this Why is the pilot doing this to us? 	<ul style="list-style-type: none"> I can handle this I'm feeling calm, relaxed, in a trance I don't care about this anymore I'm distracted, thinking about other things
Fidgeting	<ul style="list-style-type: none"> Repetitive (at least twice) motoric activity of the limbs that is not specific to task at hand 	<ul style="list-style-type: none"> Tapping hands Shaking foot or leg Playing with objects on desk or body (buttons, earrings, tie) Twirling hair 	<ul style="list-style-type: none"> rocking single adjustment of limbs or whole body scratching an itch stretching shifting body position leaning in any direction turning around

Appendix C-2: Behavioral Observation Checklist

Check to indicate the presence of each behavior within the time frame for each video. If you are unsure, mark with a “?” and then go back and decide. If you decide the presence of the behavior, check it. If not, make no other mark other than the original “?” in the appropriate box. Err on the side of caution.

Each DVD has four sessions on it. Using the DVD program, select the DVD with menu option. This should bring up the main menu with four sessions, each approximately 20 minutes long. Code only the first 20 minutes of tape after the session actually starts if the session is longer than 20 minutes.

Circle the Type of Session: <i>Imaginal / Virtual Reality</i>		Subject's Number:
Time (Mins)	Behavior	Session
2-3	Breathing	
	Crying	
	Fidgeting	
	Rocking	
	Verbalized	
7-8	Breathing	
	Crying	
	Fidgeting	
	Rocking	
	Verbalized	
12-13	Breathing	
	Crying	
	Fidgeting	
	Rocking	
	Verbalized	
17-18	Breathing	
	Crying	
	Fidgeting	
	Rocking	
	Verbalized	

Appendix D
ITC-SOPI

Please read the instructions below before continuing

Instructions: We are interested in finding out what you feel about the experience you have just had in the 'DISPLAYED ENVIRONMENT'. We use the term 'displayed environment' here, and throughout this questionnaire, to refer to the film, video, computer game or virtual world that you have just encountered. Some of the questions refer to the 'CONTENT' of the displayed environment. By this we mean the story, scenes or events, or whatever you could see, hear, or sense happening within the displayed environment. The displayed environment and its content (including representations of people, animals, or cartoons, which we call 'CHARACTERS') are different from the 'REAL WORLD': the world you live in from day-to-day. Please refer back to this page if you are unsure about the meaning of any question.

There are two parts to this questionnaire, PART A and PART B. PART A asks about your thoughts and feelings once the displayed environment was over. PART B refers to your thoughts and feelings while you were experiencing the displayed environment. Please do not spend too much time on any one question. Your first response is usually the best. For each question, choose the answer CLOSEST to your own.

Please remember that there are no right or wrong answers – we are simply interested in YOUR thoughts and feelings about the displayed environment. Please do not discuss the questionnaire with anyone who may also complete it as this may affect your answers or theirs. We should be grateful if you would also complete the 'Background Information' overleaf.

All of your responses will be treated confidentially.

BACKGROUND INFORMATION

Age: _____ years **Sex:** Male /Female

Occupation: **Nationality:**

Rate your level of computer experience

(tick one):

None.....
 Basic
 Intermediate
 Expert.....

Rate how often you play computer games (tick one):

Never
 Occasionally (once or twice/month)
 Often but less than 50% of ays.....
 50% or more of days
 Every day.....

Rate your average weekly TV viewing (tick one):

0-8 hours
 9-16 hours
 17-24 hours
 25-32 hours
 33-40 hours
 41 hours or more.....

Education (tick highest qualification achieved):

None
 CSE/O-level/GCSEs (or equivalent).....
 A-level (or equivalent).....
 City & Guilds
 Diploma.....
 Professional Qualifications.....

What is the TV size you watch the most?

(tick one)

Small/portable (14'' or less)
 Medium (15-28'')
 Large (more than 28'').....

How would you rate your level of TV/film production knowledge?

None
 Basic.....
 Intermediate.....
 Expert

Have you viewed stereoscopic (3D) images using polarised glasses (e.g. IMAX 3D) before?

Yes/ No

Have you used an experimental Virtual reality system before (beyond a consumer computer/arcade game)?

Yes /No

How would you rate your knowledge of how 3D images are produced? (tick one):

None.....
 Basic
 Intermediate
 Expert.....

How would you rate your knowledge of virtual reality (i.e. how it works)?

None
 Basic.....
 Intermediate.....
 Expert

Code (researcher use only): _____

PART A

Please indicate **HOW MUCH YOU AGREE OR DISAGREE** with each of the following statements by circling just **ONE** of the numbers using the 5-point scale below.

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	2	3	4	5

AFTER MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT...

1. I felt sad that my experience was over1 2 3 4 5
2. I felt disorientated.....1 2 3 4 5
3. I had a sense that I had returned from a journey.....1 2 3 4 5
4. I would have liked the experience to continue1 2 3 4 5
5. I vividly remember some parts of the experience.....1 2 3 4 5
6. I'd recommend the experience to my friends.1 2 3 4 5

PART B

Please indicate **HOW MUCH YOU AGREE OR DISAGREE** with each of the following statements by circling just **ONE** of the numbers using the 5-point scale below.

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	2	3	4	5

DURING MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT...

1. I felt myself being 'drawn in'.1 2 3 4 5
2. I felt involved (in the displayed environment).....1 2 3 4 5
3. I lost track of time.....1 2 3 4 5
4. I felt I could interact with the displayed environment.....1 2 3 4 5
5. The displayed environment seemed natural.1 2 3 4 5
6. It felt like the content was 'live'.1 2 3 4 5
7. I felt that the characters and/or objects could almost touch me.....1 2 3 4 5
8. I enjoyed myself.1 2 3 4 5
9. I felt I was visiting the places in the displayed environment.....1 2 3 4 5
10. I felt tired.1 2 3 4 5

(Strongly disagree)	(Disagree)	(Neither agree nor disagree)	(Agree)	(Strongly agree)
1	2	3	4	5

DURING MY EXPERIENCE OF THE DISPLAYED ENVIRONMENT...

- 11. The content seemed believable to me.....1 2 3 4 5
- 12. I felt I wasn't *just* watching something.1 2 3 4 5
- 13. I had the sensation that I moved in response to parts of the displayed environment1 2 3 4 5
- 14. I felt dizzy.1 2 3 4 5
- 15. I felt that the displayed environment was part of the real world.1 2 3 4 5
- 16. My experience was intense.....1 2 3 4 5
- 17. I paid more attention to the displayed environment than I did to my own thoughts (e.g., personal preoccupations, daydreams etc.).1 2 3 4 5
- 18. I had a sense of being in the scenes displayed.....1 2 3 4 5
- 19. I felt that I could move objects (in the displayed environment).1 2 3 4 5
- 20. The scenes depicted could really occur in the real world.....1 2 3 4 5
- 21. I felt I had eyestrain.1 2 3 4 5
- 22. I could almost smell different features of the displayed environment.1 2 3 4 5
- 23. I had the sensation that the characters were aware of me.....1 2 3 4 5
- 24. I had a strong sense of sounds coming from different directions within the displayed environment.....1 2 3 4 5
- 25. I felt surrounded by the displayed environment1 2 3 4 5
- 26. I felt nauseous.1 2 3 4 5
- 27. I had a strong sense that the characters and objects were solid.....1 2 3 4 5
- 28. I felt I could have reached out and touched things (in the displayed environment).....1 2 3 4 5
- 29. I sensed that the temperature changed to match the scenes in the displayed environment.....1 2 3 4 5
- 30. I responded emotionally1 2 3 4 5
- 31. I felt that *all* my senses were stimulated at the same time.....1 2 3 4 5
- 32. The content appealed to me.1 2 3 4 5
- 33. I felt able to change the course of events in the displayed environment. ...1 2 3 4 5

ITC-SOPI

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Appendix E

Informed Consent

Psychological Evaluation Research and Counseling Center (PERCC)
 Hofstra University
 Hempstead, NY 11549
 (516) 463-5660

Fall 2009

The following research study about treatment procedures for fear of flying is part of a Ph.D. dissertation being conducted at the Hofstra University Department of Psychology by Melissa Strilicic, M.A., under the supervision of Mitchell L. Schare, Ph.D., ABPP.

As a participant you will be asked to meet with a researcher for a half hour session, during which you will experience the stages of a standard commercial flight and complete several questionnaires. You will go through a procedure known as "exposure." This entails experiencing a certain amount of anxiety as you go through different stages of a flight. A very small percentage of participants may experience symptoms of motion sickness. If this occurs, the procedure will be discontinued and you will be asked to rest for five minutes before the study is ended.

Your responses during the session as well as completed questionnaire will be held in confidence and not be released to anyone. Data will be coded without identification of individuals and will be analyzed and reviewed by members of the Department of Psychology,

You may withdraw from this research experiment at any time without penalty of any sort. We anticipate 60 undergraduate students will participate and that it will take about a half hour for you to complete the experiment. You will receive two credits toward your Psychology 001 research requirements or any extra credit deemed appropriate by your professor.

I am very appreciative of your help and will be happy to answer any questions you may have. In addition, you may call Dr. Mitchell Schare, Director of the Ph.D. program if there are other questions (516) 463-5662.

Finally, if you would like, I would be happy to share the findings of the study with you when it is completed. Again, thank you for your cooperation.

Sincerely,

I have read and understand the information given above and agree to participate in this project. I understand that I may receive a copy of this consent form.

Signed _____

Date _____

Appendix F

Exposure Script

“As you can see, you’re in JFK Airport inside the terminal. Look at the airport lobby seats in front of you. Feel free to look around your gate and explore your environment. You see a plane outside the window, waiting to be boarded. You see some empty cups on tables that previous passengers forgot. Let’s take a walk up the hallway. As you’re walking, you look closely and see there are coffee shops on your left and right. You smell the coffee brewing. You turn and see a smoking lounge. You smell cigarette smoke coming from inside the lounge. You see some people standing in line waiting to board their plane. You hear the announcements of other flights being called, you know, the sounds of an airport. Tell me, on a scale of 0 to 100, zero meaning absolutely no anxiety and 100 meaning as much as anxiety as you’ve ever experienced or could possibly imagine, how nervous or anxious are you feeling right now in the terminal?”

The experimenter will remain quiet for about 30 seconds.

“I just checked and your flight is about to be called. Please make your way toward your gate. Your boarding pass says that you’re in seat 17A in Zone 3.” The experimenter will remain quiet for about 15 seconds before speaking in an “official” voice: “Flight 2681, New York’s JFK to Boston’s Logan Airport. Families with small children and passengers with first class tickets may now begin boarding. Passengers in rows 1-8, Zone 1, may now begin boarding, rows 1-8, Zone 1.” The experimenter will remain quiet for about 15 seconds.

“Passengers in rows 9-16, Zone 2, may now begin boarding, rows 9-16, Zone 2.”

The experimenter will remain quiet for about 15 seconds. The experimenter returns to

his/her “normal” voice: “By the way, tell me, on a scale of 0 to 100, how nervous or anxious are you feeling right now before boarding?” The experimenter will remain quiet for about 30 seconds. The experimenter returns to his/her “official” voice: “Passengers in rows 17-25, Zone 3, may now begin boarding, rows 17-25, Zone 3.”

The experimenter returns to his/her “normal” voice: “That means you. As you walk through the jet way, you can see the door to the plane. It looks like a 747.” The experimenter will remain quiet for about 15 seconds. “By the way, tell me, on a scale of 0 to 100, how nervous or anxious are you feeling right now in the jet way?” The experimenter will remain quiet for about 30 seconds.

“You’re now sitting in the airplane. Feel free to look around you and out the window. Soon, you will hear the roar of the engines as the aircraft starts up. There’s the sound. You may soon hear the flight attendant’s announcements.” The experimenter will remain quiet for about 30 seconds. “The flight attendant asked that you put your tray table in an upright, locked position. She also asked that you put on your seat belt. You may feel bumps as the aircraft taxis toward the runway. Feel free to look out the window. You may see other planes, the tower with air traffic controllers, runways. You may hear other planes taking off or landing. Feel free to examine your environment as we head toward the runway.” The experimenter will remain quiet for about 15 seconds. “By the way, tell me, on a scale of 0 to 100, how nervous or anxious are you feeling right now?” The experimenter will remain quiet for about 30 seconds.

“The captain has cleared us for takeoff. You may feel sensations below your feet as the plane takes off. It will also be loud. As you know, takeoff is often loud and sometimes rough.” The experimenter will remain quiet for about 15 seconds. “Your plane

is now taking off; you are slowly ascending higher and higher into the sky.” The experimenter will remain quiet for about 60 seconds. “By the way, tell me, on a scale of 0 to 100, how nervous or anxious were you feeling during takeoff?” The experimenter will remain quiet for about 30 seconds.

“Feel free to look out your window. You might see some white, puffy clouds outside. The sky looks light blue and all you can hear is the sounds of the engines whirring as we fly.” The experimenter will remain quiet for about 60 seconds. “By the way, tell me, on a scale of 0 to 100, how nervous or anxious are you feeling right now?” The experimenter will remain quiet for about 30 seconds.

“I think the weather’s looking a bit grim. You may hear thunder outside and even see a bolt of lightning now and then. You may feel the turbulence get worse. It looks pretty bad out there.” The experimenter will remain quiet for about 30 seconds. “That weather is rough. The thunder is so loud; I can barely hear myself think. What are they doing flying in weather like this?” The experimenter will remain quiet for about 15 seconds. “By the way, tell me, on a scale of 0 to 100, how nervous or anxious are you feeling right now?” The experimenter will remain quiet for about 30 seconds.

“Well, the weather looks a lot better now. You may see the white, puffy clouds again instead of the dark, gloomy ones we just saw. It probably doesn’t feel as turbulent as it did a few minutes ago. You may hear the engines whirring again.” The experimenter will remain quiet for about 60 seconds.

“The captain just told us that we’ll be landing shortly. You may see trees, the tops of houses, highways, cars, maybe even some water below us. You may feel sensations below your feet again as we head toward the ground, rapidly in our decent. You may hear

the engines getting louder as we touch down.” The experimenter will remain quiet for about 60 seconds. “By the way, tell me, on a scale of 0 to 100, how nervous or anxious were you feeling during landing?” The experimenter will then tell the participant that the virtual / imaginal flight is over.