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Panic and Agoraphobia in a Virtual World

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ABSTRACT

Virtual reality (VR) offers a great new perspective on what it can offer an individual. These new approaches can give an individual the immersion and cognitive guidance that they need to help overcome his or her disorder. VR differs from the traditional displays in computer graphics as these various displays are integrated to give the user a sense of presence or immersion in the virtual world. To more effectively treat panic and agoraphobic patients using VR, it is necessary to determine the physiological responses of nonphobics when placed in the virtual panic and agoraphobia environments. This study exposed nonphobic participants to virtual panic and agoraphobia worlds with a program entitled "Virtual Medicine." Individuals without a diagnosis of panic and agoraphobia, as confirmed by intake and self-report questionnaires, were exposed to four different VR environments (elevator, supermarket, town square, and beach). During these VR experiences, physiology was measured by noninvasive sensors (peripheral skin temperature, heart rate, heart rate variability, respiration, and skin conductance). These measurements were compared to baseline physiology, which was recorded for five min prior to the VR exposure. These levels of physiological arousal will be useful in comparing against the phobic responses during virtual exposure. It will be useful to explore differences between immersion, physiological responses, and self-report responses in nonphobics versus phobics.

INTRODUCTION

PANIC DISORDER is characterized by an intense sense of death, doom, or even destruction. In community samples, lifetime prevalence rates have been reported as high as 3.5%, with prevalence even higher among clinical samples. Of those referred to mental health clinics, approximately 10% are diagnosed with panic disorder. In medical settings, prevalence rates are 10–30% for patients presenting to vestibular, neurology, or respiratory clinics, and up to 60% for those presenting to cardiology clinics. Many patients will feel dizzy, hyperventilate and gasp for air, sweat, and experience chest pain, nausea, and a fear of losing control or impending death.[1,2] Agoraphobia is a condition that can be diagnosed either with or without panic. A criterion for agoraphobia consists of anxiety about being in places from which escape might be difficult or in which help might not be available. The situations are avoided or else endured with marked distress or anxiety about having a panic attack or panic-like symptoms.

Virtual reality (VR) offers an advantage to those suffering from panic with agoraphobia, in that exposure to anxiety-provoking situations can first be attempted in the office. This allows the patient to feel immersed and

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experience initial anxiety, which may then be overcome. VR differs from the traditional displays in computer graphics, and often various displays are integrated to give the user a sense of presence or immersion in the virtual world.[3] Knowing how nonphobics respond, both physiologically and subjectively, in environments created to treat those with panic and agoraphobia will help establish a baseline upon which to compare the initial responses of phobics exposed to virtual worlds and the subsequent levels we can expect when the phobics achieve desensitization.

MATERIALS AND METHODS

Participants

Nine graduate students enrolled at the California School of Professional Psychology, San Diego, were recruited to participate in a study investigating nonphobics' responses to VR environments created for treatment of panic and agoraphobia. Participants who met inclusion criteria and were included in the study included eight females and one male aged 22–27.

Basic task

Participants were first instructed to sit quietly for a 5-min baseline recording during which physiology was measured, including heart rate, skin conductance, peripheral skin temperature, and respiration. This was followed by the VR task in which the participants wore a head-mounted display and continued to have physiology monitored. Participants were then asked to move around a series of virtual environments, which they could explore via headtracking as well as through the use of a joystick. Environments included (1) an elevator without people, (2) an elevator filled with people, (3) a grocery store, (4) a town square with people, (5) a town square without people, and (6) a beach setting that included portions with people and a section of beach without people. Each environment was experienced for 2 min. The six virtual environments were created by Dr. Giuseppe Riva (www.psicologia.net).

Experimental design

A within-group repeated measures analysis of variance (ANOVA) statistical test was performed using SPSS 11.0 software (SPSS, Inc., Chicago, IL).

Measures

Self-report auestionnaires. The following questionnaires were administered prior to the beginning of the study to determine if participants had the ability to become absorbed into the virtual environments, and to help confirm that participants did not meet criteria for Panic Disorder with Agoraphobia as stated in the *Diagnostic and Statistical Manual of Mental Disorders,* Version IV–Revised.[3]

- *Tellegen Absorption Scale (TAS):* This scale helps to indicate how absorbed a person can become in the virtual world by identifying how absorbed they become in actual reality situations. Questions consist of true or false answers to vivid memories, scents, and images. The total score can range from 0 to 34.[4]
- *Dissociative Experiences Scale (DES):* This questionnaire consists of 28 questions about experiences that are involved in daily life. This questionnaire has been shown to be correlated with the level of immersion in the virtual environment. The total score can range from 0% to 100%.[5,6]
- *Agoraphobia Questionnaire (ACQ):* This questionnaire measures activities you do or do not do almost always or never/infrequently. It is designed to find out if one is agoraphobic. Scores range from 0 to 35.[7]
- *Beck Depression Inventory (BDI-2):* This questionnaire is designed to identify how one has felt during the past 2 weeks. It helps to determine if one is depressed. Scores range from 0 to 63.[8]
- *Fear Questionnaire:* This questionnaire measures how much an individual avoids situations because of fear or unpleasant feelings. Scores range from 0 to 192.[9]
- *Panic Attacks Cognitions Questionnaire (PACQ):* This questionnaire is designed to measure frightening thoughts that accompany panic

attacks. It is a good indicator of panic disorder. Scores range from 46 (not at all) to 184 (totally dominate thoughts).[10]

After the exposure session, participants completed the following self-report questionnaires:

Physiology. An I-330 C-2 computerized biofeedback system manufactured by J&J Engineering (Poulsbo), WA) was used to collect physiological data. The following parameters were measured: skin conductance (SC), which changes in relation to increased sympathetic nervous system activity (anxiety, panic); heart rate, which increases with increased anxiety response; peripheral skin temperature, which decreases due to vasoconstriction as one's anxiety increases; and respiration rate, which increases as one experiences anxiety. SC was measured with two silver/silver chloride electrodes on the ring and index finger. Heart rate was measured by two electrodes placed on the back side of the wrist. Peripheral skin temperature was measured with a thermistor, which was attached with cloth tape at the fingertip and near the base of the middle finger on the palmer side of the hand. Respiration was measured by a strain gauge attached with a Velcro strip placed 1 inch above the umbilicus.

RESULTS

All participants scored in the nonclinical range on panic and agoraphobia self-report questionnaires given prior to virtual exposure. All participants also scored low to zero on the BDI-II and zero to low on the Fear Questionnaire. Self-report questionnaire scores given postexposure showed Presence and Realism Questionnaire scores were high to average, ranging from 13 to 21. Also, the Tellegan Absorption Scale scores were high to average, ranging from 8 to 33, indicating an ability to become absorbed. This seems to indicate that many participants had the ability to become immersed in the virtual world and felt this immersion during the virtual experience. This may also account for the clinically significant increases in arousal participants experienced during exposure.

Analysis was done using a repeated measures ANOVA, which showed that the nonphobic participants had a clinically significant increase in physiological arousal during virtual exposure, as shown by skin conductance, with the most arousal occurring in the last exposure, which was of a beach (Fig. 1). Participants showed an increase in physiological arousal in each environment, and since exposures in each environment were only 2 min in duration, they were not able to return to baseline physiology levels at the end of the 17-min exposure. What we have found in prior studies is that, after a 20-min exposure in an environment, the majority of nonphobic individuals, realizing that the new, novel stimulus is nonthreatening, show a decrease in physiological arousal and are able to return to baseline levels. The immersive quality of the virtual environments is enough to initially cause a physiological response and, in this experiment, appears to have been enough to maintain arousal during the 17-min exposure, since it involved six new environments. A variety of unique individual skin conductance responses were seen during exposure, however (Fig. 2).

In analyzing the change in heart rate, skin conductance, and temperature from baseline through each of the six VR exposure, we can see some very interesting trends (Fig. 3). In particular, as exposure continues, we see a decrease in heart rate, which is initially 7% above baseline levels, to below baseline levels, until the very last environment, the beach, at which time there is an increase again to 3% above baseline. Temperature remains above baseline levels, although at the beginning of the exposure period, it is only 1% above and drops to this 1% increase again during the last environment, the beach. Skin resistance shows an initial increase of 15% above baseline, indicating arousal, and at one point decreases to only 5% above baseline before increasing again to 15% above baseline during exposure to the agoraphobic town square environments. During the beach scene, skin conductance leaps to 54% above baseline.

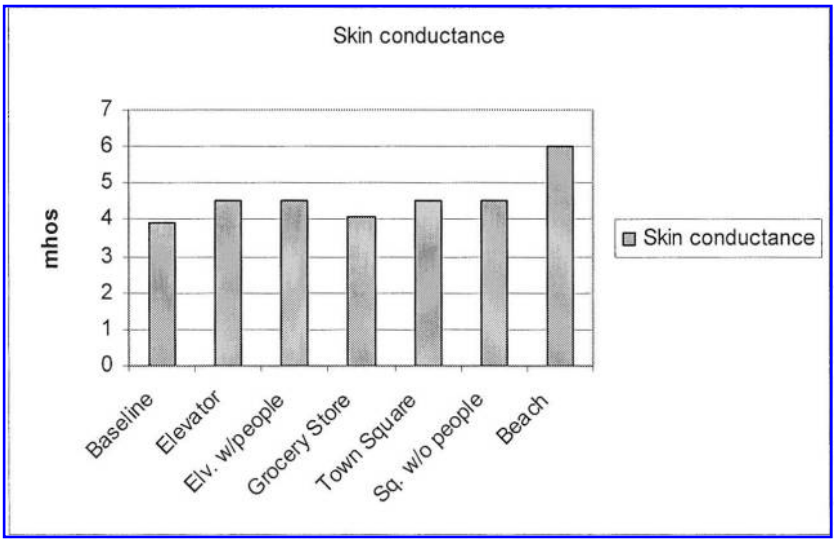

FIG. 1. Average skin conductance levels for nine nonphobic participant during a baseline relaxation period and during exposure to six virtual environments created to treat patients with panic disorder with agoraphobia.

DISCUSSION

This study was undertaken to help lay a foundation for future research on treating individuals with panic and agoraphobic using virtual worlds for exposure to fearful situations. Determining how nonphobics respond in VR worlds created for panic and agoraphobia individuals can help establish a baseline for physiological responses during clinical treatment of those with panic and agoraphobia. VR may provide an effective solution for both exposures during desensitization to outward stimuli and events, as well as an ideal place in which to safely practice interoceptive exposure.[13] Currently, interoceptive exposure can either be practiced in the safety of a therapist's office, which is not a real world setting; or it must be practiced in the real world setting, which is not seen by many persons who are beginning therapy as a "safe" setting.

The results from the present study support the hypothesis that nonphobic individuals

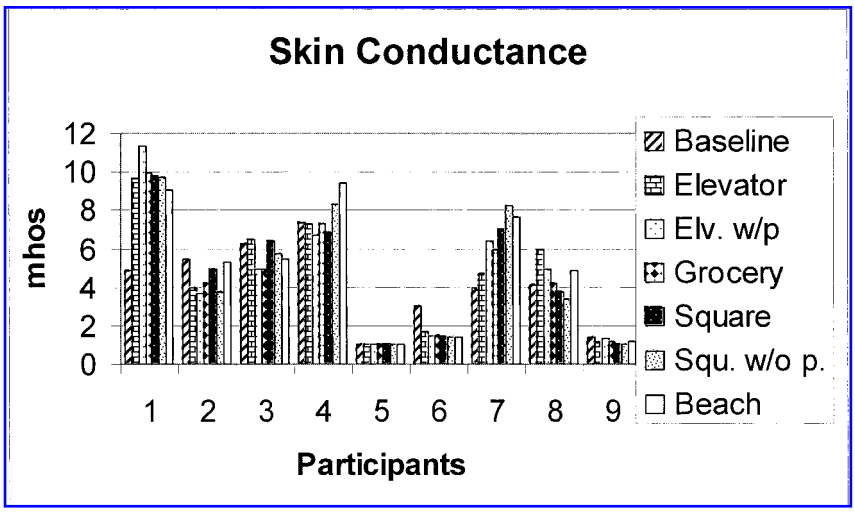

FIG. 2. Individual skin conductance levels shown by participants during a baseline relaxation period and during exposure to six virtual environments.

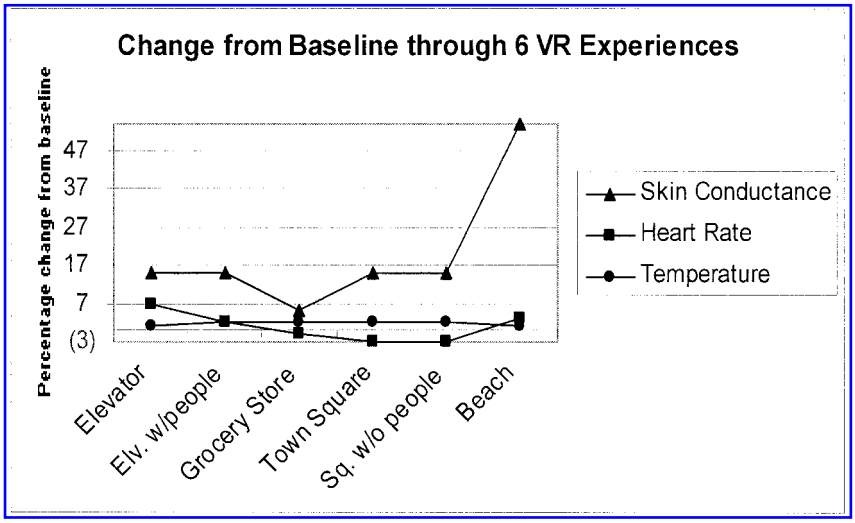

FIG. 3. Percentage change in skin conductance, heart rate, and peripheral skin temperature from a baseline recording period through VR exposure to six different environments, each of 2-minute intervals.

may become significantly sympathetically aroused when exposed to virtual environments exhibiting nonthreatening stimuli. Their physiology is, however, much more stable, and tends to normalize towards baseline arousal levels as compared to individuals with panic and agoraphobia. At the deserted end of the beach, some participants recorded feelings related to an infinite horizon.[14,15] When you are at this point in the environment, there is an ocean ahead of you, and as you look to the right, you see a very tall mountain. When you look behind you, there is a very tall ledge, hiding the pool and people that are standing on the ledge, and as you look to your left, there is no one on the beach with you. This "nothingness" seems to have affected some individuals in this study, although by self-report they are not agoraphobic.

By knowing what the reaction of nonphobic individuals is, however, we can more clearly know what levels of arousal might be realistic to expect from patients when entering the virtual world, and then as therapy progresses and desensitization occurs. Since these worlds required navigation via a head-mounted display as well as a joystick, a longer amount of time may be necessary before habituation occurs.

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