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**HOW REAL IS GOOD ENOUGH?
300 DEGREES OF VIRTUAL IMMERSION**

by

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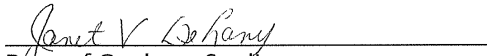
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ABSTRACT

HOW REAL IS GOOD ENOUGH? 300 DEGREES OF VIRTUAL IMMERSION

Debbie Patton

Presence research lacks the assessment of interactions between psychological and physiological responses in interactive immersive environments. Additionally, a consensus regarding how to best examine presence does not exist. This research investigated measures to identify and provide operationally-relevant information regarding the realism of presence in a 300-degree immersive simulation. Participants engaged in a Shoot-Don't-Shoot simulation under three types of feedback: 1) shock, 2) life-bar, and 3) no feedback. It was hypothesized that: 1) the shock condition would be more immersive, 2) shock condition performance would be better than the other two conditions, 3) trait uncertainty would a) correlate immersion responses and b) moderate the stress experience. Both hypotheses 1 and 3b were supported. Immersion was significantly greater in the shock condition compared to the other feedback conditions. The shock condition was associated with more incorrect decisions, sometimes referred to as "spray and pray." Recommendations for effective immersive training strategies are included.

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Introduction

HOW REAL IS GOOD ENOUGH?

300 DEGREES OF VIRTUAL IMMERSION

The concept of “presence” in reference to immersive virtual environments (IVR) refers to just how realistically an individual responds to the environment and his or her subjective sense of actually “being there” in the environment represented by the simulation. Witmer and Singer (1998) define immersion as a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences. Therefore, it stands to reason that greater realism produces a greater sense of presence; for that reason, the question just *how real is good enough* in an IVR environment needs to be answered? The pros and cons of IVR have been evaluated for a variety of applications, such as surgical procedures and pain management (Hoffman, Patterson, Carrougner, 2000; Rauterberg, 2004), evaluating resiliency training using the Virtual World of Second Life, (Rice, V. 2012), helping persons with clinical depression (Huang & Alessi, 1999), and even by lawyers in the courtroom as a mechanism for argumentation and persuasion (Bailenson, Blascovich, Beall, & Noveck, 2006). Dr. Richard Haas of the York College/WellSpan Health Nurse Anesthetists (2011) stated that, “when doing a simulation, there are two things you want to know; does it look the same, and does it psychologically feel the same?” (Schmidt, 2011).

Much of the presence research discusses the importance of the psychological aspect of simulation but it is seldom measured. Although simulation researchers understand the importance of the psychological constructs of presence, the psycho-physiological metrics and more importantly, the interactions of the psychological and physiological responses have been overlooked. While these systems are regularly used in training, research is needed to understand how immersive the training is and how comparable it is to real situations.

This study investigated how immersive a 300-degree virtual environment is based on feedback. Standardized and validated metrics were used to measure psychological (arousal) and psycho-physiological (HPA, ANS, PNS) responses along with subjective responses to existing presence questionnaires between three different types of feedback (shock, life-bar, and no feedback.)

The simulator used in this study has five screens to present 300 degrees of immersion. The simulator comes with preprogrammed scenarios used in law enforcement and some military relevant training environments. Through the use of its editing software, custom scenarios can be created. The novel feature this system brings to presence research is its capability to provide threat feedback via the ThreatFire™ belt. There are other feedback systems but they rely on human control. This automated-response belt does not rely on human intervention for control. Therefore, human error is removed from the threat. The belt uses a small shock (50micro-amps) to simulate return fire from a combatant's weapon. It is believed that this capability provides a more realistic military operational stressor and that psych-physiological measures respond more so when using

the ThreatFire™ belt versus the life-bar or no feedback. The 300-degree immersive simulator is a different type of simulation. It is more similar to a Computer-Aided Virtual Environment (CAVE) environment without the HMD or tracking equipment. Instead of using a virtual character or avatar, you play yourself and interact with the scenarios on the screens. One potential use of this simulator could be to investigate the effects of stress on decision-making. The participant looks at a computer-generated scene on five screens providing a 300-degree surround. Characters (computer generated or video of real people) either pop up or step-out from behind an obstacle at various locations on each screen. Participants must decide if the character is a friend or foe before firing upon the foe characters with a modified real M-4 carbine or 9mm Beretta weapon.

Literature Review

Virtual environments are for the most part either on a gaming machine (e.g. Xbox, Wii), computer based, online or presented through head-mounted displays. There are a few virtual environments that are, immersive interactive environments like the 300-degree simulator and a CAVE environment. This section discusses the types of VR used in the military.

The US Army has instituted two simulation houses, Program Executive Office for Simulation, Training and Instrumentation (PEO STRI) in Orlando, FL and the National Sim Center (NSC) in Ft. Leavenworth, KS. PEO STRI's mission is to provide "simulation, training, and testing capabilities for the Nation's Security and put the power of simulation into the hands of the Soldier (<http://www.peostri.army.mil/ABOUTUS/vision.jsp>).” Their experts, trainers and technicians champion Soldier and leader requirements to the acquisition community while providing top-notch training support. They lead efforts to integrate Army training through live, virtual and constructive environments at home stations and schools. The NSC also manages gaming as a training enabler (<http://usacac.army.mil/cac2/NSC/>).

Military simulations are used to train many diverse tactical and social skills, as well as test the integration of new systems for future force use. Early simulation use was generally aircraft, tank, or other vehicle simulators. Often they required large open bays to hold the enormous simulators that sat upon hydraulic lifts for motion, required constant cool temperatures and a large amount of manpower and money to keep them up and running. Over time and as technology changed, simulations became more manageable and more cost effective. The Dismounted Infantry Survivability and Lethality Testbed

(DISALT) was one of the first shooting simulators. It was initially used as a marksmanship trainer for ship-borne operations. It is also “highly effective as a research tool because of its high-fidelity data-capturing capability and flexibility in providing many types of target and three-dimensional environment scenarios” (Scribner, Wiley and Harper, 2007). Another feature of the DISALT is its high-fidelity recoil system (attached cable to upper rear stock of the weapon) that imparts a similar impulse to a M16 and M4 rifle 5.56-mm round when fired. The DISALT uses compute-generated scenes, which allows for very controlled environments and scenarios. Although this is very useful for research the computer generated environments are not as realistic as some training requires.

In an attempt to solve this problem, the Army invested in the Engagement Skills Trainer (EST.) The EST is an interactive video simulator designed to foster Soldiers basic marksmanship and combat engagement skills. The EST provides scenarios that include basic rifle marksmanship (qualification range), squad tactical training, military operations urban terrain, and rules of engagement training. The current system has a scenario editor for modifying or generating new scenarios (Army Field Manual 3-22.9). The current system uses compressed air to cycle the bolt, through a series of tethered cables attached to the front of the weapon, which provides the “feel” of shooting. Although similar in design to the DISALT it can also use video. Video allows for a more “real feel” compared to the simple computer generated scenes of the DISALT.

Other types of simulations have been developed due to new mission demands. These new demands require more interaction among team members and critical thinking. Some of the new simulations used are presented in a variety of ways. For example,

ELECT BiLAT is a desktop PC game that teaches culturally relevant negotiation skills. FLATWORLD is a mixed reality simulation developed by the Institute for Creative Technologies. FLATWORLD enhances kinetic skills in a small village performing missions such as room clearing and patrol. Although this system exists, there is only one and it is not known if it may be possible in the future to make this type of training more accessible. VirTra is a 300-degree interactive immersive simulator that has the capability of shooting back via the ThreatFire™ belt. This system was designed primarily for training law enforcement skills. US Army PEO-STRI has investigated purchasing one of these systems for that purpose. All these systems offer more cost effective training and in support of research, the VirTra affords repeatability and controllability.

Actual deployment calls for quick decision-making processes under potentially hostile situations such as threat of return fire. Current virtual simulations rarely mimic the actual harsh environmental conditions that our military encounter during deployment, such as sound, light, smell, or threat of return fire. However, the US military uses Survival, Evasion, Resistance, and Escape (SERE) training as high intensity military training for those at high risk of capture. SERE training is both physically and psychologically demanding. It was designed to parallel the stress experienced during real war, captivity and other combat missions. Additionally, the US military uses the National Training Center (NTC) (www.training.sfhq.com/survival_training.htm). The NTC is designed to prepare the US military personnel for any type of mission they may need to execute. The training is composed of two types: force-on-force and live fire. The force-on-force training uses eye safe lasers and weapon simulations such as the Multiple Integrated Laser Engagement System (MILES) (www.fas.org/man/dod-

101/sys/land/miles.htm) equipment for return fire. The MILES equipment receives the lasers and when it is hit the system activates a sound to signal hit by return fire. The live-fire training uses real weapons for both small arms and large units. However, this training does not fire upon live opposing forces.

(www.fortirwinlandexpansion.com/PDFs/NTC%20Land%20Expansion%20Article.pdf)

Measurement

Gratch, Marsella, and Petta (2009), state how emotions are the components that make up human perception and effect decision-making. These emotional components also make up one's responses to acute situations in either the social or physical environment. This is particularly relevant because Soldiers face difficult decisions under varying stressful conditions. Having more exposure to stressful situations and understanding one's perceptions and how to handle the situation could contribute to a Soldier's resilience.

Returning Soldiers and Officers say that the training received in simulations helped them in theatre. Replicating the extreme environment of theatre would pose unacceptable levels of risk; therefore training tools in a safe setting that can simulate an extreme environment are needed. According to the Army Regulation 350-1, 18 December 2009/RAR 4 August 2011, the Army will train units and staffs in their core competencies under conditions that accurately and "realistically portray the operational environment" in targeted regions that exist within the operational environment to integrate observations, insights, and lessons learned in order to adapt training based on the operational condition. Currently no low cost VR system that accurately portrays the adverse operational conditions a Soldier may encounter in theater exists. The available

VR systems used in training have not been investigated to determine the degree to which they are replicating the harsh conditions of war.

Lazarus and Folkman (1984) define stress as a state produced when stressors (environmental or social) tax or exceed an individual's adaptive resources. Over the past 20+ years, the ARL-HRED has investigated a variety of stressful training events, some civilian and numerous military, and as a result, developed a conceptual definition of stress that is congruent with Lazarus and Folkman. Fatkin and Patton (2008) state that stress is a "multifaceted, dynamic, and interactive process with psychological and physiological dimensions." Much of the training provided by the Army is known not to produce high levels of stress in which to make accurate arousal and performance measurements. In recent years the introduction of immersive virtual reality (IVR) has created a new venue with which to teach Soldiers how to better engage in their duties. Although the training is used, there has not been enough research on just how stressful the training is and the effects of the stressors on performance. An imperative on the battlefield is to avoid being shot. The introduction of a stressor threat may induce real-world behaviors and performance that is more representative of how a soldier responds to battlefield situations.

While the SERE and NTC offer more realistic training and studies have been conducted during this training (Taylor, Sausen, Mujica-Parodi, Potterat, Yanagi, & Kim, 2007; Morgan, Aikins, Steffian, Coric, & Southwick, 2007), they do not allow for the level of control needed in research. Morgan et. al. (2007) assessed vagal tone during the classroom training portion of SERE training and one week prior to the experiential phase of the training. This is the phase where the classroom training is tested. However, data

was not collected during the field portion of the training. On the other hand, Taylor et. al. (2007) was able to collect physiological measures during the field portion of the training. Taylor, et. al (2007) investigated trait and state anxiety, salivary cortisol, and heart rate. Unfortunately, the collection times were baseline and only during the first two days of a 12-day training.

Using IVR systems that simulate the field-like operational environment allows for good experimental design and control that may provide insights on the effectiveness of training or discover the reasons for improved or impeded performance (i.e., too much high stress) and in the process learn and apply effective mitigation strategies.

Immersion and presence have many definitions. The multitude of definitions can lead to some confusion. Slater and Wilbur (1997) define immersion as “the extent to which the actual system delivers a surrounding environment, one which shuts out sensations from the ‘real world’, which accommodates many sensory modalities, has rich representational capability, and so on.” Witmer and Singer (1998) say presence is a “psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences.” Others emphasize the importance of “involvement” which is defined as a “psychological state experienced as a consequence of focusing one's energy and attention on a coherent set of stimuli or meaningfully related activities and events” (Huang & Alessi, 1999). They validated psychological techniques for assessing emotions using subjective reports, behavioral observations and facial analysis. They believe that all of these should increase our understanding of presence in a virtual environment. Witmer and Singer (1998) recognize that immersion and involvement are necessary to experience

presence. The cognitive state is usually accompanied with a distorted sense of time, and intense focus. Staffan Björk and Jussi Holopainen (2004) define three types of immersion: 1) sensory-motoric immersion, which uses the tactile operations and the sense of being in the zone, 2) cognitive immersion - the mental involvement in the immersion such as the strategic planning performed by chess players, and 3) emotional immersion is where the person becomes invested in the simulation similar to emotions from reading a book or watching a movie. Cognitive absorption (CA) describes the interaction of these three types of immersion. Agarwal & Karahana (2000) defined CA as a state of deep involvement exhibited in attention focus, heightened arousal, control, interest, and temporal dissociation.

Sheridan (1992) warned that presence is a subjective awareness. In the past arousal measurement consisted of only one aspect, psychological or physiological. The importance of this interaction must not be overlooked. The US Army has considered this interaction and it's importance to the understanding that when the body is aroused as measured by physiological measures it is important to use the psychological measures for interpretation. One might consider the physiological measures acting as a thermometer. They tell us that something is happening but not why and the psychological measures provide the interpretation, as perceived by the person.

Psychological Measures

Within immersion/presence research there are two sides: the components of the system and pictorial realism and interactivity (Slater, 1999). In his response to Witmer and Singer (1997) he mentions that these two sides need to come together and suggests looking at different types of people to the same system configuration. Together system

immersion and independent measures of individual characteristics along with state arousal would help bring those sides together. Therefore, in addition to individual characteristics, the subjective response of the individual significantly contributes to the experience of immersion or cognitive absorption. Huang and Alessi (1999) notes that emotions are a critical component to experiencing the world and that “any theory of presence must take emotional factors into account.”

In order to investigate independent measures of individual characteristics in a simulation, arousal must be measured both psychologically and physiologically. Psychological aspects of presence as measured by subjective arousal metrics have not previously been assessed. Dixon, Patton, Fatkin, Grynovicki, & Hernandez (2006) investigated the subjective arousal of students at the Captain’s Career Course, Fort Sill, Oklahoma, while training using a video based scenario. Under the guidance of the US Army – Field Artillery School, WILL Interactive, Inc., designed the scenario used. It incorporates a full operational virtual experience with all the tools a Battery Commander needs to make sound leadership decisions in all aspects of a US Army Captain’s mission from pre-deployment through peacekeeping operations. The use of the psychological measures during this investigation allowed researchers to identify the presence experienced by the students. Six psychological constructs were measured (anxiety, depression, hostility, positive affect, sensation seeking, dysphoria).

Because of the improved discriminant validity and the control of checking the response set, the Multiple Affect Adjective CheckList-Revised (MAACL-R; Lubin & Zuckerman, 1999) Today form has been found to be particularly suitable for investigations which hypothesize changes in specific affects in response to stressful

situations. Therefore, data was collected using the MAACL-R. To measure the experience of certain tasks, the students were instructed to select all the words that described how they felt at specific time points during the scenario. The changes in affect at these time points correlated with specific events in the simulation. Dixon et. al. (2006) identified this to be a measure of immersion. They also found that the trait measures, anxiety, uncertainty response scale and the desire for change predicted overall performance in the simulation. Results indicated that as critical events occurred with the captain in the video, the captains in training experienced a corresponding sense of presence while in the role of the captain.

Physiological Measures

The salivary glands produce α -Amylase in response to circulating epinephrine and norepinephrine resulting from activation of the sympathoadrenal medullary system (SAM). α -Amylase, an enzyme, hydrolyzes starch to oligosaccharides and then slowly to maltose and glucose. Chatterton, Vogelsong, Lu, Ellman & Hudgens (1996) and Skosnik, Chatterton, Swisher & Park, (2000) reported that salivary amylase concentrations are predictive of plasma catecholamine levels and can be used as a quantifiable measure of stress. Not all stress causes the same response. For instance, first time parachute jumpers waiting for their time to jump exhibited a decrease in cortisol but an increase in α -amylase levels in saliva. After the first jump, as the jumpers were actively engaged in preparation for the jump and during the jump, both salivary cortisol and α -amylase levels dramatically rose.

α -Amylase can be collected non-invasively and can be assayed in the field without the need of laboratory equipment. During the late 1980's through the middle

1990's the US Army set out to develop a non-invasive field practical measure of stress (Fatkin, Hudgens, Torre, King, & Chatterton, 1991; Fatkin & Hudgens, 1990; Hudgens, Fatkin, Torre, King, Slager, & Chatterton, 1991). They contracted Robert Chatterton of Northwestern University to develop the field assay. This field assay was used until in 2011, when the US Army funded Andrology Labs and Chatterton to make a more field practical assay that would cut down on time and materials. This new procedure now can be conducted in roughly five minutes compared to thirteen minutes. All pieces of the kit are disposable except for the colorimeter (Jeyendendran, Ramu, & Chatterton, 2011).

Salivary cortisol is a steroid produced by the adrenal cortex in response to adrenocorticotropin. Both α -Amylase and salivary cortisol are usually increased by most stress-related stimuli but cortisol takes longer to respond and persists for a longer time in the circulation (Jeyendendran, Ramu, & Chatterton, 2011). Another study conducted during training exercises involving landing on aircraft carriers, the pilots who had control over the landing showed increased cortisol levels. However, the radiomen in the control tower who had no control over the landing had lower cortisol levels (Chatterton et al, 1996). This measurement also quantifies a physiological measurement of stress arousal.

When predicting Soldier performance in a threat of return fire scenario, stressors for which a person acts passively should decrease cortisol secretion but stressors in which a person must actively be involved, like in self-defense increase cortisol secretion.

Galvanic skin response measures the electrical conductance of the skin, which varies with its moisture level. Stress is experienced by the activation of the sympathetic nervous system (SNS) and causes the sweat glands to produce sweat when stressed thus creating the stress experience. GSR has been used as an indication of psychological or

physiological arousal. Research using GSR in immersion is relatively standard in practice. A participant sits still in front of a computer and views images on a computer monitor. The images are either neutral or arousing and the GSR is measured and compared between groups. Arousing images activate the SNS causing the sweat glands to produce sweat (Choi, Lee, Yang, Kim, Choi, Park, Jun, Tack, Lim, Chung, 2010.)

Oxygen saturation (SAO₂) as measured through a transcutaneous device indicates the amount of oxygen in the blood. For healthy individuals, the normal range of oxygen saturation is 95%–100%. Exercise increases oxygen consumption and may reduce blood saturation, but an increase in both breathing rate and blood flow compensate for this. In general, values below 92 percent indicate that the body is under some distress and below 90 percent is considered hypoxemia. This distress could be due to illness or psychological stress (Aesciman, Blue, Williams, Cobb, and MacNeill, 2003).

Cardiac vagal tone is believed to be an index of the central-peripheral neural feedback mechanisms. Therefore, vagal tone serves as a quantification of the physiological resources, how they are organized and how the appropriate response is selected. Vagal tone is measured by using high-frequency spectral power or respiratory sinus arrhythmia. Morgan, Aikins, Steffian, Coric, & Southwick (2007) ran three experiments to test hypotheses that vagal tone and performance in high stress situations are related. The premise of these studies was that heart rate variability (vagal tone) is an index of emotion regulation and cognitive ability. They investigated military personnel going through SERE training and measured vagal tone with performance during the stressful part of the training. Contrary to expectations, they found that low baseline vagal

tone predicted better performance in a real S.E.R.E. military training program. These results were duplicated in two additional studies.

Immersion/Presence Measures

Presence has been extensively studied and a multitude of questionnaires have been used. van Baren & Jsselsteijn (2004) wrote a compendium of all the presence measurements available as of 2004. They grouped the measures by type of measurement. They ended up with three categories: subjective measures, continuous assessment and objective measures. Each category has subdivisions. Subjective measures contain all the existing presence questionnaires. Continuous assessment contains the qualitative, psychophysical, and subjective corroborative measures. Objective measures contain psychophysiological, neural correlates, behavioral measures and task performance. When combined they reported over 62 measures. See Table 1 for all measures.

The most used is the Presence Questionnaire (PQ) by Witmer and Singer (1998). The questionnaire originally contained 32 items. Through experimentation and the PQ showed internal consistency of $\alpha = .88$ it was reduced to 19 questions. It now contains variables of Involved/Control, Natural, and Interface Quality. The questionnaire correlates with simulator sickness questionnaires as well as psychomotor tasks and spatial knowledge. Additionally, it was significantly correlated with the Witmer & Singer's Immersive Tendency Questionnaire. This questionnaire is given before performing in a virtual environment.

The Slater-Usuh-Steed (SUS) questionnaire is often used as well. They believe that internal and external factors play into the role of presence. To test the relation between presence and task performance an investigation on aircraft maintenance the SUS

was negatively correlated with errors however, no correlations were found for practice as compared to the PQ.

Statement of the Problem

Presence research has a missing link: the interaction of psychological and physiological responses in an interactive immersive environment. Additionally, no consensus exists as to which self-report or psychological metrics best measure presence. This thesis researched the interaction to identify and provide operationally relevant information regarding the realism of presence in a 300-degree immersive simulation.

The author made three hypotheses:

1. The ThreatFire™ belt feedback would induce more immersive responses than the life-bar or no feedback conditions.
2. The ThreatFire™ belt condition would perform better than the other conditions.
3. The measures of trait uncertainty would a) correlate with immersion responses and b) act as a moderator of the stress experience.

Methods

Participants

A total of 18 male participants were recruited. The participants were current military, police and special reaction team personnel. These groups of people are similarly trained and weapon qualified at least as a marksman. All participants ranged in age from 27 – 48, $M = 34$. A Health Screening was used to determine possible risk to participants. No participants were excluded due to potential risk. In order to keep personal identification private, each participant was assigned a unique identification number. This number was the only identifier on all data collected. All participants were instructed not to eat or drink for 30 minutes prior to arrival at the CASEL. This requirement ensured that the saliva would not be diluted or that the amylase activity measured was not related to food consumption. Participants did not receive compensation for their time.

Procedures

Data collection was conducted one participant at a time. In order to keep personal identification private, each participant was assigned a unique identification number. This number was the only identifier on all data collected. Test participants experienced a demonstration shock prior to signing the volunteer agreement. This was to ensure full knowledge of what they would experience. All participants were informed that they might receive small welts at the location where the shock made contact with their skin. They were instructed to contact the researcher know if any discomfort existed after six

hours. The tenderness associated with these welts was not noticeable within an hour of completion; many of the participants had to be reminded about the possibility of welts. Of concern throughout the study was an unexpected reaction to the shock. Precautions were taken to minimize any adverse effects. Therefore, all participants wore the same amount of clothing, were reminded several times during their participation that they could withdraw at anytime without penalty; during the shock condition they were reminded that they could take off the belt or press the power button.

Then, after signing the volunteer agreement, they completed the demographics survey, uncertainty measures, and the Immersion Tendency Questionnaire. Next, participants donned the LifeShirt and a researcher ensured proper fit and electrode pad and SAO2 sensor and turned on the data collection box. At this point the participant was asked to stand quietly for 10 minutes to collect baseline physiological measures and at the end of the 10 minutes a saliva sample was collected while they completed the “right now” version of the Multiple Affect Adjective Check List-Revised (MAACL-R).

Then the participants began the training. The training and familiarization was conducted following the baseline data collection. The training and familiarization allowed the participant to interact in the same way they would during the experimental conditions. This training also allowed the participants to adjust their aiming techniques. Once the training and familiarization was over, about 10 minutes, each participant provided a saliva sample and completed the SSE and “right now” form of the MAACL-R. This served as the pre-measure. Following this, the participant was informed of the condition they would be participating. If they are in the shock condition, the researcher placed the ThreatFire™ belt on the participant just as during the demonstration shock.

The no-feedback and life-bar conditions followed the same procedure minus the ThreatFire™ belt aspects. Breaks were offered after each condition.

All participants then engaged in three pre-programmed scenarios. The first scenario was a parking lot surrounded by buildings, trees, cars, and a temporary work trailer. See Figures 1a, 1b, and 1c. The M4 Carbine rifle used in the simulator was fitted with a laser in the barrel and a clip specially designed to hold CO2 simulated the same amount of recoil as one would experience when shooting live rounds.

Instrumentation and Facilities

Experimental Apparatus:

ThreatFire™ belt: The ThreatFire™ (*Figure 2*) safe return fire system uses a rechargeable battery pack and delivers a 200 millisecond to 2.5 second electric shock to simulate the pain of hostile return fire. The United States Marine Corp and the Air Force (USAF) use the same system but in training. Following the USAF procedures, this project also used a 200-millisecond electric shock. To date, only one scientific report has been published (Patton, Loukota, and Avery, 2013). The system has a dual built-in safety control that does not allow a continuous electric shock to be delivered and only ‘fires’ once every 30 seconds at the earliest alternating between the two electricity housing units.

Insert Figure 2 here

M4 Carbine: The M4 Carbine rifle (*figure 3*) used in the simulator was fitted with a laser in the barrel and a clip specially designed to hold CO2 that simulates the same amount of recoil as one would experience when shooting live rounds on a training range. This shooting scenario served as training.

Insert Figure 3 here

Facilities

The facility used was the Cognitive Assessment and Simulation Engineering Facility (CASEL). The simulation room houses the 300-degree immersive simulator. Data collection was conducted here. See *Figure 3*.

Insert Figure 3 Here

Materials, Tests, Tasks, and Stimuli

Consent Form: (Appendix F) A form was used to document voluntary consent.

Health Screening Form: (Appendix G) The health screening form was used to identify issues precluding participation. The VirTra's ThreatFire™ Belt documentation states that persons with a pace maker or heart condition cannot participate. ARL-HRED does not have expertise to assess an individual's physical fitness and therefore, relied on the potential volunteer to report their condition accurately. If participants answered yes to either question then they would be released from participation.

Demographic Questionnaire: (Appendix H) The demographic questionnaire asked about general demographic information such as age, virtual game play, hours of game play, etc.

Uncertainty Response Scale: (Appendix I) (Greco & Roger, 2001). The URS contained 48-items designed to predict individual differences in coping with uncertainty. The Uncertainty Response Scale has three factors: Emotional Uncertainty (EU), Desire for Change (DFC), and Cognitive Uncertainty (CU). Participants rate statements on the

degree to which each statement relates to them using a 5-point scale: 1 = Never, 5 = Always. Scores for subscales are determined by totaling the point value of statements associated with each subscale. Higher scores indicate a greater tendency toward maladaptive responses to uncertainty (EU), greater enjoyment of the unknown (DFC), and greater preference for control under uncertain conditions (CU). The author administered the URS only one time at the beginning of the study.

Immersive Tendencies Questionnaire: (Witmer & Singer, 1998) (Appendix J)

The ITQ measures one's capability or tendency to be involved or immersed. It consists of 29 questions about involvement in common activities (identifying with a character in a movie, a video game, current fitness and alertness, etc.)

Presence Questionnaire: (Witmer & Singer, 1998) (Appendix K) The PQ has 32 questions that measures the degree to which one experiences presence in a virtual environment and the influence of possible contributing factors (control factors, sensory factors, distraction factors and realism factors) on the intensity of the experience.

Slater-Usuh-Steed Questionnaire (SUS): (Usuh, Arthur, Whitton, Bastos, Steed, Slater, et al. (1999). (Appendix L) The SUS contains seven questions with ratings from 1 to 7.

Physiological Measures of Arousal:

One-inch square sponges were used for the collection of saliva. They were obtained from Andrology Labs, Chicago, IL.

Salivary Amylase: The new salivary amylase field test was performed to derive a quantifiable level of stress (Fatkin, Patton, Burton & Carty, 1999). This assay used a colorimeter to observe the chemical color change according to standard photometric procedures developed by Andrology Labs and Northwestern University (Jeyendran,

Ramu, S. & Chatterton, R.T., 2011). The concentration of amylase was then determined from a table of values relating time of color change to amylase activity.

Saliva samples are collected by placing a 1" x 1" square sponge in your mouth. If participants choose, they may spit directly into a specimen vial. The sponge needs to be rolled, not chewed, around in the mouth for one minute until it was saturated. The saliva samples were used to calculate physiological stress levels. Following the measure of physiological stress, once the collected sample has been squeezed into plastic tubes, the sponge was discarded in the garbage. For each sample collected from the specified times, the same saliva sample was be used for the amylase assays. The salivary amylase assay was performed in the CASEL with the newly developed field assay.

LifeShirt: A lightweight (8 oz.), machine washable shirt with embedded sensors. Respiratory function sensors are woven into the shirt around the patient's chest and abdomen. These sensors provided measurements of respiration, heart rate, heart rate variability, and galvanic skin response. It cycles at 200 Hz, which was recommended and the typical sampling rate for HRV data sampling. The shirt was connected to electro pads placed on the wearer's body. See *Figure 4*.

Insert Figure 4 here

Psychological Measures of Arousal:

The following measures were administered as questionnaires using paper and pencil.

Multiple Affect Adjective Checklist – Revised: (Appendix M) The Today form of the Multiple Affect Adjective Checklist – Revised (MAACL-R; Lubin & Zuckerman, 1999) was administered. This form consists of a list of 132 adjectives in which

participants were instructed to check all those words describing how they “feel right now,” or “have during the scenario they just completed.” The MAACL-R assessed six validated subscales: anxiety, depression, hostility, sensation seeking, positive affect, and dysphoria.

Situational Self-Efficacy (SSE) Scale: (Appendix N) The SSE (Bandura, 1977) was administered to evaluate the predictive power of efficacy expectations about behavior or task performance. Participants were asked to rate (from 1 to 10) their level of confidence in their ability to do well in their upcoming task (Sherer, Maddux, Mercandante, Prentice-Dunn, Jacobs, & Rogers 1982).

Exit Survey: (Appendix O; a, b, c) Three versions of an exit survey were administered to all participants upon completing each feedback condition. Each version asked about perceived level of immersion, perceived performance, and has open space for any additional comments. The shock condition asked specific questions regarding the ThreatFire™ belt. Participants selected their responses on a scale of one to ten.

Tasks and Stimuli

Each participant, one by one, participated in three pre-programmed scenarios. The first scenario was the training scenario. This provided experience with how the weapon fired by providing a shot marker on the screen where the laser hit the screen and to practice in a similar scenario to the experimental scenarios. Each scenario lasted approximately 10-22 minutes. Minor Technical difficulties caused the scenarios to run over. Technical difficulties include the weapon’s magazine ran out of CO2, if the participant requested a pause, if the physiological-data collection box failed, or if parts of the software running the scenarios crashed.

Each scenario used all five screens to provide 300 degrees of visibility. The scenes took place on a bombed street somewhere in the Mideast, in a quarry, an industrial

area or parking lot surrounded by buildings and trees. Target pairs were presented in various locations within each scene (e.g. behind a car, wall, building, natural terrain, rocks). The foe targets pointed and fired a M-9 pistol weapons at the participant. The friend targets performed actions like handing over a soda, pulling out a wallet, or showing the “I surrender hands.” The target pairs were either two friendly or one enemy and one friend. Two enemy targets were not presented. The participants were instructed to only shoot at the foe targets. Based on SME input, we used a two-second-presentation to induce a hasty decision. The interval between target pairs displays varied between two, four and six seconds. This inter-trial interval was used to minimize a pattern effect. There were a total of 128 target pairs that could be presented. There were 64 friend target pairs and 64 foe target pairs. The no feedback condition was the only condition that presented all target pairs. In the shock and life-bar condition, a shock or change in the life bar occurred when a foe was not hit and a minimum of 30 seconds had passed since the last shock or change in life bar. Therefore, both conditions were capable of providing feedback not more than 15 times.

Just prior to target presentation an indicator sound was activated. Because the military and first responders work with a partner, an indicator sound was presented from the screen it appeared. This sound acted as a virtual partner. The sound indicated where the participant should focus his attention and that his “partner” has the rest covered. During the shock condition, they received a small shock based on their performance during the scenario. That was, if they miss a foe target they may receive a small shock as delivered by the Threat-Fire™ belt. Each shock was considered to a wound rather than a lethal hit until the final shock and the screen indicated the scenario ended. They were

also told that even if they shoot the proper target, there was a chance that they may receive a small shock because the target has the potential to fire while falling to the ground. The life-bar condition turned a “life” from green to red when the participant was injured until the last box turned red and the scenario ended. Target pairs were presented on the same screen for two seconds.

Design

A within subjects repeated measures design was used to investigate the level of presence in a 300-degree immersive simulator.

The independent variables were trait uncertainty and immersion susceptibility as measured by the Immersive Tendency Questionnaire (Witmer and Singer, 1998). The dependent measures were the subjective stress appraisals via the MAACL-R, physiological measures through salivary amylase, and subjective reports of immersion in the simulation. Baseline psycho-physiological measures were collected. Initially a recovery collection was planned but based on the pilot study by Patton, Loukota, and Avery (2013) this was deemed not necessary. A dependent measure, performance, was response accuracy on target identification as identified by firing the weapon at the appropriate target.

Results

The main finding of this study was that the shock condition significantly affected performance on decision-making compared to the life-bar and no feedback conditions. The shock condition significantly increased errors in decision-making. An incorrect decision was when a shot was fired at a friend or not an enemy. A correct decision was when a shot was fired at an enemy or not at a friend. The data was checked for outliers. Any values above 3.1 were removed before further analyses were

conducted. The data was checked for skewness and any data higher than 2 was transformed by the SQRT before conducting analysis. The Pillai's Trace statistic was used if MANOVA data did not meet the sphericity test. General Linear Model (GLM) Repeated Measures were used in all analyses. If the multivariate model was significant then a post-hoc univariate ANOVA or paired T-tests were used to determine specific differences. The Greenhouse-Geisser statistic was reported if the data in the univariate test violated assumptions.

PERFORMANCE

A GLM Repeated Measures was used to test for differences between the feedback conditions for correct and incorrect decisions.

A GLM Repeated Measures indicated a significant difference in performance. The number of incorrect decisions was significantly different between conditions (Wilks' lambda (2,16) = 15.532, $p < .05$, partial eta squared = .660, power = .997). Paired t-tests indicate that the shock condition produced significantly more decision errors compared to both the life bar, $t(17) = 3.762, p < .05$, and no feedback conditions $t(17) = 5.745, p < .05$. *Figure 5* shows the mean percent incorrect decision and *Figure 6* shows the mean percent correct decisions. The number of correct decisions was significantly different between conditions (Wilks' lambda (2,16) = 15.375, $p < .05$, partial eta squared = .658, power = .997). Paired t-tests indicate that the shock condition produced significantly fewer correct decisions compared to both the life bar, $t(17) = -3.259, p < .05$, and no feedback conditions $t(17) = -5.690, p < .05$.

Insert Figure 5 and 6 here

Shots Fired. Although this data was not part of the initial proposal, viewing the data it seemed to make sense to discuss it.

Figure 7 shows the total shots fired by condition. The no feedback condition produced more shots fired because all 128 pairs of targets were presented. The shock condition produced 2257 shots, roughly 2% less than the no feedback yet about 20% more than the life-bar condition. The life-bar condition produced 1810 shots, about 20% fewer than the no feedback condition.

Insert Figure 7 here

Figure 8 shows the total number of presented targets. The no feedback condition presented all 128-target pairs, the shock condition showed on average 85 and the life-bar condition showed on average 89. The shock and life-bar condition presented roughly 30% less targets than the no feedback condition.

Insert Figure 8 here

IMMERSION

Pre Immersion

Immersion Tendency Questionnaire (ITQ). The highest possible immersion tendency score was 203. The participants in this study report on average score of 94.36 with a minimum value of 74 and a maximum value at 134. To investigate the relationship between pre-immersion tendency and the dependent measures a Pearson R correlation between ITQ and the dependent measures was performed. The Pearson R correlation indicated a significant correlation between ITQ and α -Amylase during the shock condition ($r(17) = .529, p < .05$).

Post Immersion

Presence Questionnaire (PQ). A GLM Repeated Measures did not indicate significant differences. The means and SEMs for each are listed in Table 3.

Exit Survey. A GLM Repeated Measures indicated a significant difference in reports of immersion between conditions. The level of immersion was significantly different between conditions (Wilks' lambda = (.455); $F(2,16) = 9.567, p < .05$, partial eta squared = .545, power = .953). Paired t-tests indicate that significantly higher levels of immersion were reported in the shock condition compared to both the life bar, $t(18) = 4.267, p < .05$, and no feedback conditions $t(18) = 3.497, p < .05$.

Slater-Usch-Steed Questionnaire (SUS). A GLM Repeated Measures indicated a significant difference between conditions (Wilks' lambda = 0.489; $F(2,16) = 8.356, p < .05$), partial eta squared = .511, power = .923). Paired t-tests indicate that significantly higher levels of immersion were reported in the shock condition compared to both the life bar, $t(18) = 2.607, p < .05$, and no feedback conditions $t(18) = 4.007, p < .05$.

PHYSIOLOGICAL MEASURES

Because the purpose was to test the hypotheses for changes in effect, the baseline measurements are not included as covariates in the analyses.

Heart Rate. A GLM Repeated Measures model indicated a significant difference between conditions (Wilks' lambda = 0.190; $F(2,14) = 11.743, p < .05$, partial eta squared = .810, power = .997). Paired T-tests indicate a significant increase in heart rate from pre to the shock condition ($t(14) = -6.310, p < .05$), and to the life-bar ($t(14) = -6.208, p < .05$) and to the no feedback condition ($t(14) = -4.489, p < .05$). See *Figure 9*.

Heart Rate Variability (Inter-beat Intervals) (RR). A GLM Repeated Measures model used on the RR indicate significant differences between conditions (Wilks' lambda = 0.150; $F(3,11) = 15.557, p < .05$, partial eta squared = .850, power = 1.000). Paired T-tests indicate a significantly more variability in the pre measurement compared to both the life bar ($t(15) = 7.340, p < .05$) and no feedback conditions, ($t(15) = 5.237, p < .05$). The paired t -tests indicate a significantly more variability during baseline compared to the shock ($t(15) = 6.266, p < .05$), life bar ($t(15) = 3.866, p < .05$), and the no feedback conditions ($t(15) = 3.585, p < .05$). See *Figure 10*.

Pulse Oxygen Saturation. A GLM Repeated Measures model used on the SAO2 indicate no differences between conditions. See *Figure 11*.

α -Amylase. A GLM Repeated Measures model indicated no significant difference for the raw data. To control for the large individual variance in the α -Amylase, percent changes between conditions were calculated. A GLM Repeated Measures model indicates no significant differences. See *Figure 12* for means \pm SEMs. A Paired t -test was conducted to test for differences between the pre collection and the shock collection. The t -test was significant ($t(16) = -2.323, p < .05$).

PSYCHOLOGICAL MEASURES

Multiple Affect Adjective Check-List Revised (MAACL-R). A GLM MANOVA indicated a significant difference between conditions for (Pillai's Trace = 1.007; $F(24) = 3.700, p < .05$, partial eta squared = .252, power = 1.000). Univariate ANOVA was used to identify specific measures with significant differences among conditions. Finally, paired t -tests were used identify the specific differences between conditions. The Grenhouse-Geisser model was used if assumptions were violated.

Anxiety. A univariate ANOVA indicated a significant difference among conditions (Greenhouse-Geisser = 6.054 (2.755), $p < .05$, partial eta squared = .263, power = .930) for the anxiety subscale. Paired t-tests indicate that baseline anxiety is significantly lower than the shock condition ($t(16) = -2.323, p < .05$). Paired t-tests indicate a significant increase in anxiety for the shock condition compared to the life bar ($t(17) = 5.004, p < .05$); and no feedback conditions ($t(17) = 3.751, p < .05$). See *Figure 13*.

Depression. A univariate ANOVA did not indicate significant differences among conditions for the depression subscale. See *Figure 14*.

Hostility. A univariate ANOVA indicated a significant difference among conditions (Greenhouse-Geisser = .11.324 (2.681), $p < .05$, partial eta squared = .400, power = .998) for the hostility subscale. Paired t-tests indicate that baseline hostility is significantly lower than during the shock, ($t(17) = -5.365, p < .05$); life bar ($t(17) = -2.656, p < .05$); and no feedback conditions ($t(17) = -2.870, p < .05$). Paired t-tests indicate a significant increase from pre to during the shock condition ($t(17) = -3.917, p < .05$). Paired t-test indicates a significant increase during the shock condition compared to life bar ($t(17) = 4.252, p < .05$); and no feedback conditions ($t(17) = 3.515, p < .05$). See *Figure 15*.

Positive Affect. A univariate ANOVA indicated a significant difference among conditions (Greenhouse-Geisser = 8.895 (2.816), $p < .05$, partial eta squared = .344, power = .990) for the positive affect subscale. Paired t-tests indicate that baseline positive affect is significantly higher than during the shock, ($t(17) = -5.365, p < .05$); life

bar ($t(17) = -2.656, p < .05$); and no feedback conditions ($t(17) = -2.870, p < .05$). See *Figure 16*.

Sensation Seeking. A univariate ANOVA indicated a significant difference among conditions (Greenhouse-Geisser = 3.221 (2.333), $p < .05$, partial eta squared = .159, power = .625) for the sensation seeking subscale. The effect size and power are not strong enough with the current number of participants. Paired t-tests indicate that baseline sensation seeking is significantly lower than the pre collection ($t(17) = -2.400, p < .05$), shock condition ($t(17) = -2.462, p < .05$) and compared to life bar ($t(17) = -2.469, p < .05$). See *Figure 17*.

Dysphoria. A univariate ANOVA indicated a significant difference among conditions (Greenhouse-Geisser = 7.653 (2.562), $p < .05$, partial eta squared = .310, power = .966) for the dysphoria subscale. Paired t-tests indicate that baseline dysphoria is significantly lower than during the shock condition ($t(17) = -5.071, p < .05$), Paired t-tests indication that the pre collection is significantly lower compared to the shock condition ($t(17) = -2.614, p < .05$) and the shock condition is significantly higher than the life bar ($t(17) = 4.235, p < .05$) and no feedback conditions ($t(17) = 3.856, p < .05$). See *Figure 18*.

CORRELATIONS

Uncertainty Response Scale. To investigate trait uncertainty as a mitigation of the stress experience, Pearson R correlations were used.

Emotional Uncertainty (EU). EU was significantly and positively correlated with levels of hostility experienced in the no feedback condition ($r(17) = .597, p < .05$).

Desire For Change (DFC).

Desire for Uncertainty (DFC). DFC was significantly and positively correlated with levels of hostility experienced in the no feedback condition ($r(17) = .686, p < .05$).

Cognitive Uncertainty (CU). CU was significantly and positively correlated with levels of hostility experienced in the no feedback condition ($r(17) = .662, p < .05$).

CONFIDENCE

SSE and MAACL. Levels of confidence in performing well during the experiment negatively correlated with pre measures of depression ($r(16) = -.53, p < .05$), hostility ($r(16) = -.54, p < .05$) and dysphoria ($r(16) = -.51, p < .05$).

SSE and Performance. Confidence is correlated with performance. SSE negatively correlated with incorrect decisions in the shock ($r(16) = -.55, p < .05$), life bar ($r(16) = -.64, p < .05$), and no feedback ($r(16) = -.57, p < .05$) conditions. SSE positively correlated with correct decisions in the shock ($r(16) = .53, p < .05$) and life bar ($r(16) = .49, p < .05$) conditions.

Immersion and Psychological. The SUS during the shock condition negatively correlated with levels of positive affect ($r(18) = -.500, p < .05$). Positive affect during the shock condition also negatively correlated with SUS and exit survey immersion question during the no feedback conditions ($r_{\text{SUS}}(18) = -.716, p < .05$; $r_{\text{SUS}}(18) = -.559, p < .05$). Baseline positive affect positively correlated with the shock condition exit survey immersion question ($r(18) = .476, p < .05$) and with the no feedback condition exit survey immersion question ($r(18) = .494, p < .05$).

Post Immersion and Physiological. No significant correlations between immersion, HR, RR, SAO2, and α -amylase were found.

Post Immersion and Psychological. Pre anxiety positively correlated with the exit survey immersion question during the life-bar condition ($r(18) = .510, p < .05$).

Discussion

This thesis focused on immersion as measured by responses to psychological and physiological variables under three feedback conditions, shock, the life-bar image, and no feedback. There were three hypothesis: 1) The shock feedback would induce more immersive responses than the life-bar or no feedback conditions, 2) The shock condition would produce better performance than the other conditions, 3) The measures of trait uncertainty would a) correlate with immersion responses and b) act as a moderator of the stress experience. Of the three, hypothesis one and 3b were supported.

This thesis supports Witmer and Singer's argument that the presence experienced in an IVR requires the ability to focus on the task without notice to unrelated stimuli. Bomyea, Amir, and Lange (2012) suggest that goal-directed behaviors allow for participants to use cognitive control to maintain attention on the scenario while inhibiting irrelevant information (external stimuli). Participants in this study reported that the external stimuli did not interfere with their experience. Therefore, their goal-directed behavior of shooting the enemy and not shooting friendly targets in order to not get shot added to their cognitive load in the Shock condition. This may account for more friendly targets being shot, and may point to recommendations for a change in training method that can mitigate the individual's cognitive load. To validate this conjecture, a follow-up study that measures cognitive load is recommended.

The Witmer and Singer post immersion questionnaire did not provide any information regarding immersion. However, the one question on the exit survey used in this study did. Ma and Kaber (2006) reported they found similar findings using two

questions relating to immersion versus the existing validated questionnaires like that of Witmer and Singer. Huang and Alessi (1999) suggest that measuring presence through subjective measures, behavioral observation, and facial analysis would lead a better understanding of the virtual experience. In this study, although behavioral and facial analyses were not conducted, they were certainly noticeable. Often after the shock condition, the participants displayed the behavior of trying to avoid getting shot or squinting their face in preparation of a potential shock. But not when the shock condition was last. Incorporating some of the newer presence questionnaires may provide other information about presence and involvement. A factor analysis of all the questions used in this study may bring forth a new subjective questionnaire that would measure presence in a 300-degree simulator.

Although one finding in this study showed that the shock condition significantly affected performance on decision-making compared to the life-bar and no feedback conditions it was contrary to the hypothesis. An incorrect decision was when a shot was fired a friend or not an enemy. A correct decision was when a shot was fired at an enemy or not at a friend. The shock condition significantly increased errors in decision-making such that more friendly targets were shot. During the out brief after the experiment was complete, many of the participants said that they shot at all targets because they felt they had a better chance of not getting “shot.” As expected, we did find a positive correlation with confidence and performance. The more confidence one had in their ability to perform during the experiment, the better they did and the less confidence one, the worse they performed.

Although not part of the exit survey, participants were asked how many shocks they think they received. Most answered less than 5; they all received 15. This may be because the shock scenario required more cognitive resources in order to focus on identifying and shooting the targets. If they made contact with the enemy target, they would not receive a shock. This may reflect that the cognitive load was too great to focus and make a precise decision. From a training standpoint, Wirth, Kunsting, & Leutner (2009), explained that cognitive load might be higher in the shock condition, and therefore detrimental to training performance, because the specific instructions, shoot only the enemy, seem to restrict shooters to a specific strategy whereas nonspecific instructions allow them to use a learning strategy. Wirth, Kunsting, & Leutner (2009), concluded that in order for training to be effective, participants must be provided with goals that allow them to employ their own learning strategy. Additionally, providing them with nonspecific goals should decrease cognitive load and, thus, enable participants to learn with less effort.

As indicated in Hypothesis 3(b), trait uncertainty seems to act as a moderator of the stress experience. According to Bar-Tal & Spitzer (1999), one's decision-making patterns in uncertain situations are often related to personality traits and coping styles. The feedback condition with the highest level of uncertainty regarding individual performance was expected to be the No Feedback condition. The significant and positive correlations with levels of hostility or frustration experienced in the No Feedback condition supported the hypothesis. Individuals with a predisposition toward maladaptive responses to uncertainty or a preference for control indicated they

experienced higher levels of hostility or frustration when they were not provided with and performance feedback.

Research suggests that low heart rate variability and anxiety are related. This thesis did not find support for this using RR as a measure. Future assessment should include the low-frequency variability in heart rate and to look closer at the QT interval. The QT interval, time between the Q and T in the heart rate waveform, increases in response to mental stress (Taylor, et. al 2007, Pagani, Furlan, Pizzinelli, et. al. 1989, & Dinca-Panaitescu, Dinca-Panaitescu, Achim, Negoescu, 1999).

Patton, Loukota, and Avery (2013) ran a pilot study using the same equipment. The main point in that study was to test that all systems worked together and that the data output and collection was useful. They did find that all systems worked well except for the GSR. The GSR system was not sensitive enough for this type of simulation and caused the system to ceiling. Therefore, GSR was not collected in this study. Instead, SAO2 was collected. SAO2 did not show differences, although the means during the shock and life-bar conditions dipped below 92. 92% saturation is considered a response to stress. There was a large variability within the shock and life-bar conditions. One way to tease out any differences might be to break down these two conditions into more time points during each condition. The dips may be significant at the times the shock occurred or when a life-bar turned red. The SAO2 measurement did not show significant differences. On a closer look at the data, it may be a good idea to look at the data where it surrounds the shock or loss of life in the life bar condition.

The α -amylase data did not show differences among conditions in the MANOVA. However, the average values during the baseline and shock conditions were considered

on the upper end of moderate to high levels of stress; pre collection time, mild to moderate and the life bar and no feedback are moderate. A moderate level is believed to be where vigilance occurs. For a training purpose, the life-bar and no feedback may prove to be good training procedures, but if you want to test the training putting the shock condition in you can assess the reality of the training. There was a significant increase in amylase from the pre-collection to the shock condition. This indicates that the shock condition was more stressful than after training but the other conditions did not show the same effect.

Limitations and Future Directions

The current study used very limited motion such as squat to stand, step out and return. Producing more realistic scenarios by creating more naturalistic moving targets, incorporating props and allow for no shocks received if taking cover, could increase the immersive experience.

When considering the performance measures, because there was no penalty for shooting a friendly target, this may be the result in the shooting of ore friendly targets in the shock condition. In the future, adding a penalty for shooting a friendly may provide a more realistic measure of performance under stress. Another possibility would be to limit the number of rounds in the magazine to replicate the real number of rounds in an M-4. This process would also keep the breaks in the scenario to those only of the technical nature.

While investigating psycho-physiological measures of stress, it might be useful to assess amylase as a moderator of the stress experience as suggest by TaKai, Yamaguchi, Aragaki, Eto, Uchihashi, and Nishicawa (2004). They reported that α -Amylase was a

better index of stress than cortisol in a stressful situation and that it acts as a soother or relaxation index. Therefore, the author suggests using the data from this study and any future studies to compare them to those of existing high stress military training exercises.

Consideration should be given to adding other cognitive stressors. By limiting the number of rounds per magazine would require the participant to keep track of how many bullets remain in the clip and for the inevitable changing of the magazines. Other cognitive stressors might include situational awareness. This could be obtained by asking question about the surrounding areas or of the targets themselves. Because stress affects memory, the shock condition should affect one's memory of the target or other variables in the scenario. The possibilities are endless.

APPENDICES

Appendix A: Tables

Table 1: Immersion and Presence Measurements

Subjective Measures	
Presence Questionnaires	
Barfield et al. Questionnaire	Swedish Viewer-User Presence Questionnaire (SVUP)
Cho et al. Questionnaire	Lombard & Ditton Questionnaire
Dinh et al. Questionnaire	Nowak & Biocca Questionnaire
Gerhard et al. Questionnaire	Schroeder et al. Questionnaire
Igroup Presence Questionnaire (IPQ)	Thie & Van Wijk Questionnaire
ITC-Sense of Presence Inventory (ITC-SOPI)	Bailenson et al. Questionnaire
Kim & Biocca Questionnaire	Basdogan et al. Questionnaire
Krauss et al. Questionnaire	CMC Questionnaire / Social Presence and Privacy Questionnaire (SPPQ)
Murray et al. Questionnaire	GlobalEd Questionnaire
Nichols et al. Questionnaire	IPO Social Presence Questionnaire (IPO-SPQ)
Object Presence Questionnaire (OPQ)	Networked Minds Questionnaire
Presence Questionnaire (PQ)	Para-Social Presence Questionnaire
Questionnaire on Presence and Realism	Semantic Differential Technique
Reality Judgment and Presence Questionnaire	
Slater-Usuh-Steed Questionnaire (SUS)	
Continuous Assessment	
Qualitative Measures	
Autoconfrontation Method	Interaction Analysis
Content Analysis	Interview
Ethnographic Observation	Presence Probe
Experience Sampling Method (ESM)	Repertory Grid Analysis
Focus Group Exploration	Thinking Aloud
Free Format Self-Reports	
Psychophysical Measures	
Cross-Modality Matching (CMM)	
Free-Modulus Magnitude Estimation	
Paired Comparison	
Virtual Reality Turing Test	

Subjective Corroborative Measures

Breaks in Presence (BIPs)
Duration Estimation
Simulator Sickness Questionnaire (SSQ)
Memory Characteristic Questionnaire (MCQ)
Attention/Awareness
Spatial Memory
Spatial Memory Awareness States
Gravity-Referenced Eye Level (GREL)
Subjective Tilt Angle

Objective Corroborative Measures

Psychophysiological Measures

Cardiovascular Measures
Skin Measures
Ocular measures
Facial Electromyography (EMG)

Neural Correlates

Electroencephalogram (EEG)
Functional Magnetic Resonance Imaging (fMRI)

Behavioural Measures

Facial Expression
Nulling
Postural responses
Pointing (conflicting cues)
Reflex Responses
Social Responses

Task Performance Measures

Completion Time and Error Rate
Number of Actions
Secondary Task Performance
Transfer

Table 2. Means and SEMs for the PQ

Descriptive Statistics			
	N	Mean	
	Statistic	Statistic	Std. Error
shock	18	128.22	5.129
life	18	122.50	6.399
none	18	124.72	5.808
Valid N (listwise)	18		

Shock = shock condition, life = life-bar condition, none = no feedback conditon

Appendix B: Figures



Figure 1a. Background for scenario one, the quarry.



Figure 1b. Background for scenario two, the island.



Figure 1c. Background for scenario three, bombed street.

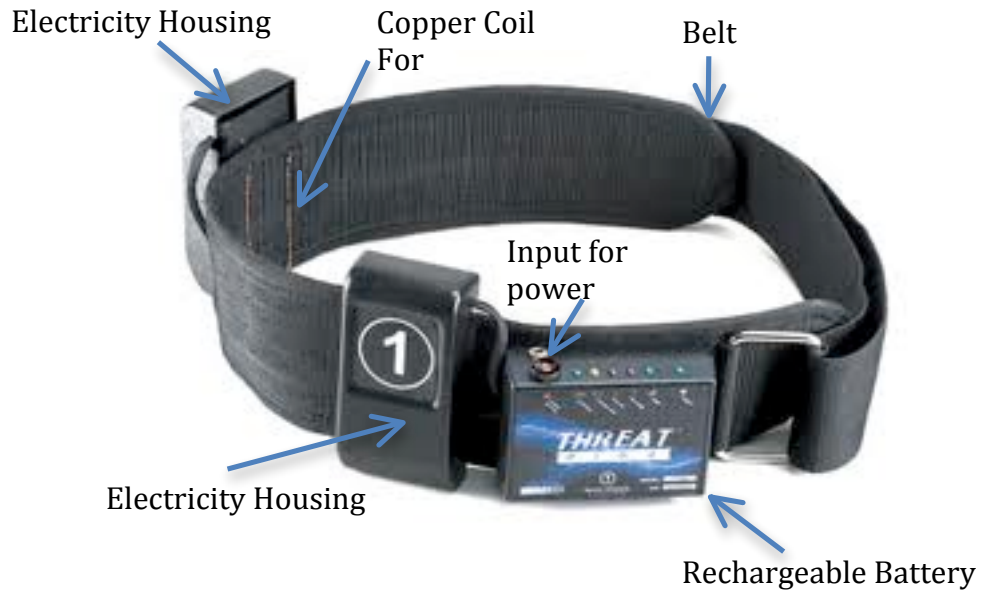


Figure 2. ThreatFire™ Belt with two electrical housings and a rechargeable battery.



Figure 3. M-4 Carbon rifle.



Figure 4. 300-Degree Simulator by VirTra.



Figure 5. LifeShirt by VivoNoetics.

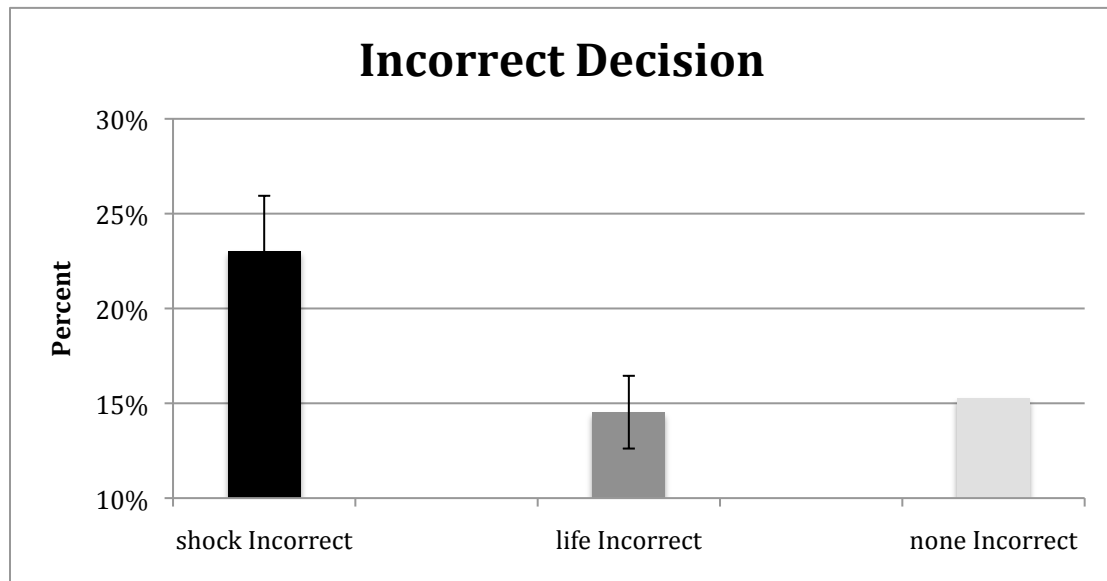


Figure 6. Percent \pm SEM decision accuracy by condition.

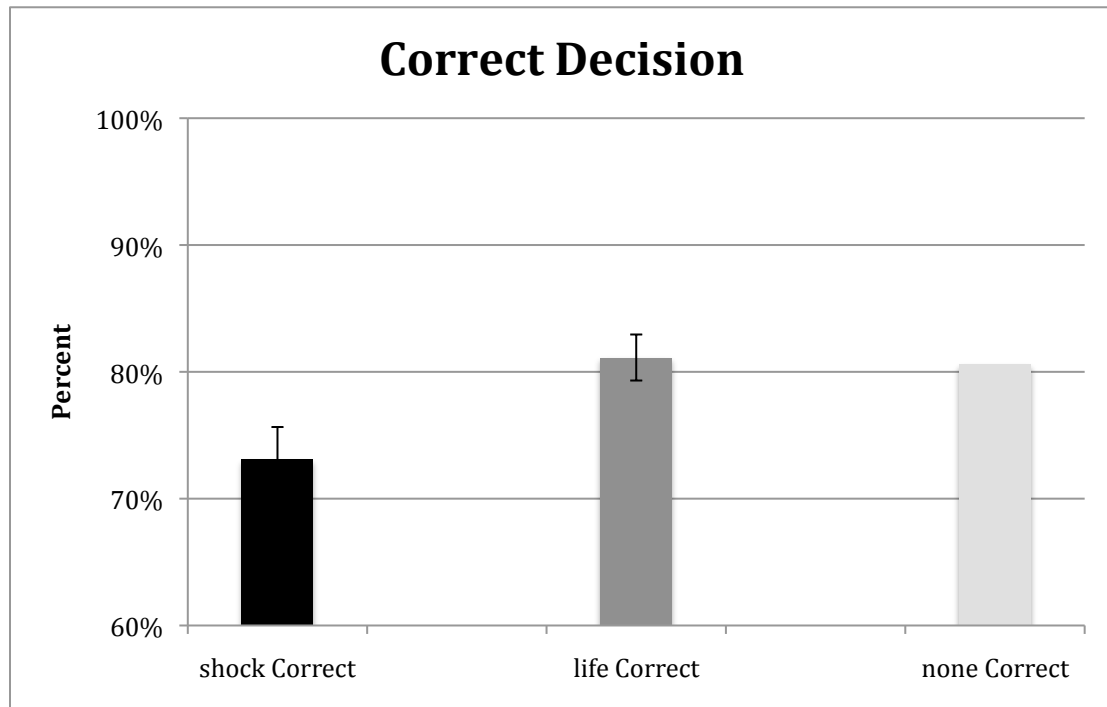


Figure 7. Percent \pm SEM decision accuracy by condition.

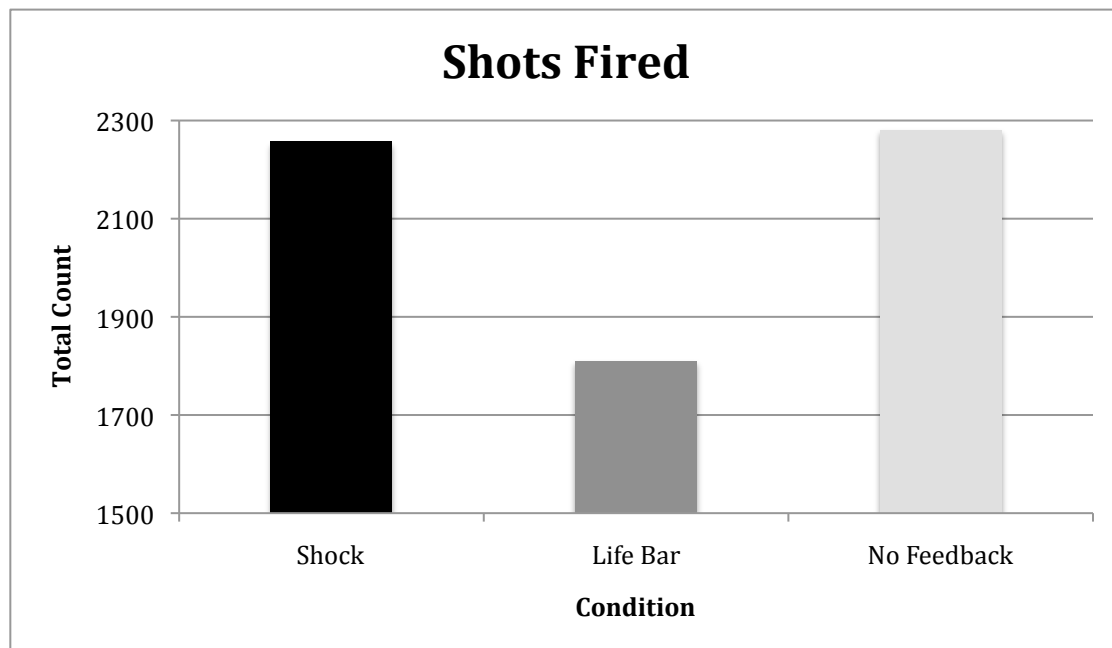


Figure 8. Total shots fired by condition.

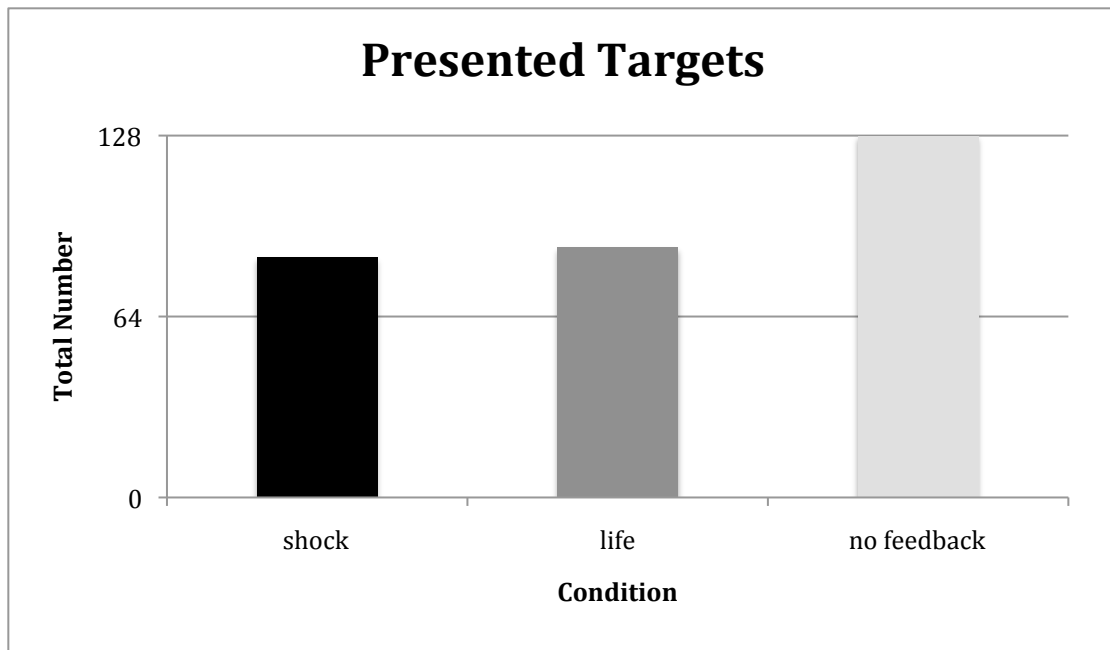


Figure 9. Total presented targets by condition.

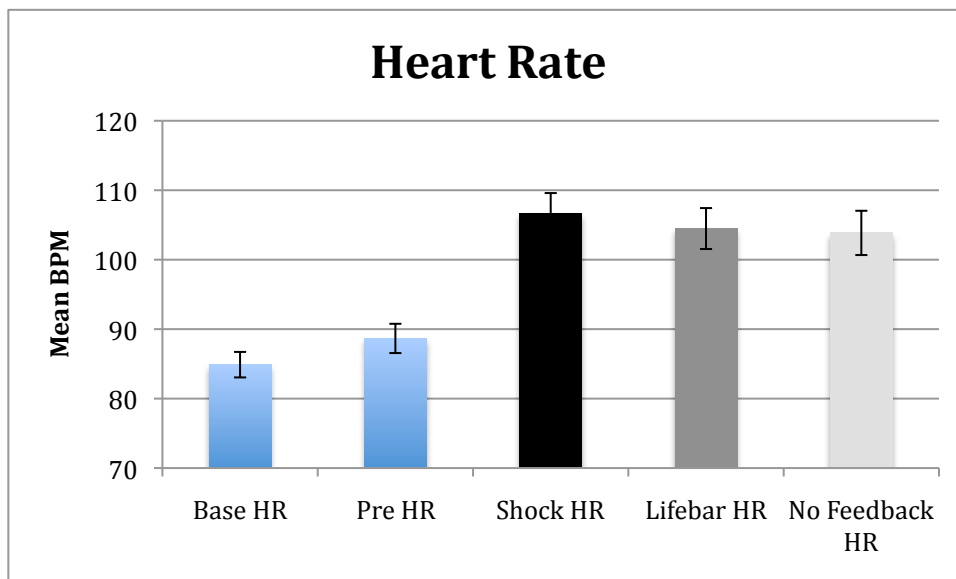


Figure 10. Mean heart rate (bpm) \pm SEM by condition.

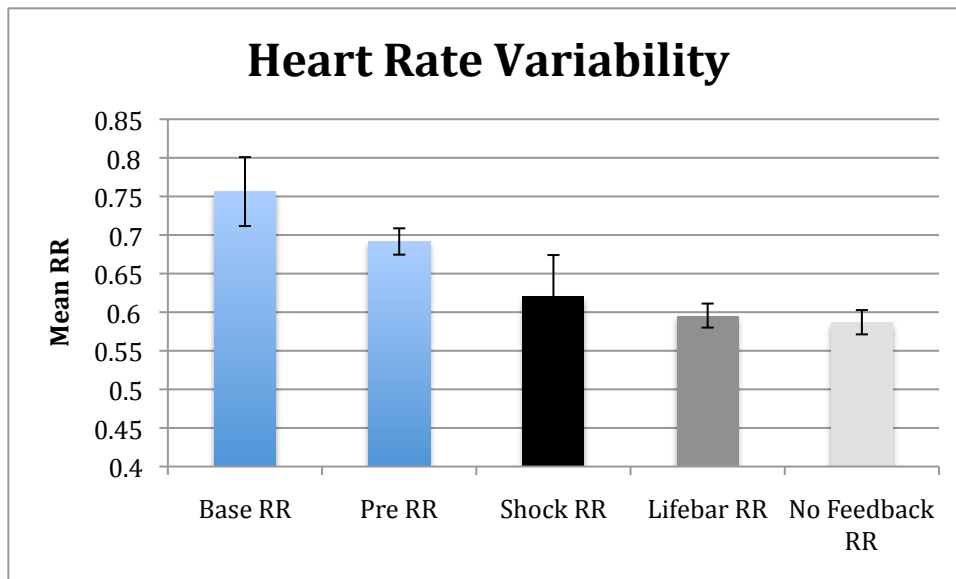


Figure 11. Mean heart rate variability by condition.

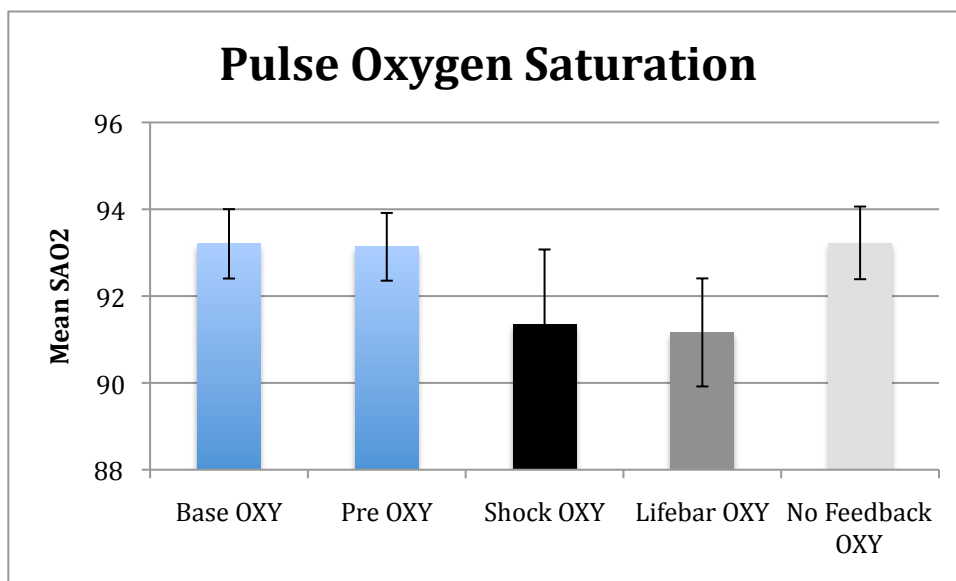


Figure 12. Mean pulse oxygen saturation by condition.

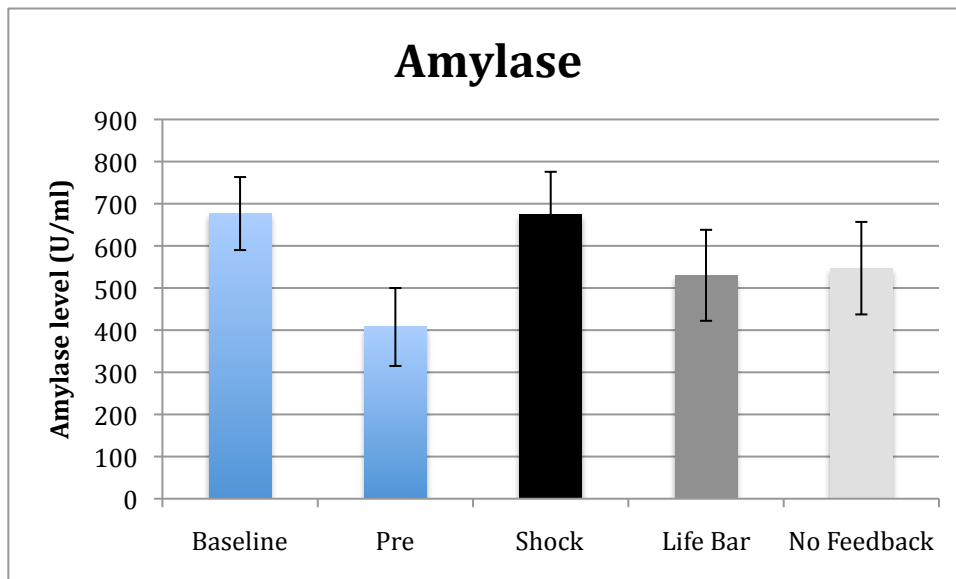


Figure 13. Mean \pm SEM Salivary SAA.

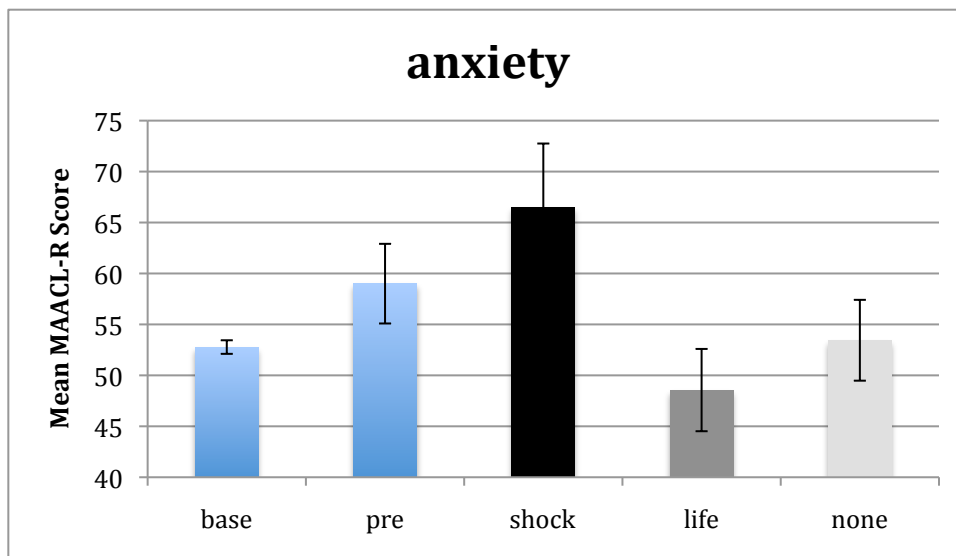


Figure 14. Mean \pm SEM MAACL-R Anxiety subscale by condition.

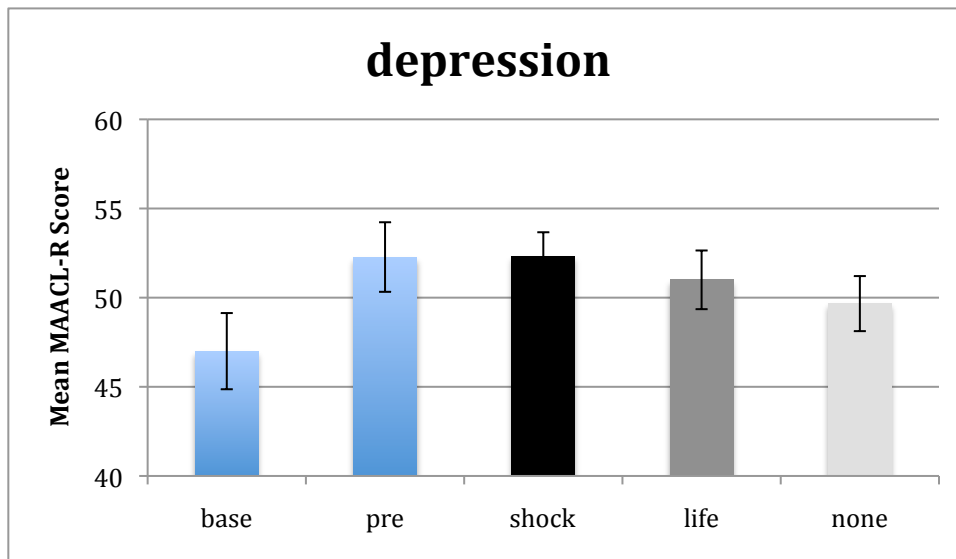


Figure 15. Mean +SEM MAACL-R Depression subscale by condition.

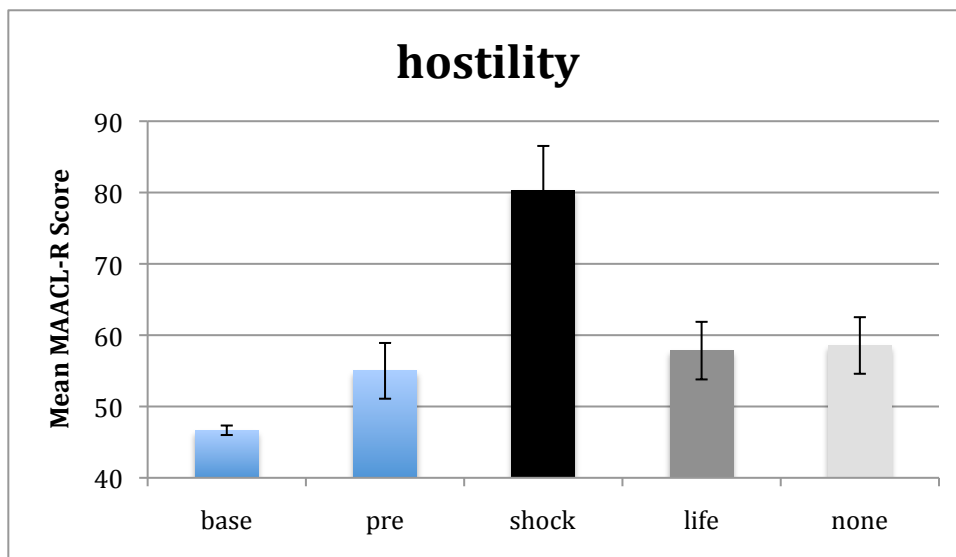


Figure 16. Mean +SEM MAACL-R Hostility subscale by condition.

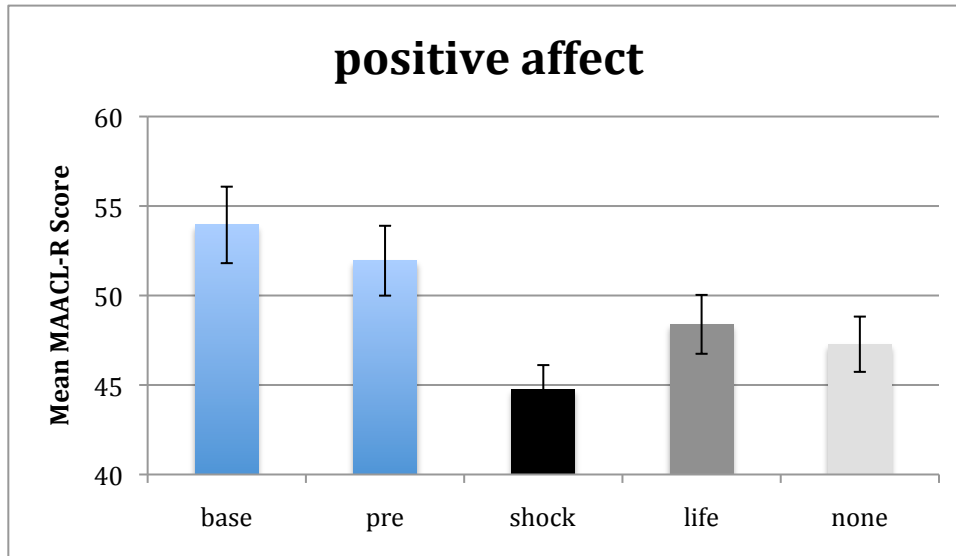


Figure 17. Mean +SEM MAACL-R Positive Affect subscale by condition.

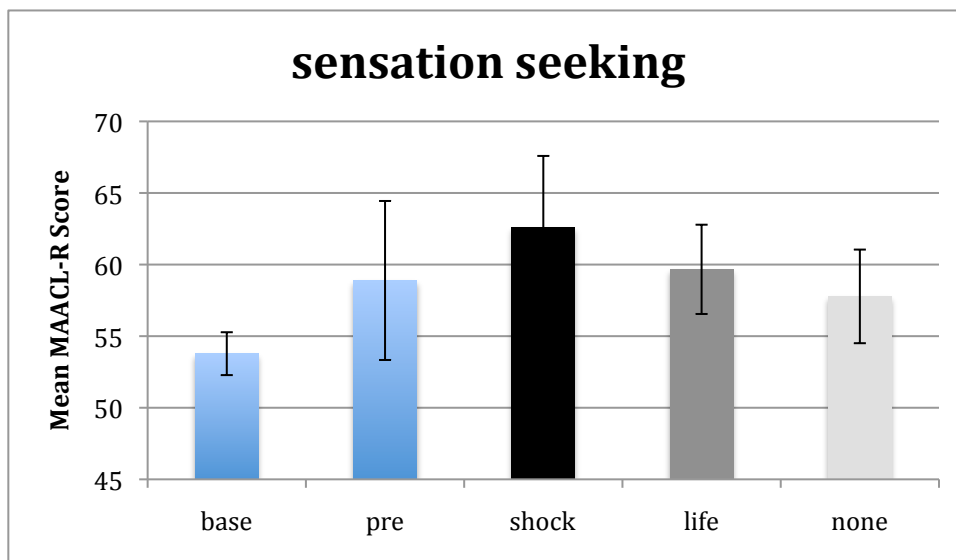


Figure 18. Mean +SEM MAACL-R Sensation Seeking subscale by condition.

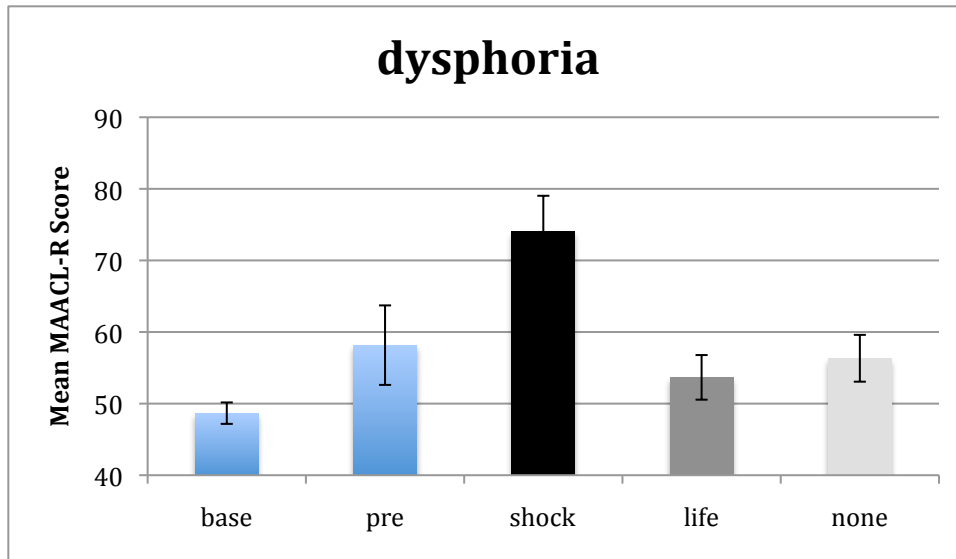


Figure 19. Mean +SEM MAACL-R Dysphoria subscale by condition.

APPENDIX C**COUNTERBALANCE SCHEME FOR PARTICIPANTS**

ID	Shock	Life Bar	No Feedback
1	1	2	3
2	1	3	2
3	2	1	3
4	2	3	1
5	3	1	2
6	3	2	1
7	1	2	3
8	1	3	2
9	2	1	3
10	2	3	1
11	3	1	2
12	3	2	1
13	1	2	3
14	1	3	2
15	2	1	3
16	2	3	1
17	3	1	2
18	3	2	1

APPENDIX D

Exit Survey Comments by Condition

life bar	on and off throughout the scenario I would glance at the life bar
life bar	could be very realistic with a more realistic ability to go to cover and better graphics to identify weapons like in real life bar
life bar	life bar made it feel more like a competition as opposed to survival
life bar	I think more interaction would seem more realistic
life bar	
none	the only time I noticed the researchers was when a target was near the exit without the feed back in seemed like the scenario took longer
none	targets are too far for decision making shoot don't shoot training
none	screen little grainy, overall the scenes provide a realistic environment in which I work/socialize with the public
none	shadows made in difficult to identify people with dark clothing
none	I noticed the ceiling a lot more during the scenario
none	use more realistic movements. A normal person would not raise a cell phone or soda can the way a person drawing a gun does
Shock	caused increased heart rate
shock	I think it is realistic real world training and I enjoyed it
shock	I could definitely feel when the threat-fire belt shocked me. I noticed it, but it wasn't over bearing.
shock	it will turn an expert shooter into a less than accurate shooter
shock	it makes you tune/turn your senses up a notch. Wearing the belt made me feel the decision I made would/could save a life bar. Makes you step-up your reaction to the scenario
shock	the threat scenario's happening so quickly together pay a part in decisional and accurate shooting.
shock	actions weren't very realistic, objects hard to see, found myself more apt to fire and anticipating the shock before it even cam toward the end
shock	I don't like it when it goes off, it hurts
shock	I felt it made me more likely to fire liberally vs identify targets first
shock	the belt is a great addition, forcing the users into accepting the reality in front of them due to the possible consequences

APPENDIX E

REPLY TO
ATTENTION O

DEPARTMENT OF THE ARMY
US ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND
ARMY RESEARCH LABORATORY
BUILDING 459
ABERDEEN PROVING GROUND MD 21005-5425

RDRL-HRS-E

30 December 2012

MEMORANDUM FOR: Debbie Patton, Cognitive Science Branch, ARL-HRED, APG, MD
FROM: Army Research Laboratory, Institutional Review Board
SUBJECT: Approval of Initial Research Protocol

PROJECT TITLE: How Real is Good Enough? A Soldier Experience in the Immersive
Cognitive Readiness Simulator (ICORS)
PROJECT NUMBER: ARL 12-078
SUBMISSION TYPE: Initial Protocol
REVIEW TYPE: Expedited Review
APPROVAL PERIOD: 30 December 2012 to 29 December 2013

The purpose of this memorandum is to notify you that the research identified above has been approved after an expedited review. The initial protocol was reviewed by the IRB chairperson on 23 November 2012. The review identified required modifications of the protocol, consent form, and ancillary documents. The modified documents were returned by the principal investigator on 10 December, and final review of those documents was completed on 30 December 2012.

I have determined that risk to subjects is no more minimal and that it falls into expedited categories 4, which involves the collection of data through noninvasive procedures (physical sensors applied to the surface of the body); and 7, which involves research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The following revised items were received and reviewed:

1. Protocol
2. Consent Form
3. Appendix A. Pictorial of Procedure
4. Appendix B. Counterbalancing Scheme
5. Appendix C. Health Screening Form
6. Appendix D. Demographic Information
7. Appendix E. Pre-Immersive Tendency Questionnaire
8. Appendix F. Presence Questionnaire
9. Appendix G. Slater-Usch-Steed Questionnaire
10. Appendix H. Temple Presence Inventory
11. Appendix I. Multiple Affect Adjective Checklist – Revised

RDRL-HRS-E

SUBJECT: Approval of Protocol, ARL 12-078

12. Appendix J. Situational Self-Efficacy
13. Appendixes K–M. Exit Survey (3 versions)
14. Appendixes N & O. Solicitations statements for military and civilian subjects.

As principal investigator, you are responsible for ensuring that the study is conducted in accordance with the final version of your protocol. You cannot delegate your supervisory responsibility to anyone else associated with the project. If you leave the project a new principal investigator should be designated for the research. Designation of a new principal investigator should be reported to the IRB.

In addition, you must report the following to the IRB chairperson:

- You must report changes in research personnel, including the principal investigator, involved in the study.
- You must report changes in the research procedures before they are initiated. You can report minor changes by completing the ARL amendment form. You are authorized to enroll 8 subjects in your study. Changes in the number of subjects constitute a minor change and should be reported to the IRB on the amendment form.
- You may make changes in research procedures implemented to eliminate immediate hazards to the subjects, but they must be reported within 10 days of their implementation on the amendment form.
- You must report completion or discontinuation of your study by submitting a completion or discontinuation report to the IRB.
- You must report plans to continue your study beyond the expiration date before you attain that date, by submission of a continuing review form 30 days before the expiration date.
- You must promptly report any injury or unanticipated problem to the IRB. This report should describe the event, evaluate its probable relationship to the study, and summarize the resulting outcome. An unanticipated problem is an adverse event that is not expected, given the nature of the research procedures and the subject population being studied, and places subjects or others at greater risk of harm or discomfort than was previously known or recognized. In general, adverse events that occur that are not listed in the protocol or consent form can be considered to be not expected and would constitute an unanticipated problem. In addition, adverse events that may be expected, but are of greater magnitude or occur more often than expected, may also be considered to be unanticipated problems.

I have included a copy of the approved consent form with this memorandum. I have place an approval seal on it and filled in expiration dates. Please use it in your study. I have also included a copy of the Appendixes file. I altered the dates of the study to 30 December 2012 to 29 December 2013.

Good luck with your research.



Paul N. Rose, Ph.D.
Chairperson, Institutional Review Board

APPENDIX F



PI: Debbie Patton
Date: 10 December 2012
Protocol No: ARL 12-078



Informed Consent Form

Army Research Laboratory, Human Research & Engineering Directorate
Aberdeen Proving Ground, MD 21005

Title of Project: HOW REAL IS GOOD ENOUGH? A SOLDIER EXPERIENCE IN THE IMMERSIVE COGNITIVE READINESS SIMULATOR (ICORS)

Project Number: ARL 12-078

Sponsor: Army Research Laboratory

Principal Investigator:

Debbie Patton
Army Research Laboratory
Human Research & Engineering Directorate
RDRL-HR-S
Aberdeen Proving Ground, MD 21005
410) 278-5890; dpatt@arl.army.mil

Engaged Personnel

Pam Burton
Army Research Laboratory
Human Research & Engineering Directorate
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Patrick Loukota, Contractor
Army Research Laboratory
Human Research & Engineering Directorate
RDRL-HR-S
Aberdeen Proving Ground, MD 21005
410-278-5854
patrick.w.loukota.ctr@mail.mil

You are being asked to join a research study that will take place at ARL-HRED's Cognitive Assessment Simulation and Engineering Laboratory (CASEL) research facility, bldg 517. This consent form explains the study and your part in it. Please ask questions at any time about anything you do not understand. You may take as much time as you need to review this form before agreeing to participate by signing this form.

Purpose of the Study: The purpose of this study is to investigate the levels of arousal caused by three different types of feedback (shock, life-bar, no feedback) in a 300-degree simulator.

Procedures to be followed: In order to keep personal identification private, you will be assigned a unique identification number that will be the only identifier on all data collected except for this form. You are being asked to participate in a study investigating the effects of feedback on psychological and physiological stress responses to three different types of feedback (no feedback, life-bar, and a small shock). These responses will be measured during your participation using questionnaires, through an instrumented vest, and collecting samples of your saliva. Saliva samples will be collected by placing a 1" x1" square sponge in your mouth. The saliva sample and vest will be used to calculate physiological stress levels. Upon signing this consent form, you will be asked to complete a health screening form that may identify that you are not a candidate for participation, and therefore you will be excused from the study. Today, you will experience a sample shock like you will receive during the shock condition. The ThreatFire Belt will be placed on your waist just above the top of your pants and on the outside of all your clothing. Then you will receive one 200-millisecond shock (equivalent to 1/5 of a second). At this time, or at any time, you may withdraw. Next you will complete a set of questionnaires that do not have right or wrong answers and all responses will not be shared with your supervisor, peers, or chain of command. At the end of today we will begin scheduling dates and times to come to APG for the rest of the research. You are asked that on your schedule day and time not to eat or drink 30 minutes prior to arrival. When you arrive at APG on your scheduled day and time you will don the instrumented vest under your Army t-shirt. If preferred, a male investigator will ensure proper fit and proper placement of electrode pads. Otherwise, a female investigator will perform this task. Next, you will be taken to the simulator room where the researcher will turn on the vest data collection device. You will stand still for 10 minutes then fill out a series of questionnaires after which you may take a short break. Then you will participate in the training scenario followed by a short set of questionnaires. Then you will begin the three scenarios, one for each of the feedback conditions. Breaks will be discouraged during the simulations; however breaks are planned between each scenario.



PI: Debbie Patton
 Date: 10 December 2012
 Protocol No: ARL 12-078

Each of the four scenarios uses all five screens to provide 300 degrees of visibility. Friend (FF) or foe (FE) target pairs will be presented for 2-seconds. Your objective is to fire at the foe targets. All targets will be presented two (FF or FE) at a time for 2-seconds within various locations across the same screen. Prior to target presentation an indicator sound will be played from the screen in which the target pair will appear. If the targets are shot or are not hit within the allotted time they will disappear. In the shock scenario, if the foe target is not neutralized within the allotted time then you may receive a shock. In the "life-bar" condition, a life may be removed. In the no-feedback condition you will have no feedback. During the scenarios you will need to change the magazine clip. You will change them when they stop working and replace it with one on your magazine belt. Then you will engage in the three feedback conditions. At the end of each scenario you will complete a set of questionnaires and provide a saliva sample. You will have a break between each of the feedback conditions. Although breaks are highly discouraged during data collection, if you need to, you may take a break at any time. After the last scenario and the questionnaires are complete the vest data collection device will be switched off and you can change your clothing. At this time, barring any questions you will be released from the study and are free to leave.

Discomforts and Risks: There are no known risks associated with participation in no shock condition and are no greater than risks you might encounter in a normal military personnel workday. The shock condition uses a 50 micro-amp charge and may cause discomfort similar to a bee sting or being hit with rubber bands. The Threat-Fire Belt is likely to leave small raised bumps on the skin where the belt provided the shock and should fade away with no notice of the area within a few hours. To minimize this potential effect, the belt will not fire repeatedly in the same location and it has an off button that you may press at anytime to disable the belt. There will always be a minimum of two investigators present inside the simulation room. Although, no known health risks are associated with the VirTra's Threat-Fire™ Belt usage, it is recommended by the manufacturer that people with pacemakers or any heart conditions not use the Threat-Fire™ Belt.

Benefits: There are no personal benefits for you by taking part in this study. The results of this study will help us understand the effects of a small shock as an operational stressor. Consequently, the results could lead to more cost effective and better ways to simulate stress of Army operations and offer mitigation strategies.

Duration: Today should not exceed 90 minutes. Time required to participate in the simulator should not exceed 3.5 hours. This time does not include travel time.

Confidentiality: Your participation in this research is confidential. The volunteer agreement will be stored in a locked file cabinet in the principal investigator's office for three years after all data is collected. All data will be transferred to a password-protected computer for data analysis. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared nor be shared with anyone outside the research staff. Officials of the U. S. Army Human Research Protections Office and the Army Research Laboratory's Institutional Review Board may inspect the records obtained in this study to insure compliance with laws and regulations covering experiments using human subjects.

Participation terminated by the investigator. The investigator has authority to terminate your participation in the research; however, you may also withdraw from the study at any time, if you wish.

Consequences of withdrawal. There are No consequences if you ask to be withdrawn from the study. Withdrawing has no impact on your career evaluation.

Contact Information for Additional Questions: You have the right to obtain answers to any questions you might have about this research both while you take part in the study and after you leave the research site. Please contact anyone listed at the top of the first page of this consent form or the Chairperson of the Human Research & Engineering Directorate, Institution Review Board, at (410) 278-5992 with questions, complaints, or concerns about this research, or if you feel this study has harmed you. The Chairperson can also answer questions about your rights as a research participant. You may also call this number if you cannot reach the research team or wish to talk to someone else.

Voluntary Participation: Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you would receive by staying in it. You must be 18 years of age or older to take part in this research study. Military personnel cannot be punished under the Uniform Code of Military Justice for choosing not to take part in or withdrawing from this study, and cannot receive administrative sanctions for choosing not to participate. If you agree to take part in this research study based on the information outlined above, please sign your name and the date below.

You will be given a copy of this consent form for your records.
 This consent form is approved from 30 December 2012 to 29 December 2013.
 Do not sign after the expiration date of 29 December 2013.

 Participant Signature

 Date

 Person Obtaining Consent

 Date

APPENDIX G
Health Screening Form

Participant ID _____

Do you have a pacemaker?	Yes	No
--------------------------	-----	----

Are you aware of any heart conditions you may have?	Yes	No
---	-----	----

APPENDIX H

Demographic Information

Participant ID _____

1. Age _____
2. Military Occupational Series (MOS) _____ (leave blank if civilian)
3. Time in service _____ (leave blank if civilian)
4. Military: Weapon qualification _____

Civilian: hunter or gun club member

5. Do you play video games? Yes _____ No _____
6. If yes, how many times a week?
1 2 3 4 5 6 7
7. During those times, how many hours?
1, 2, 3, 4, 5, 6, 7 Other _____
8. What type of games do you play?

9. Which platforms do you use to play these games?

Computer _____

Xbox _____

Wii _____

Kinect _____

Other _____

Please describe Other _____

APPENDIX I

URS

Directions: Please rate each statement as it relates to you.

	<i>Never</i>	<i>Now and Then</i>	<i>Sometimes</i>	<i>Often</i>	<i>Alwa</i>
D1. I tend to give up easily when I don't clearly understand a situation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D2. When I go shopping, I like to have a list exactly of what I need.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D3. I feel better about myself when I know that I have done all I can to accurately plan my future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D4. Sudden changes make me feel upset.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D5. When making a decision, I am deterred by the fear of making a mistake. <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D6. When uncertain, I act very cautiously until I have more information about the situation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D7. I like to have things under control.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D8. When the future is uncertain, I generally expect the worst to happen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D9. Facing uncertainty is a nerve-wracking experience.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D10. I get worried when a situation is uncertain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D11. Thinking about uncertainty makes me feel depressed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D12. I find the prospect of change exciting and stimulating.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D13. Uncertainty frightens me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D14. There is something exciting about being kept in suspense.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D15. The idea of taking a trip to a new country fascinates me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D16. I like going on holidays with nothing planned in advanced.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D17. I think you have to be flexible to work effectively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D18. Taking chances is part of life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D19. When I feel uncertain about something, I try to rationally weigh up all the information I have.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D20. Before making any changes, I need to think things over, thoroughly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D21. I prefer to stick to tried and tested ways of doing things.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D22. I like to have my weekends planned in advanced.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D23. I feel curious about new experiences.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D24. I like to think of a new experience in terms of a challenge.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D25. A new experience is an occasion to learn something new.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D26. When I feel a situation is unclear, I try to do my best to resolve it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D27. I like to know exactly what I'm going to do next.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D28. When facing an uncertain situation, I tend to prepare as much as possible, then hope for the best.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

URS

Directions: Please rate each statement as it relates to you.

	Never	Now and Then	Sometimes	Often	Alwa
D1. I tend to give up easily when I don't clearly understand a situation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D2. When I go shopping, I like to have a list exactly of what I need.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D3. I feel better about myself when I know that I have done all I can to accurately plan my future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D4. Sudden changes make me feel upset.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D5. When making a decision, I am deterred by the fear of making a mistake. <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D6. When uncertain, I act very cautiously until I have more information about the situation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D7. I like to have things under control.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D8. When the future is uncertain, I generally expect the worst to happen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D9. Facing uncertainty is a nerve-wracking experience.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D10. I get worried when a situation is uncertain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D11. Thinking about uncertainty makes me feel depressed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D12. I find the prospect of change exciting and stimulating.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D13. Uncertainty frightens me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D14. There is something exciting about being kept in suspense.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D15. The idea of taking a trip to a new country fascinates me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D16. I like going on holidays with nothing planned in advanced.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D17. I think you have to be flexible to work effectively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D18. Taking chances is part of life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D19. When I feel uncertain about something, I try to rationally weigh up all the information I have.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D20. Before making any changes, I need to think things over, thoroughly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D21. I prefer to stick to tried and tested ways of doing things.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D22. I like to have my weekends planned in advanced.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D23. I feel curious about new experiences.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D24. I like to think of a new experience in terms of a challenge.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D25. A new experience is an occasion to learn something new.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D26. When I feel a situation is unclear, I try to do my best to resolve it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D27. I like to know exactly what I'm going to do next.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D28. When facing an uncertain situation, I tend to prepare as much as possible, then hope for the best.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX J

Immersive Tendency Questionnaire

Participant ID _____

Please mark one circle for each question below.

1. Do you ever get extremely involved in projects that are assigned to you by your boss or your instructor, to the exclusion of other tasks?

Never					Sometimes	Always

2. How easily can you switch your attention from the task in which you are currently involved to a new task?

Not at all					Relatively	Very
Easy					Easy	Easy

3. How frequently do you get emotionally involved (angry, sad, or happy) in the news stories that you read or hear?

Never					Sometimes	Always

4. How well do you feel today?

Not Very					Alright	Very
Good						Good

5. Do you easily become deeply involved in movies or TV dramas?

Not at all					Relatively	Very
Easy					Easy	Easy

6. Do you ever become so involved in a television program or book that people have problems getting your attention?

Never					Sometimes	Always

7. How mentally alert do you feel at the present time?

Not at all					Relatively	Very
Alert					Alert	Alert

8. Do you ever become so involved in a movie that you are not aware of things happening around you?

| | | | |
Never Sometimes Always

9. How frequently do you find yourself closely identifying with the characters in a story line?

| | | | |
Never Sometimes Always

10. Do you ever become so involved in a video game that it is as if you are inside the game rather than moving a joystick and watching the screen?

| | | | |
Never Sometimes Always

11. On average, how many books do you read for enjoyment in a month? _____

12. What kind of books do you read most frequently?

(CIRCLE ONE ITEM ONLY!)

*Spy novels *Adventure *Westerns Biographies *Fantasies *Romance novels
*Mysteries *Science fiction *Historical novels *Other fiction
*Other non-fiction *Autobiographies

13. How physically fit do you feel today?

| | | | |
Not at A Little Very
All

14. How good are you at blocking out external distractions when you are involved in something?

| | | | |
Not A Little Very
Good Good

15. When watching sports, do you ever become so involved in the game that you react as if you were one of the players?

| | | | |
Never Sometimes Always

16. Do you ever become so involved in a daydream that you are not aware of things happening around you?

| | | | |
Never Sometimes Always

17. Do you ever have dreams that are so real that you feel disoriented when you awake?

| | | | |
Never Sometimes Always

18. When playing sports, do you become so involved in the game that you lose track of time?

| | | | |
Never Sometimes Always

19. Are you easily disturbed when working on a task?

| | | | |
Never Sometimes Always

20. How well do you concentrate on enjoyable activities?

| | | | |
Not Very Very
Well Well

21. How often do you play arcade or video games? (OFTEN should be taken to mean every day or every two days, on average.)

| | | | |
Never Sometimes Always

22. How well do you concentrate on disagreeable tasks?

| | | | |
Not Very Very
Well Well

23. Have you ever gotten excited during a chase or fight scene on TV or in the movies?

| | | | |
Never Sometimes Always

24. To what extent have you dwelled on personal problems in the last 48 hours?

| | | | | | |
Not at A All the
All little Time

25. Have you ever gotten scared by something happening on a TV show or in a movie?

| | | | | | |
Never Sometimes Always

26. Have you ever remained apprehensive or fearful long after watching a scary movie?

| | | | | | |
Never Sometimes Always

27. Do you ever avoid carnival or fairground rides because they are too scary?

| | | | | | |
Never Sometimes Always

28. How frequently do you watch TV soap operas or docu-dramas (CSI, reality TV, etc.)?

| | | | | | |
Never Sometimes Always

29. Do you ever become so involved in doing something that you lose all track of time?

| | | | | | |
Never Sometimes Always

APPENDIX K

Presence Questionnaire – given for each scenario

Participant ID _____

Please mark one circle for each question below for the scenario you just completed.

1. How much were you able to control events?

Not At		Sometimes	The Whole
All			Time

2. How responsive was the environment to actions that you initiated (or performed)?

Not At		Sometimes	The Whole
All			Time

3. How natural did your interactions with the environment seem?

Not At		Sometimes	The Whole
All			Time

4. How completely were *all* of your senses engaged?

Not At		Sometimes	The Whole
All			Time

5. How much did the visual aspects of the environment involve you?

Not at		Sometimes	Very
All			Much

6. How much did the auditory aspects of the environment involve you?

Not at		Sometimes	Very
All			Much

7. How natural was the mechanism, which controlled movement through the environment?

Not at		Sometimes				Very	
All						Much	

8. How aware were you of events occurring in the real world around you?

Not at		Sometimes				Very	
All						Aware	

9. How aware were you of your display and control devices?

Not at		Sometimes				Very	
All						Aware	

10. How compelling was your sense of objects moving through space?

Not at		Sometimes				Very	
All						Compelling	

11. How inconsistent or disconnected was the information coming from your various senses?

Not at		Sometimes				Very	
All						Consistent	

12. How much did your experiences in the virtual environment seem consistent with your real-world experiences?

Not at		Sometimes				Very	
All						Much	

13. Were you able to anticipate what would happen next in response to the actions that you performed?

Never		Sometimes				Always	

14. How completely were you able to actively survey or search the environment using vision?

Never		Sometimes				Always	

15. How well could you identify sounds?

Not Very		Sometimes				Very	
Well						Well	

16. How well could you actively survey or search the virtual environment using touch?

Not Very		Sometimes				Very	
Well						Well	

17. How compelling was your sense of moving around inside the virtual environment?

Not at		Sometimes				Very	
All						Compelling	

18. How closely were you able to examine objects?

Not Very		Sometimes				Very	
Well						Well	

19. How well could you examine objects from multiple viewpoints?

Not Very		Sometimes				Very	
Well						Well	

20. How well could you move or manipulate objects in the virtual environment?

Not Very		Sometimes				Very	
Well						Well	

21. To what degree did you feel confused or disoriented at the beginning of breaks or at the end of the experimental session?

Not at		Sometimes				Very	
All						Much	

22. How involved were you in the virtual environment experience?

Not at							Very
All							Much

23. How distracting was the control mechanism?

Not at							Very
All							Much

24. How much delay did you experience between your actions and expected outcomes?

None							Constantly

25. How quickly did you adjust to the virtual environment experience?

Never							Immediately
Did							Minutes

26. How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?

Not at							Very
All							Proficient

27. How much did the visual display quality interfere or distract you from performing assigned tasks or required activities?

Never							Always

28. How much did the control devices interfere with the performance of assigned tasks or with other activities?

Never							Always

29. How well could you concentrate on the assigned tasks or required activities rather than on the mechanisms used to perform those tasks or activities?

Not Very							Very
Well							Well

30. Did you learn new techniques that enabled you to improve your performance?

31. Were you involved in the experimental task to the extent that you lost track of time?

Never Sometimes Always

APPENDIX L

Slater-Usuh-Steed Questionnaire

Participant ID _____

1. Please rate your sense of being in the environment, on the following scale from 1 to 7, where 7 represents your normal experience of being in a place.

I had a sense of “being there” in the environment:

1 2 3 4 5 6 7

Not
at all

Very
Much

2. To what extent were there times during the experience when the environment was the reality for you?
There were times during the experience when the environment was reality for me:

1 2 3 4 5 6 7

At
no time

Almost
all the time

3. When you think back about your experience, do you think of the environment more as images that you saw or more as somewhere that you visited?

The environment seems to me to be more like:

1 2 3 4 5 6 7

Images
that I saw

Somewhere that
I visited

4. During the time of the experience, which was strongest on the whole, your sense of being in the environment or being elsewhere?

I had a stronger sense of ...

1 2 3 4 5 6 7

Being
elsewhere

Being in the
office space

5. Consider your memory of being in the office space. How similar in terms of the structure of the memory is this to the structure of the memory of other places you have been? By ‘structure of memory’ consider things like the extent to which you have a visual memory of the environment, whether that memory is in colour, the extent to which the memory seems vivid or realistic, its size, location in your imagination, and other such structural elements.

I think of the environment as a place in a way similar to other places that I’ve been:

1 2 3 4 5 6 7

Not
at all

Very
much so

6. During the time of the experience, did you often think to yourself that you were actually in the environment?

During the experience I often thought that I was really standing in the environment...

1	2	3	4	5	6	7
Not very often					Very much so	

7. Please write down any further comments that you wish to make about your experience. In particular, what things helped to give you a sense of 'really being' in the environment, and what things acted to 'pull you out' of this?

APPENDIX M

Multiple Affect Adjective Check List - Revised

Instructions for all data collection time points other than the post (Pre) read "Please check all the words that describe how you feel right now."

For the post collection the instructions read, "Please check all the words that describe how you felt during the scenario you just completed."

	A PA	D SS	H
1 <input type="checkbox"/> active	45 <input type="checkbox"/> fit	89 <input type="checkbox"/> peaceful	
2 <input type="checkbox"/> adventurous	46 <input type="checkbox"/> forlorn	90 <input type="checkbox"/> pleased	
3 <input type="checkbox"/> affectionate	47 <input type="checkbox"/> frank	91 <input type="checkbox"/> pleasant	
4 <input type="checkbox"/> afraid	48 <input type="checkbox"/> free	92 <input type="checkbox"/> polite	
5 <input type="checkbox"/> agitated	49 <input type="checkbox"/> friendly	93 <input type="checkbox"/> powerful	
6 <input type="checkbox"/> agreeable	50 <input type="checkbox"/> frightened	94 <input type="checkbox"/> quiet	
7 <input type="checkbox"/> aggressive	51 <input type="checkbox"/> furious	95 <input type="checkbox"/> reckless	
8 <input type="checkbox"/> alive	52 <input type="checkbox"/> lively	96 <input type="checkbox"/> rejected	
9 <input type="checkbox"/> alone	53 <input type="checkbox"/> mad	97 <input type="checkbox"/> rough	
10 <input type="checkbox"/> amiable	54 <input type="checkbox"/> sad	98 <input type="checkbox"/> sad	
11 <input type="checkbox"/> amused	55 <input type="checkbox"/> silly	99 <input type="checkbox"/> safe	
12 <input type="checkbox"/> angry	56 <input type="checkbox"/> good	100 <input type="checkbox"/> satisfied	
13 <input type="checkbox"/> annoyed	57 <input type="checkbox"/> good-natured	101 <input type="checkbox"/> secure	
14 <input type="checkbox"/> awful	58 <input type="checkbox"/> grim	102 <input type="checkbox"/> shaky	
15 <input type="checkbox"/> bashful	59 <input type="checkbox"/> happy	103 <input type="checkbox"/> shy	
16 <input type="checkbox"/> bitter	60 <input type="checkbox"/> healthy	104 <input type="checkbox"/> soothed	
17 <input type="checkbox"/> blue	61 <input type="checkbox"/> hopeless	105 <input type="checkbox"/> steady	
18 <input type="checkbox"/> bored	62 <input type="checkbox"/> hostile	106 <input type="checkbox"/> stubborn	
19 <input type="checkbox"/> cautious	63 <input type="checkbox"/> impatient	107 <input type="checkbox"/> stormy	
20 <input type="checkbox"/> cautious	64 <input type="checkbox"/> incensed	108 <input type="checkbox"/> strong	
21 <input type="checkbox"/> cheerful	65 <input type="checkbox"/> indifferent	109 <input type="checkbox"/> suffering	
22 <input type="checkbox"/> confident	66 <input type="checkbox"/> inspired	110 <input type="checkbox"/> sullen	
23 <input type="checkbox"/> content	67 <input type="checkbox"/> interested	111 <input type="checkbox"/> sunk	
24 <input type="checkbox"/> content	68 <input type="checkbox"/> irritated	112 <input type="checkbox"/> sympathetic	
25 <input type="checkbox"/> contrite	69 <input type="checkbox"/> nervous	113 <input type="checkbox"/> tame	
26 <input type="checkbox"/> cooperative	70 <input type="checkbox"/> joyful	114 <input type="checkbox"/> tender	
27 <input type="checkbox"/> cooperative	71 <input type="checkbox"/> kindly	115 <input type="checkbox"/> tense	
28 <input type="checkbox"/> critical	72 <input type="checkbox"/> lonely	116 <input type="checkbox"/> terrible	
29 <input type="checkbox"/> cross	73 <input type="checkbox"/> lost	117 <input type="checkbox"/> terrified	
30 <input type="checkbox"/> cruel	74 <input type="checkbox"/> loving	118 <input type="checkbox"/> thoughtful	
31 <input type="checkbox"/> daring	75 <input type="checkbox"/> low	119 <input type="checkbox"/> timid	
32 <input type="checkbox"/> desperate	76 <input type="checkbox"/> lucky	120 <input type="checkbox"/> tormented	
33 <input type="checkbox"/> destroyed	77 <input type="checkbox"/> mad	121 <input type="checkbox"/> understanding	
34 <input type="checkbox"/> devoted	78 <input type="checkbox"/> mean	122 <input type="checkbox"/> unhappy	
35 <input type="checkbox"/> disagreeable	79 <input type="checkbox"/> meek	123 <input type="checkbox"/> unsociable	
36 <input type="checkbox"/> discontented	80 <input type="checkbox"/> merry	124 <input type="checkbox"/> upset	
37 <input type="checkbox"/> discouraged	81 <input type="checkbox"/> mild	125 <input type="checkbox"/> vexed	
38 <input type="checkbox"/> disgusted	82 <input type="checkbox"/> miserable	126 <input type="checkbox"/> warm	
39 <input type="checkbox"/> displeased	83 <input type="checkbox"/> nervous	127 <input type="checkbox"/> whole	
40 <input type="checkbox"/> energetic	84 <input type="checkbox"/> obliging	128 <input type="checkbox"/> wild	
41 <input type="checkbox"/> enraged	85 <input type="checkbox"/> offended	129 <input type="checkbox"/> willful	
42 <input type="checkbox"/> enthusiastic	86 <input type="checkbox"/> outraged	130 <input type="checkbox"/> wilted	
43 <input type="checkbox"/> fearful	87 <input type="checkbox"/> panicky	131 <input type="checkbox"/> worrying	
44 <input type="checkbox"/> fine	88 <input type="checkbox"/> patient	132 <input type="checkbox"/> young	

APPENDIX N

Situational Self Efficacy (SSE)

Participant ID _____

On the scale from 1 to 10 below, how confident are you in your ability to perform well in the upcoming scenario with a high degree of success? Please circle one of the numbers below.

1	2	3	4	5	6	7	8	9	10		
Not at all										Extremely	
confident										confident	

Please explain why: _____

APPENDIX O-A

Exit Survey

Participant ID _____

ThreatFire Condition

Please answer the following questions regarding your experience with the ICORS 300 degree simulator.

Have you ever been shot? Yes No (skip Question #1)

1. If you have ever been shot, how realistic is the Threat-Fire™ belt feedback?

1	2	3	4	5	6	7	8	9	10
Not at all					Very much				
Like the real thing					like the real thing				

2. How immersed did you feel during the scenario?

1	2	3	4	5	6	7	8	9	10
Not at all					Very				
immersed					immersed				

3. Were you distracted by other parts of the environment that were not part of the scenario (e.g., researchers, the room, etc)?

1	2	3	4	5	6	7	8	9	10
Not at all					Very				
distracted					distracted				

4. * The Threat-Fire™ belt is painful:

1	2	3	4	5	6	7	8	9	10
Not at all					Extremely				
painful					painful				

5. * The Threat-Fire™ belt affected my decision accuracy.

1	2	3	4	5	6	7	8	9	10
Not at All					Extremely				

6. How realistic did you feel the experience was?

1	2	3	4	5	6	7	8	9	10
Not at all					Extremely				
Realistic					Realistic				

7. Do you have any additional comments about the simulator or the Threat-Fire™ belt?

APPENDIX O-B

Exit Survey

Participant ID _____

No Feedback Condition

Please answer the following questions regarding your experience with the ICORS 300 degree simulator.

1. How immersed did you feel during the scenario?

1	2	3	4	5	6	7	8	9	10
Not at all immersed								Very immersed	

2. Were you distracted by other parts of the environment that were not part of the scenario (e.g., researchers, the room, etc)?

1	2	3	4	5	6	7	8	9	10
Not at all distracted								Very distracted	

3. How realistic did you feel the experience was?

1	2	3	4	5	6	7	8	9	10
Not at all Realistic								Extremely Realistic	

4. Do you have any additional comments about the simulator?

APPENDIX O-C

Exit Survey

Participant ID _____

Life-Bar Condition

Please answer the following questions regarding your experience with the ICORS 300 degree simulator.

1. How immersed did you feel during the scenario?

1	2	3	4	5	6	7	8	9	10
Not at all immersed								Very immersed	

2. Were you distracted by other parts of the environment that were not part of the scenario (e.g., researchers, the room, etc)?

1	2	3	4	5	6	7	8	9	10
Not at all distracted								Very distracted	

3. How realistic did you feel the experience was?

1	2	3	4	5	6	7	8	9	10
Not at all Realistic								Extremely Realistic	

4. Do you have any additional comments about the simulator or Life-Bar feedback?

APPENDIX P

Participant Request Form –Military

Military Study Participants

I would like to invite you to participate in a study that I am conducting at the ARL HRED located at Aberdeen Proving Ground during the months of December 2012, through December 2013.

The study will take place in the ARL-HRED Cognitive Assessment and Engineering Laboratory (CASEL) in bldg 517 (area C). The purpose of this study is to examine the amount of stress induced by a small shock. It will also examine the experience of presence in the simulation.

You will perform a simulated shooting task in a 300-degree immersive simulator. Using the M4 Carbine, fitted with a laser to register hits and a CO2 cartridge to simulate recoil, you will be asked to distinguish between friend and foe targets with the goal of shooting only enemy targets. You will perform this task in one training scenario followed by three experimental scenarios. One scenario will use the ThreatFire Belt (50 microamps) shock; the Life Bar scenario will use visible life bar similar to video games and the no feedback condition will provide no feedback on performance. I will be collecting a variety of information during your participation. The information collected will include questions about your experience, your feelings, and how your body responds during the task. All measures are non-invasive and are collected using pencil and paper or computer generated, wearing a LifeShirt and providing saliva samples. Some samples will be collected continuously while others at specified times. You will be instructed not to eat or drink 30 minutes prior to entering the CASEL on the day of participation.

If you have not experienced the shock before or would like an example shock prior to the simulated shooting task, you will receive one 200-millisecond shock. This shock will let you know what to expect from the ThreatFire belt. At this time and any time during your participation you may withdrawal from the study.

To participate in this study, you must be, a U.S. Citizen, Male, at least 18 years of age, and have NO known heart conditions or use a pacemaker. You must also be qualified as a marksman.

The study will last for approximately 3.5 hours. I'm flexible, and you may participate whenever you're available, during duty hours. The experiment requires only one session. There will be no monetary compensation, however, local travel costs will be covered.

You can withdraw from this study at any time. Even if you come to the research site and start the study, you can change your mind and withdraw from the study without penalty.

Please send an email or phone us if you are interested.

Debbie Patton 410-278-5890, debra.j.patton4.civ@mail.mil

Thanks,

Debbie
Cognitive Sciences Branch
Human Research and Engineering Directorate
U.S. Army Research Laboratory

APPENDIX Q

Participant Request - Civilian

Civilian Study Participants

I would like to invite you to participate in a study that I am conducting at the ARL HRED located at Aberdeen Proving Ground during the months of December 2012, through December 2013.

The study will take place in the ARL-HRED Cognitive Assessment and Engineering Laboratory (CASEL) in bldg 517 (area C). The purpose of this study is to examine the amount of stress induced by a small shock. It will also examine the experience of presence in the simulation.

You will perform a simulated shooting task in a 300-degree immersive simulator. Using the M4 Carbine, fitted with a laser to register hits and a CO2 cartridge to simulate recoil, you will be asked to distinguish between friend and foe targets with the goal of shooting only enemy targets. You will perform this task in one training scenario followed by three experimental scenarios. One scenario will use the ThreatFire Belt (50 microamps) shock; the Life Bar scenario will use visible life bar similar to video games and the no feedback condition will provide no feedback on performance. I will be collecting a variety of information during your participation. The information collected will include questions about your experience, your feelings, and how your body responds during the task. All measures are non-invasive and are collected using pencil and paper or computer generated, wearing a LifeShirt and providing saliva samples. Some samples will be collected continuously while others at specified times. You will be instructed not to eat or drink 30 minutes prior to entering the CASEL on the day of participation.

If you have not experienced the shock before or would like an example shock prior to the simulated shooting task, you will receive one 200-millisecond shock. This shock will let you know what to expect from the ThreatFire belt. At this time and any time during your participation you may withdrawal from the study.

To participate in this study, you must be, a U.S. Citizen, Male, at least 18 years of age, and have NO known heart conditions or use a pacemaker. You must also be qualified as a marksman.

The study will last for approximately 3.5 hours. I'm flexible, and you may participate whenever you're available, during duty hours. The experiment requires only one session. There will be no compensation, and you must clear time away with your supervisor.

You can withdraw from this study at any time. Even if you come to the research site and start the study, you can change your mind and withdraw from the study without penalty.

Please send an email or phone us if you are interested.

Debbie Patton 410-278-5890, debra.j.patton4.civ@mail.mil

Thanks,

Debbie
Cognitive Sciences Branch
Human Research and Engineering Directorate
U.S. Army Research Laboratory

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CURRICULUM VITA

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Education

- Exp. 2013 M.A. Experimental Psychology, Towson University
 Major Professor: Evangeline Wheeler, PhD
 Current GPA: 3.96 Thesis: How Real is Good Enough: 300 Degrees of
 Virtual Immersion
- 2003 B.S. Fine Arts and Communications, Towson University
 Concentration: Art History

Published Works

- Patton, D.** (2013, in press). *How real is good enough? 300 degrees of virtual immersion*. (Master's thesis). Towson University, Towson, MD, USA.
- Patton, D.** (2013, in press). From the Inside Out: What We Bring to the Table. Submitted to Fall 2013 DoD HFE TAG
- Patton, D., Loukota, P. & Avery, E.** (2013). Validating the ThreatFire™ belt in 300 Degrees: A pilot study. In T.S. Jastrzembski (Ed.), *22nd Proceedings of the Behavior Representation in Modeling & Simulation (BRiMS) Conference*.
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Conferences

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| 2013 | Validating the ThreatFire™ belt in 300 Degrees
A Pilot Study. 22 nd Annual Conference on Behavior Representation in Modeling & Simulation in conjunction with the 12 th International Conference on Cognitive Modeling, Ottawa, Canada. July 2013 |
| 2012 | Co-Chair of the Social Networks/Social Media. 5 th International Conference on Applied Human Factors and Ergonomics, Cross-Cultural Decision Making, San Francisco, CA. July 2012 |
| 2011 | Effects of Acute Stress on Performance & Confidence in the Virtual Morris Water Maze: A Pilot Study (Patton, D., Ancona, M. and Bauerband, A.) Student Research Expo. Towson University, April 2011 |
| 2007 | Honorary member of the Potomac Chapter of the Human Factors and Engineering Society |
| 2005 – 2007 | Chair: Stress and Workload sub-TAG of the DoD Human Factors Engineering (HFE) Technical Advisory Group (TAG) |

Research Experience

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| 1992- | Psychology Technician, Army Research Laboratory, Human Research and Engineering Directorate, Cognitive Science Branch |
| 1989-1992 | Psychology Technician, Human Engineering Laboratory |

Honors and Awards

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| 2010 | Commander’s Award for Civilian Service |
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