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Assessing the Effects of Stress Resilience Training on Visual Discrimination Skills: Implications for Perceptual Resilience in U.S. Warfighters

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Assessing the Effects of Stress Resilience Training on Visual Discrimination Skills:
Implications for Perceptual Resilience in U.S. Warfighters

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy at Virginia Commonwealth University.

by

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ACKNOWLEDGEMENTS

This is for you, Daddy.

I would like to acknowledge the patient and graceful support of my advisor, Dr. Amy Armstrong. Her insight made this dissertation possible, and I am grateful. I also have gratitude for my additional committee members – Dr. Carolyn Hawley, Dr. Sae Schatz, and Dr. Michael West. Their expertise tremendously improved my work.

I am indebted to my VCU Allied Health classmates who provided lively and thoughtful debate over the years. Their friendship enriched the experience immeasurably. I must also express my deepest appreciation to my family - Mom, Grant, Kim, Stacy and Matthew - who provide constant support throughout all of my endeavors. Thank you.

This work is supported in part by the Office of Naval Research. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Department of Defense or Office of Naval Research. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation hereon. This work was supported, in part, by the Office of Naval Research project N00014-11-C-0193, Perceptual Training Systems & Tools (PerceptS).

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LIST OF ACRONYMS

ACEP	Army Center for Enhanced Performance
ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
BUD/S	Basic Underwater Demolition/SEALS
CD-RISC	Connor Davidson Resilience Scale
CENTCOM	U.S. Central Command
HIP Model	Human Information Processing Model
IED	Improvised Explosive Device
IIT	Infantry Immersion Chamber
IRB	Institutional Review Board
MHAT	Mental Health Advisory Team
MRQ	Multiple Resources Questionnaire
NASA-TLX	NASA- Task Load Index
PSS	Perceived Stress Scale
PSTD	Post Traumatic Stress Disorder
RQ	Research Question
SAM	Stress Appraisal Measure
SERE	Survival, Evasion, Resistance, Escape
SITE	Squad Immersive Training Environment
STAI-S	State Trait Anxiety Inventory – State scale
STAI-T	State Trait Anxiety Inventory – Trait scale
TSE	Tactical Site Exploitation

ABSTRACT

ASSESSING THE EFFECTS OF STRESS RESILIENCE TRAINING ON VISUAL DISCRIMINATION SKILLS: IMPLICATIONS FOR PERCEPTUAL RESILIENCE IN U.S. WARFIGHTERS

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2012.

Major Director: Amy J. Armstrong, Ph.D., CRC, Associate Professor and Interim Chair, Department of Rehabilitation Counseling

Current military operational environments are highly improvised and constantly evolving, threatening the lives of U.S. warfighters. For instance, since 2001, 60% of all hostile casualties and 65% of hostile injuries in the Middle East theater have been attributed to improvised explosive devices (IEDs). IEDs are powerful physical weapons, and the stressful atmosphere they, and other operational challenges create, can also result in a range of psychological dysfunctions, including anxiety, depression, alcohol abuse, and Post-Traumatic Stress Disorder (PTSD). Not only are these issues concerning for mental health reasons, they are also problematic in terms of combat performance.

Extreme arousal (i.e., stress) negatively affects performance through the suppression of cognitive and physiological resources, which inhibits verbal, perceptual, and motor performance. Perceptual abilities are particularly susceptible to the effects of acute hyperarousal, and the degradation of these abilities may limit warfighters' threat detection skills. Therefore, military researchers are interested in whether and how the visual perceptual field is changed under stress, and the Services are making predeployment training programs a priority, in an attempt to mitigate these concerns.

This dissertation first outlines the cognitive processes related to visual perceptual abilities and how these processes are negatively affected by acute arousal. Current training programs in perceptual skills and stress tolerance are then described, along with recommendations for areas of improvement within the status quo.

Based on these recommendations, an experimental procedure and five hypotheses were designed to assess training effects on visual perceptual skills and performance under stress. Experimental outcomes suggest that participants who were trained using a novel integrated perceptual skills plus stress resilience (“perceptual resilience”) program performed faster and with higher accuracy during a stressful threat detection task than participants trained using a perceptual skills-only program and participants trained using an existing status-quo knowledge trainer. Participants in this perceptual resilience training group also reported lower feelings of acute stress and anxiety immediately post-task than the two other training groups who did not receive the stress resilience training component. Based on these outcomes, implications for future military-specific training development, study limitations, and recommendations for future research is presented.

CHAPTER 1: INTRODUCTION

“War is uncertain, mentally complex, physically demanding, and an intensely emotional experience. Soldiers must be physically and mentally tough enough to dominate their opponents despite these challenges” (United States Army, 2002).

Statement of the Problem

Military service has always been an inherently stressful profession; however, the contemporary irregular and ambiguous military environment places novel physical and emotional demands on warfighters (Cammaert & Clappe, 2006; Bartone, 2009). This combat setting has an improvised and adaptive nature, which not only engenders marked levels of stress but also makes it difficult to identify and predict patterns of potential threats.

The most devastating threats include Improvised Explosive Devices (IED) and insurgent snipers. Since 2001, 60% of all hostile casualties and 65% of hostile injuries in the Middle East theater have been attributed to IED explosions (Department of Defense Personnel and Military Casualty Statistics, 2011). In addition, a 2005 report indicated that the rates of ambush, attack, being shot at, or exposed to small arms fire are between 58-66% for Soldiers in Afghanistan, between 89-93% for Soldiers in Iraq, and between 95-97% for Marines in Iraq (Kavanaugh, 2005).

The pressures of military operations can result in a range of physiological and psychological dysfunctions, such as anxiety, depression, alcohol abuse, or Post-Traumatic

Stress Disorder (PTSD). Not only are these issues concerning for mental health reasons, they are also significantly problematic in terms of combat performance. In response, the military Services are urgently working to treat—as well as prevent—such stress-induced maladies.

Theoretical Foundations

Overview of Arousal, Stress, and Anxiety

Before exploring potential strategies for reducing operational stress while enhancing threat detection performance, it is first necessary to define the constructs “stress,” “arousal,” and “anxiety” as they are used in this paper. Although not interchangeable, each of these constructs is similarly affected by a stimulus-rich environment and produce similar acute and chronic symptoms.

Arousal refers to a broad construct defined by general physiological and/or psychological activation, ranging along a continuum from deep sleep to extreme excitement (Hardy, 1990). The Yerkes-Dodson model roughly explains the relationship between arousal and performance (Yerkes & Dodson, 1908). According to this heuristic, which is illustrated by an inverted-U continuum (shown in Figure 1), performance increases with arousal to a certain point, then decreases as arousal rises too high. In these terms, arousal acts as a positive motivator for tasks of minimal difficulty but negatively affects difficult or demanding tasks.

Heightened arousal produces many cognitive, emotional, or physiological outcomes, but of most interest here is the effect of arousal on anxiety and stress. Stress occurs when situational demands are perceived to exceed available coping resources (Selye, 1956).

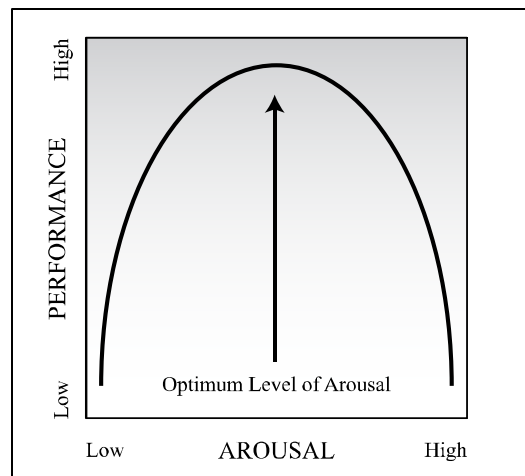


Figure 1. Relationship Between Arousal and Performance

Foundational stress research (Selye, 1936) proposes the idea of stress as a process involving three phases: activation, resistance, and exhaustion. The body responds to challenges first with physiological activation of a defense system. A resistance (or coping) phase follows during which stress is to be resolved; if unsuccessful, the body may experience exhaustion. Activation that endures beyond the resistance stage is hypothesized to contribute to disease, but stress along any phase can inhibit cognition and task performance.

The general construct of stress can be divided into several specific sub-categories. Eustress, as defined by Lazarus (1974) is considered healthy stress because it enhances functioning or is caused by an enjoyable activity (such as through physical exercise, playing a video game, or difficult but fulfilling work). Distress, on the other hand, is the most commonly referred-to definition of stress. Caused by an aversive stimulus, distress occurs when an individual lacks the resources to be able to respond adequately to mental,

emotional, or physical demands, whether real or imagined (Selye, 1956). This paper is concerned primarily with distress and its effects on perception.

Distress can have physical, emotional, or cognitive causes. Physical stress is a result of over-extending the limits of the body to the point of pain (rigorous exercise or breaking a bone), or lasting physiological symptoms of heightened arousal (headache, back ache). Emotional or affective stress is caused by a negative emotional response to a stimulus (feeling sad or angry). Cognitive stress occurs when the brain's processing system is overloaded (taking a standardized test).

Finally, all types of distress can last for any length of time. Acute stress refers to negative responses to a relatively short-lived stimulus. When the stimulus subsides, so does the experience of distress with no lingering effects. Chronic stress lasts a relatively long time in response to continuing aversive conditions with no clear end point. Feelings and/or symptoms of distress may never subside or pass. The physiological and emotional effects of chronic stress can greatly contribute to mental and physical illness.

The second outcome of interest related to arousal, anxiety, is generally considered a component (or result) of either acute or chronic stress; it is characterized by dominating thoughts of worry, concern, and uncertainty (Martens, Burton, Vealey, Bump, & Smith, 1990; Woodman & Hardy, 2001). Anxiety can be divided into state (transient and context-specific) and trait (enduring, general, and dispositional) dimensions (Spielberger, 1966). In addition, anxiety symptoms can be cognitive (negative thoughts, worries, and concerns) or somatic (the perception of physiological arousal) (Liebert & Morris, 1967; Davidson & Schwartz, 1976). Physiological manifestations of anxiety can be detrimental

short- and long-term in the form of increased heart rate and blood pressure, headaches or migraines, and digestion problems. Chronic anxiety is also the foundation of several mental health issues such as PTSD, generalized anxiety disorder, and many cases of depression and substance abuse.

Acute Distress and Performance

Physiological responses to stress occur on at least two axes within the brain (Linden, Earle, Gerin & Christenfeld, 1997; Porges, 2009). The sympathetic-adrenal axis becomes activated due to motor and cognitive efforts and has been described as a “positive stress reaction” because it is short-lived and permits adaptive responding (De La Torre, 1994). The hypothalamic-pituitary-adrenocortical axis is thought to reflect affective distress or anticipation of upcoming negative events, and its activation is the result of chronic, unresolved stress (Mason, 1968; Henry, 1975). Physiological activation systems affect the cognitive, cardiovascular, neuroendocrine, and immunological systems (De La Torre, 1994; Tucker, 2009). The different defense systems are recognized as interrelated, but still allow for differential activation depending on the nature of the challenge (acute vs. chronic, cognitive vs. affective vs. physical, etc.).

Such negative physiological responses to stress can significantly decrease operational performance. Researchers such as Hardy, Parfitt, and Pates (1994) and McTeague et al. (2009), for instance, suggest that extreme physiological arousal negatively affects performance through the suppression of cognitive and physiological resources, and Lazarus, Deese, and Osler (1952) discuss how stress greatly affects verbal, perceptual, and motor performance. Hardy and Fazey (1987) propose a “catastrophe”

model of acute stress and performance. Following Yerkes' and Dodson's traditional inverted-U, at low levels of physiological arousal, stimulation facilitates performance and at higher levels of physiological arousal stimulation degrades performance. Further, a "catastrophe" occurs at supremely high levels of physiological arousal; that is, when arousal reaches a certain threshold, performance deteriorates at a catastrophic rate and cannot be readily restored until a substantial decrease in stimulation occurs.

Effects of Acute Stress on Perception

Perceptual abilities are particularly susceptible to the negative effects of acute hyperarousal (Easterbrook, 1959; McTeague et al., 2009). Perception is narrowed under high levels of stress; attention becomes more focused on primary tasks while neglecting secondary tasks, and effects such as cognitive and physical tunnel vision, and focus lock occur (Broadbent, 1971). Further, if necessary attentional resources are unavailable, primary task performance declines.

Biologically, stress breaks down "normal" sensory processing, to the extent that some researchers have begun to consider distinctly separate processing models for stressful and non-stressful situations (Metcalf & Jacobs, 1998; Zoladz, Park, & Diamond, 2011). They propose that "hot" perceptions (i.e. arousing, autonomic, or limbic factors) are processed in the amygdala rather than the hippocampus. Research based on this theory has shown significant physiological and affective differences in sensory processing under stressful and non-stressful conditions, thus supporting the idea of separate models (e.g. Doerksen & Shimamura, 2001; Ayduk, Mischel, & Downey, 2002; Lok, Bond, & Tse, 2009).

Effects of Stress on Mental Health

Although not the primary focus of this effort, it is important to note that mental illness in the military population is a pervasive concern that grows dramatically in times of combat. Mental health disorders are the second leading cause for hospital admissions in military members (Hoge, Lesikar, Guebara, Lange, Brundage, & Engel, 2002), and exposure to extreme stressors can lead to any number of mental health disorders, including PTSD.

The 2010 Mental Health Advisory Team (MHAT) study found that approximately 18% of Soldiers in Iraq reported moderate or severe levels of acute stress, with 7-21% of total military personnel returning from Iraq or Afghanistan meeting the criteria for Major Depression, Anxiety Disorder, or PTSD (MHAT, 2010). Erbes et al. (2007) found that 27% of personnel returning from deployment demonstrated alcohol use problems, and recent figures show that 66,934 active duty combat veterans were diagnosed with PTSD between 2000 and September 2010 (Fischer, 2010). At the current rate, approximately 20% of veterans are expected to develop symptoms of PTSD or major depression (Tanielian et al., 2008).

Background

Military Training Efforts

Several existing military training programs already attempt to address personnel's stress, as well as their ability to effectively perceive threats in the operational environment. Specific efforts, and their strengths and limitations are discussed in more detail in Chapter 2. The following sections offer a brief introduction.

Stress Tolerance

The military currently utilizes several strategies in an attempt to inoculate, insulate, evaluate, or treat potential or existing stress-induced issues. Recently developed programs involving predeployment stress resilience training have been provided to some troops prior to entering an operational environment. However, these programs suffer from several limitations, including their restricted scopes, lack of integration into specific operational tasks, and inclusion of techniques that are possibly inappropriate for the intended demographic (e.g., U.S. Army Center for Health Promotion and Preventative Medicine, 2004; McCarroll et al., 2005; Miller & Rasmussen, 2010). In addition, military members are widely resistant to participating in any mental health treatment program until a severe mental illness develops (e.g., Stecker, Fortney, Hamilton & Ajzen, 2007; Greene-Shortridge, Britt & Castro, 2007). Prevention training could help address military stress disorders but more research is still required to mitigate these programs' limitations and increase warfighters' acceptance.

Perceptual Skills Training

Because of high IED casualty and injury rates, detection of IEDs and similar hazards has become increasingly important in combat applications and is expected to have ongoing and increased importance in the future (e.g., Cameron, 2008). In an attempt to enhance performance and improve visual perception, recent empirical efforts attempted to identify critical perceptual–cognitive skills and how those skills should be trained (Abernethy, Woods, & Parks, 1999; Farrow et al., 1998; Grant & Williams, 1996; Scott et al., 1998; Singer et al., 1994; Smeeton, Williams, Hodges, & Ward, 2005;

Williams & Ward, 2003; Williams, Ward, Knowles, & Smeeton, 2002; Williams, Ward, Smeeton, & Allen, 2004).

Current IED perception training methods involve instruction in the recognition and rote memorization of specific types of explosive devices through exposure to practice environments containing mock IEDs. These types of training are important in the development of hazard detection skills; however, they generally lack important cognitive components. A successful IED search requires specific perceptual and cognitive activities that are not necessarily natural responses. Recent research efforts have shown that training for threat detection can be significantly enhanced through the use of cognition-based training to augment existing field-training methods (Hess & Sharps, 2008, Murphy, 2009). Thus, additional research is also required to extend these recent findings and operationalize them into effective military training programs of instruction.

Response to the Problem

Academic literature from a range of fields (e.g. cognitive psychology, clinical psychology, neuropsychology, sports psychology) shows that cognitive decrements due to distress cause considerable breakdowns in task performance, especially those that relate to perceptual skills such as threat detection. If the deleterious effects of stress could be partially reduced, in general, and the negative influence of stress on perceptual performance could be mitigated, then potential for positive downstream effects is significant.

It is possible that this outcome could be obtained by training warfighters in a combination of stress resilience and perceptual skills. Increasing warfighters' abilities to

detect threats in theater may reduce the number of casualties caused by these threats, and in addition, reducing the impact of IEDs on warfighters has the potential to decrease the occurrence of negative affective outcomes, caused by witnessing casualties and injuries of fellow squad members. Further, these efforts may ease some of the acute environmental and emotional stress warfighters experience, which may eventually lead to reductions in chronic stress, and possibly, chronic mental health disorders. Related research within and outside the military realm lend support to the idea that these positive outcomes might be possible with the implementation of a novel stress resilience and perceptual skills training program. However, military researchers have not yet performed sufficient empirical testing to inform the development of such a program.

Perceptual Resilience Training Study

Several fields of research contain literature that recommends individual “best practices” to implement in training. It was hypothesized that integrating the best practices from general training, perceptual skills, and stress resilience literature into a novel military-based “perceptual resilience” program would increase the ability to detect threats in a stressful environment by decreasing acute stress. An empirical, experimental research study was designed as a first step toward developing a perceptual resilience program that, once fully assessed, could be delivered to military personnel. Specifically, this study compared task performance scores, self-reported acute stress, and self-reported workload among three groups of participants ($n = 20$ per group) who received different combinations of perceptual skills and stress resilience training prior to completing a stressful task.

Research Questions and Hypotheses

It was determined that the following five research questions and accompanying hypotheses related to perceptual resilience training and task performance would provide the most comprehensive foundation to inform future development of a military-based perceptual resilience training program:

RQ1. In what ways does a perceptual skills training program affect threat detection abilities when under stress, compared to status quo training?

H1: Participants in the perceptual skills-only training condition will exhibit better task performance under stress on a visual search threat detection task than participants in the Control (no additional training) condition.

RQ2. In what ways does a perceptual resilience training program affect threat detection abilities when under stress, compared to perceptual skills training and status quo training?

H2: Participants in the perceptual resilience training condition will exhibit better task performance under stress on a visual search threat detection task than participants in the perceptual skills-only training condition, who will perform better than participants in the Control (no additional training) condition.

RQ3. Do threat detection abilities differ between perceptual skills-only training and perceptual resilience training when under normal stress conditions?

H3: When under normal stress conditions, participants in the perceptual skills-only and perceptual resilience training conditions will not differ in performance ratings.

RQ4. In what ways does a perceptual resilience training program affect self-reported workload when under stress, compared to perceptual skills training and status quo training?

H4: When under stress, participants in the perceptual resilience training condition will rate lower on measures of subjective workload than participants in the perceptual skills training and Control (no additional training) conditions.

RQ5. In what ways does a perceptual resilience training program affect self-reported acute stress and state anxiety, compared to perceptual skills training and status quo training?

H5: When under stress, participants in the perceptual resilience training condition will rate lower on measures of subjective acute stress and state anxiety than participants in the perceptual skills-only training and Control (no additional training) conditions.

Methodology Overview

Sixty participants enrolled in the study, which took place at the University of Central Florida's Institute for Simulation and Training lab in Orlando, FL. Three experimental conditions were created, and included 20 participants each: a status quo/control condition, a perceptual training condition, and a perceptual resilience

training condition (i.e., perceptual training plus stress resilience training). All participants received the same status quo declarative knowledge training, which explained various visual indicators of “friendly” versus “enemy” military vehicles. The perceptual training group and the perceptual resilience training group then completed perceptual skills training, which involved a visual discrimination task. Finally, the perceptual resilience training group completed a stress resilience program, which demonstrated techniques for decreasing acute stress and anxiety.

For the experimental task, video clips of tanks, jeeps, helicopters, and transport vehicles were displayed one at a time on a computer screen. Participants used a keyboard to indicate “friendly” and “enemy” vehicles. During this time, an external stressor consisting of intermittent bursts of loud white noise, verbal trivia questions, and time pressure (selected based on the results of a pilot study) was played for the duration of the task. For all five research questions, the independent variable of interest was type of training (perceptual resilience, perceptual skills-only, and status quo declarative knowledge-only). Dependent variables of interest for each research question were measured before, during, and after the experimental task. Descriptive and inferential (*F*-tests) statistical techniques were employed in order to assess the effects of the independent variables (type of training) on the dependent variables (state anxiety, acute stress, workload, and task performance).

Summary

In order to develop training strategies targeting specific critical skills, it was necessary to first understand perceptual processes that are critical to task performance.

The following sections discuss background information, compiled from a comprehensive literature review, regarding the three stages of information processing, how they interact, and how these stages may be relevant to a perceptual military task. This information was utilized to develop the perceptual skills training, the stress resilience training, and the experimental task.

CHAPTER 2: LITERATURE REVIEW

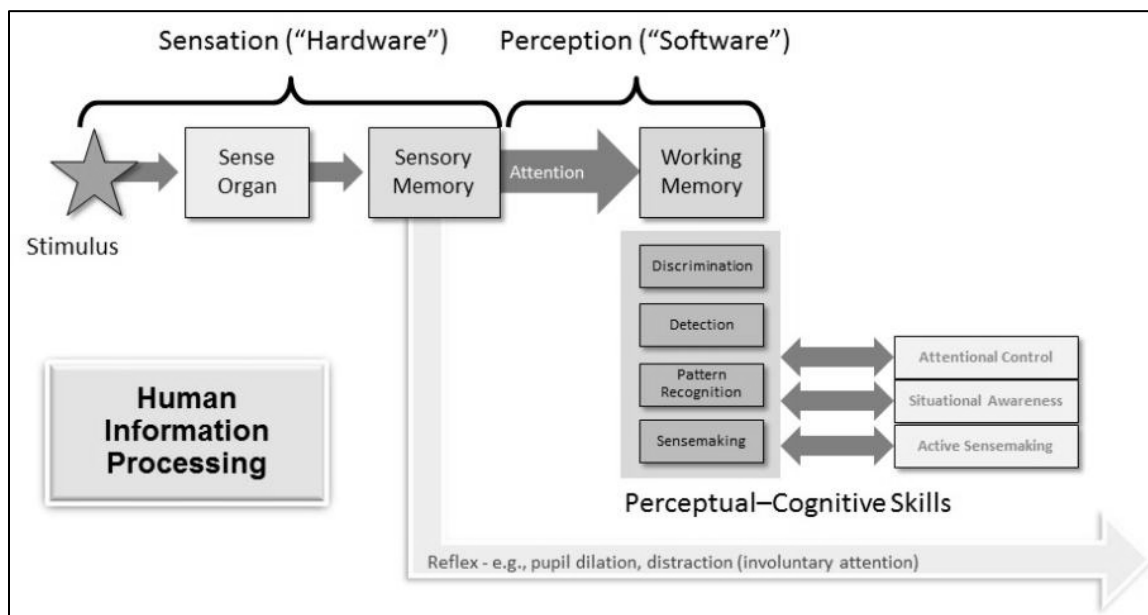
“Train with the understanding that firearms practice is 75% physical and 25% mental; however a gunfight is 25% physical and 75% mental” (Marcus Wynne, 2004).

Cognitive Mechanisms Related to Performance

Due to the improvised and evolving nature of the current operational environment, it is difficult to identify and predict patterns in threats such as IEDs, snipers, and terrorist behavior. Indicators are spread out over time and space, and they may change as an attack progresses from planning to detonation, making cognitive associations challenging. Therefore, it is not sufficient to train warfighters to simply look for specific environmental and behavioral cues, given the adaptation of the enemy. Warfighters must possess adaptive perceptual skills that enable detection of threats across any number of environmental, cultural, and situational conditions. To this end, it is necessary to first identify key perceptual skills necessary for successful threat detection, understand how they are negatively affected by stress, and then determine effective means of training (Carroll, Milham, & Champney, 2009).

Only recently have researchers begun to empirically address the cognitive processing components related to the effects stress, anxiety, and arousal on perceptual performance. Before discussing these effects, however, it is first necessary to describe the cognitive systems that may be affected. The following sections describe specific

cognitive processing components involved with perception, given their critical role in military tasks. The Human Information Processing (HIP) model (sensation, attention, perception, response selection, response execution; Wickens & Flach, 1988) serves as the basis of this brief explanation, and is illustrated in Figure 2.



Note. Courtesy of Sae Schatz, PhD. Derived from Sperling (1960), Baddeley (1966), Atkinson & Shiffrin (1968), Baddeley & Hitch (1974), Baddeley (2000). Modified to reflect components of interest.

Figure 2. Human Information Processing Diagram.

Cognition and Perception Overview

The HIP model describes the progression of processing that builds awareness from external stimuli. Awareness involves an individual understanding how information, events, or actions will impact goals and objectives, both presently and in the future (Endsley, 1997). Improved awareness is the key outcome goal for most tasks involving

perceptual skills because it ultimately aids in decision making and determining responses to the environment.

The first three HIP components, sensation, attention, and perception, are considered key to improving SA through perceptual skills development (Carroll, Milham, & Champney, 2009; Abedi, Mofidi, & Behzadfar, 2011). Individuals advance through these three cognitive stages in order to perform a perceptual task, and at any of these stages, an information processing breakdown could occur.

Information Processing

The HIP model begins with sensation. Sensation is the primary physiological processing of information via the sense organs, the visual, auditory, vestibular, and pain receptors. Following sensation, the brain analyzes the sensory inputs and determines if they will be attended to or not. The information of interest is converted into a construct that can be stored within the brain and recalled later from either working or long-term memory. The cognitive process of attention selectively focuses on choice aspects of the environment while ignoring other stimuli. Alternatively, the stimuli that are not attended decay; that is, they are filtered out after the brain determines their insignificance.

Attended-to information is actively held in working memory in order to carry out complex perceptual tasks such as pattern recognition and sensemaking. Working memory makes this possible for a short period of time, providing for temporary integration, processing, disposal, and retrieval of information. Once a stimulus is sensed and attended to, perception refers to the resulting assessment, comprehension, and interpretation of what the stimulus means.

Each of these cognitive processes lend to overall perceptual abilities in information processing. There are many ways that these processes can be hindered by stress, thus reducing the effectiveness of associated perceptual abilities needed in combat situations. Although a vast number of abilities and processes exist that can be covered by this topic, only certain constructs are of most interest to this research and were thus selected for in-depth discussion here. The following sections provide specific examples of the chosen perceptual abilities, and how stress can be detrimental within each information-processing construct.

Sensation

Sensation concerns the first contact and physiological transfer of energy between the individual and the environment (Coren, Ward, & Enns, 2004). The initialization of sensation stems from receptors in the brain that detect and respond to visual, auditory, vestibular, or pain stimuli (Brynie, 2009). Sensations are purely physiological and outside of conscious control (Baddeley, 2009).

Sensory memory. Sensory memory refers to the ability to retain impressions of sensory information after the original stimulus has ceased. Information detected by sensory receptors is retained temporarily in sensory registers that have a large capacity for unprocessed information but are only able to hold accurate images of sensory information briefly (Sperling, 1960). Sensory memory operates within the approximate time frame of less than one second to no more than two (Atkinson & Shiffrin, 1968).

Encoding. The process of conveying information within the sensory memory to the working memory is referred to as encoding. Sensory memories from the

environmental stimuli are combined into one single experience (Mohs, 2007), allowing information to be utilized in the short term. The brain identifies and indicates the strength of each connection, disposing the weakest and choosing the strongest for encoding and advancement to working memory.

Visual, acoustic, and semantic encodings are the most intensively used sensory connections. Visual encoding includes the processing of images and sensory information, forming constructs out of the input, and placing positive or negative value on that construct (Belova, Morrison, Patton, & Salzman, 2006). Acoustic encoding includes the processing of sound and words, and storing the information in the verbal working memory. Semantic encoding includes the processing of sensory input that has particular meaning or can be applied to a context.

Perception

Perception involves several processes including analyzing sensory information, constructing a description of the surrounding world, consciously experiencing objects, and forming object relationships (Pike & Edgar, 2005; Coren et al., 2004). Once a cue is sensed, perception represents the resulting assessment and comprehension of what the cue means. For example, when a warfighter notices a suspicious shape behind a bush, perception allows him/her to recognize the shape as the barrel of a sniper rifle, understand it as a potential threat, and realize that this threat must be addressed. All of these processes occur within the working memory.

Working memory. Working memory (which is similar to the construct of short-term memory) allows for holding and understanding small amounts of information. With

each new stimulus, the brain is prompted by experience, education, or training to produce more groups of connections which can ultimately create memories and determine the storage capacity, handling, and retrieval of information in the working memory (Baddeley, 1999; Ericsson & Kintsch, 1995; Just & Carpenter, 1992). Thus, the working memory is involved in higher order cognitive tasks (Gathercole & Alloway, 2006), such as understanding spoken and written language (Daneman & Merikle, 1996), mathematics (Adams & Hitch, 1997), reasoning (Engle, Carullo & Collins, 1991) and problem solving (Baddeley, 1986).

Working memory is constrained by a limited capacity. Bottlenecks, or restrictions in the flow and processing of information, occur at specific points throughout its use. These prevent overload yet slow down processing speed (Broadbent, 1958; Reiser & Dempsey, 2007). Despite the limits of working memory, individuals are capable of selecting and storing a single attribute of an object without having to store all the characteristics (Woodman & Vogel, 2008). In other words, this process continuously makes connections within the working memory in order to define an object or construct in an efficient manner.

Attention

First, of note, the construct of attention is widely studied and covers an array of cognitive abilities. A basic overview of general attention is covered here, followed by three attention sub-types of interest – divided attention, visual attention, and processing – and is not intended as a comprehensive overview.

Top-down vs. bottom-up processing. Attention is the process of selectively concentrating on one aspect of the environment while ignoring other stimuli (Anderson, 2004). Biological senses constantly take in billions of bits of information, but only about 40 are processed and attended to per second (Meyers, 2008).

Attention involves both “top-down” and “bottom-up” processing, which result in conscious awareness by selecting between the competing stimuli (Naish, 2005). The first method, top-down processing, occurs when attention is strategically and consciously directed to specific stimuli based on expectations due to past experience and current goals (Biederman, 1981). In other words, novel data are gathered based upon preexisting information that has been previously stored in long-term memory. From a top-down point-of-view, the first stage in a perceptual task is to identify where in the environment to direct attention. For example, a warfighter scans negative spaces looking for indicators of a threat and detects an unnaturally dark and straight contour behind the brush (known from memory to be the barrel of a sniper rifle).

The second method, bottom-up processing, describes a “stimulus-driven mechanism which focuses on salient changes in the environment to drive attention” (Biederman, 1981). That is, data are gathered from the senses to direct attention. For example, in scanning the terrain for a threat, a warfighter may hear a rustle in the bushes or a breaking branch, causing attention to be shifted to the location from which the sound originated.

Divided attention. The most complex level of attention, known as divided attention, refers to the ability to respond simultaneously to multiple tasks or multiple task

demands. The term “divided” is somewhat of a misnomer, as people actually switch attention rapidly from task input to task input rather than truly multitasking (Crain, Govoni, Naveh-Benjamin, & Anderson, 1996). This process, known more academically as “attentional shifting,” inhibits working memory, as the information regarding one task is discarded when attention switches to the alternate task, placing higher demand on executive functioning. Attentional shifting has shown to negatively affect overall attention and cognitive control. In general, as the number of tasks increases, performance decreases exponentially in terms of response time and information. Once the brain is overloaded with too many stimuli, attention becomes more focused on primary tasks, consequently neglecting secondary tasks, creating cognitive tunnel vision and “task shedding” (Broadbent, 1971; Easterbrook, 1959; Janis & Mann, 1977; Staw, Sandelands & Dutton, 1981; Wallsten, 1980).

Visual attention. Visual attention is generally thought to operate as a two-stage process (Jonides, 1983). In the first stage, attention is evenly distributed over the external visual scene while processing stimuli information. In the second stage, attention is concentrated (focused) to a specific area of the visual scene, and serialized processing is performed.

Visual attention has been of interest to the psychology community for decades. During this time, several models have been formed to describe the process of visual attention. The first of these, the spotlight model (LaBerge, 1983), was inspired by research that described attention as having a focus, a margin, and a fringe (James, 1890). According to this model, the focus refers to an area of extraction from the visual scene

with a high-resolution, the center of which is where visual attention is directed.

Surrounding the focus is the so-called “fringe of attention,” which extracts information in a low-resolution. This fringe extends out to a specified area to the cut-off, or margin.

The second model, the zoom-lens model, was first introduced in 1983 (Eriksen & St. James, 1986). This model includes all the properties of the spotlight model, but has the added a size-changing property inspired by a camera’s zoom lens. A change in the size of the focus affects the efficiency of processing; as such, the zoom-lens of attention can be described in terms of an inverse trade-off between the focus size of focus and processing efficiency. The proposed reasoning is that if attentional resources are fixed, the larger the focus area, the slower processing of the visual scene can occur (Castiello & Umilta, 1990).

Cognition and Perception Conclusion

Having a basic understanding of HIP helps lead to defining important skills associated with stress resilience and, therefore, increased task performance. The next sections take this knowledge of HIP and apply it to specific cognitive-perceptual abilities. Further, these sections will cover the ways that stress can negatively affect cognition and perception, leading to degradations in operational task performance.

Importance of Visual Perception for Threat Detection

Threats to military members in operational environments encompass a wide range of possibilities. The U.S. Army provides a broad definition of a threat as “an object or individual designed to destroy, incapacitate, distract, delay, or disrupt an opposing force.” Common threats in the contemporary operational environment include IEDs, snipers,

terrorist cells, and suicide bombers. Because these threats are adaptive and often improvised, no specific guidelines to identify or categorize threats exist. Therefore, the key factors in threat detection are experience, awareness, and training (Pike, 2011).

The preliminary findings of a 2007 study supported by the I Marine Expeditionary Force, the Marine Corps Warfighting Lab, and the Office of Naval Research suggest that observational skills are critical to awareness and tactical decision-making (Carroll, Milham, Champney, Eitelman, & Lockerd, 2007). Advances in combat technology have helped, but often the naked eye is still the best sensor for threats (Zorpette, 2008). Thus, teaching warfighters to become proficient at visually detecting and identifying signs of an imminent attack is especially important to military training and will be the focus of the proposed research here.

Military researchers are especially interested in whether and/or how the visual perceptual field is changed under stress. Early cognitive theory suggests that attentional shifts occur with increased arousal (e.g. Easterbrook, 1959); however, the mechanisms by which this occurs are not well understood. Most researchers do concur, however, that major deficits in threat detection occur due to visual perception errors. Several generalizations have been established regarding the basis of these errors. These are essential elements to understanding visual processes that are affected under stress, and thus should lend to the foundations of perceptual training components.

Abernethy (2001, p. 71) outlines three general errors in visual perception: 1) focusing attention on more than the relevant information (“having the searchlight too broad”); 2) focusing attention on irrelevant information (“having the searchlight pointed

on the wrong direction”); and 3) not being able to focus attention quickly enough on all relevant information in succession (“having the searchlight beam too narrow or being unable to move the searchlight rapidly enough from one spot to the next”).

However, what specific visual perceptual breakdowns lead to these errors, and how is stress involved? What is insufficient about current training protocols? In turn, what evidence-based skills should be utilized in order to increase warfighters’ performance? These questions are addressed in the following sections.

Key Visual Perceptual Abilities and the Effects of Stress

When over-stimulated, individuals are more likely to experience errors in sensation and perception. Research based in this area has shown significant physiological and affective differences in sensory processing under stressful and non-stressful conditions (e.g. Doerksen & Shimamura, 2001; Ayduk, Mischel, & Downey, 2002). As a result of these changes in processing, less and/or incorrect neurological connections are produced (Hellawell & Brewin, 2001). This, in turn, creates problems throughout the rest of the information processing pathway, such as improperly encoding stimuli from sensory to working memory, thus creating erroneous memories or memory connections (i.e. storing information in the wrong “file folder”), and ultimately carrying out inappropriate actions. Given this, we must first identify perceptual skills that are vital to establishing accurate awareness for detection. These identified skills will help to inform the development of training strategies.

Visual Search

Visual search procedures involve actively scanning the environment for a particular object or feature (the target) among other objects or features (the distracters). One of the most common factors affecting reaction time in detecting targets is the number of distracters present in the visual search task. An increase in the number of distracters often leads to an increase in search reaction time and is thus also related to an increase in the task difficulty.

Visual search tasks are also constrained physiologically. When observing a moving target, the visual system can only track very slow movements, such as a person walking three miles per hour past an observer six feet away. It is generally impossible to fully maintain visual focus on objects that are moving fast or close to the observer because of the high eye angular velocities required. The visual perceptual system compensates by processing one or two critical features of the movement rather than tracking the entire target.

Additionally, visual tracking requires saccadic eye movements in order to observe parts of the action (Ridgway & Kluka, 1987). Saccades reposition the eyes to different angles when scanning the visual field (Carpenter, 1988), but the eyes are essentially turning off as they saccade from one fixation to the next (Cambell & Wurtz, 1978). This is referred to as “saccadic suppression” and is needed to prevent vision blurring as the eyes move across the field. Therefore, it is possible that an individual might appear to be focusing directly on an event, but did not see an important aspect because the eyes were essentially “off” between fixations.

Visual search under stress. Most physiological functioning is impaired when the body is experiencing stress. Saccadic eye movements tend to take more time when shifting focus (i.e. longer saccades) with heightened arousal (Wilson, Glue, Ball, & Nutt, 1993), thus increasing the chance of a visual tracking error. Similarly, a target may be missed because of a common eye blink (averaging about 25 per minute); these keep eyes closed about 1/10 of a second (Volkman, Riggs, & Moore, 1980). The more anxious an individual becomes, the more frequently blinks occur (Volkman et al., 1980). Visual search is a very important perceptual skill, in that the information processed during the search helps to formulate environmental baselines. If detriments to physiological functioning occur when performing a visual search, an inaccurate baseline is likely to be established, leading to errors in the following perceptual skills.

Attentional Regulation

Attentional regulation is a perceptual ability that allows for monitoring and modulating cognition, emotion, and behavior to accomplish goals and/or to adapt to situational demands (Berger et al., 2007). For instance, attentional regulation enables a person to perceive or ignore stimuli, both task- and non-task-related. There is some consensus in the literature that an individual's ability to control attention is one of the main determining factors in working memory-related task performance (Engle, 2002; Kane, Bleckley, Conway & Engle, 2001).

This so-called "load theory of selective attention" proposes that attentional regulation can both positively and negatively affect perception (Lavie, Hirst, de Fockert, & Viding, 2004). For instance, if many stimuli are present (especially task-related

stimuli), non-task related stimuli are easier to ignore. On the other hand, if there are very few stimuli, such as in vigilance tasking, the brain perceives both the irrelevant and relevant stimuli. This makes filtering out irrelevant stimuli more difficult, and can decrease attentional resources attending to relevant stimuli.

Attentional regulation under stress. With the advent of less invasive direct measures of visual attention, more empirical, physiological research has been performed to determine how alterations in visual attention might influence performance. Research has shown that, during and after periods of acute stress, control over regulating attention is reduced, and non-task related stimuli are more likely to be (incorrectly) perceived as task-related stimuli, thereby diverting attentional focus from more important aspects of the environment.

This effect has been replicated in the laboratory on many occasions. For example, in a driving task, Janelle, Singer, and Williams (1999) showed that as arousal and state anxiety increased, so too did the response time required to identify the presence of task-relevant cues. Additionally, there was a reduction in the capability to discriminate task-relevant from task-irrelevant cues, and response time increased. In other words, as stimulus detection speed increased, detection accuracy decreased and driving speed was reduced.

In this study, the researchers also recorded gaze behavior. During high anxiety conditions, gaze became more eccentric, with more fixations directed towards peripheral locations. Results suggested a propensity to be distracted by task-irrelevant peripheral cues, resulting from a narrowing of the attentional field. This visual narrowing resulted in

a greater need to look directly at peripheral cues in order to attend to them. Consequently, when drivers attended to the peripheral cues, fixations to the central driving area were reduced.

Similarly, in a table tennis task (Williams et al., 2000), researchers found that more fixations per trial were used in high arousal conditions. This suggests that when stressed, more fixations were required to attend the same amount of information that was attended to with fewer fixations under low arousal.

Pattern Recognition

Pattern recognition is an innate ability that involves “interpreting forms, contours, and colors in order to identify a set of stimuli arranged in an expected way that is characteristic of that set of stimuli,” (Sutherland, 1968). An individual takes in bits of information and combines them in different ways to form a connection with the working memory. The latest Tactics, Techniques, and Procedures (Department of the Army, 2010) place emphasis on the importance of pattern recognition in order to effectively counter enemy IED operations. Specifically, the Army recommends training warfighters to “improve recognition of environmental changes” in hopes of “preventing friendly forces from entering the kill zones of IED’s and save lives” (p 27). This recognition results from template and prototypical matching.

Pattern recognition under stress. Being able to accurately recognize patterns in the environment or in human behavior is an important skill in threat detection, especially in spotting anomalies during a visual search. Research performed with Navy SEALs during “Hell Week” showed significant decrements to pattern recognition abilities when

under acute stress (Lieberman et al., 2005). The SEALS were administered pre- and during-training tests that included the Scanning Visual Vigilance Test, which assesses the ability to sustain attention during a boring, continuous scanning task. The test involves scanning the visual scene (on a computer monitor) and reporting infrequent, difficult to detect stimuli appearing at random intervals and locations. The Matching-to-Sample Test was also administered, which specifically tests pattern recognition ability. The participant is presented with a small matrix of letters and colors, waits a delay period, then is presented with two matrices from which he or she must choose the match to the original matrix.

Severe impairment was measured in all areas when the SEALS were experiencing stress during their training. Scanning visual vigilance showed 55% degradation from baseline in response time. The Matching-to-Sample test showed 37% degradation in response time, and participants were significantly more likely to make errors in pattern recognition. Comparatively, when under acute stress, the SEALS performed significantly worse on all perceptual tasks than participants tested at .10% blood alcohol level.

Behavioral and Environmental Anomaly Detection

The term “anomaly” refers to a change from baseline. Warfighters are particularly concerned with environmental anomalies (changes to the normal visual scene) or behavioral anomalies (changes in an individual’s or group’s normal physical or affective behavior). When looking for anomalies, one must first establish an accurate baseline with which to compare the current environment. Establishing a baseline may include

remembering the appearance of the physical terrain, having an understanding of normal cultural behavior, or being familiar with human biometrics.

Anomaly detection under stress. Under heightened arousal, there is a natural tendency to focus on the primary stimulus of a given situation, rather than on peripheral considerations where anomaly indicators often lie. In biological research involving administration of synthetic corticosteroids to participants (mimicking a physiological stress response), moderate to severe impairments to hippocampal activity were reported. Detriments on declarative memory tasks (including acquisition and recall) supported the hypothesis that stress negatively affects both the processing and retrieval of memories (Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996). Hippocampal breakdown under stress has also been shown when interpreting meaningful actions relative to meaningless ones (Decety et al., 1997), and recognizing novel stimuli (Habib & Lepage, 2000).

This tendency reaches its most intense with “tunnel vision” (e.g., Grossman & Christensen, 2004) which occurs often in stressful environments. At its most intense, this “core” focus of attention may be an armed assailant. Any such assailant must, of course, be the center of focus for responding warfighters. However, if that assailant has prepared his or her position with explosive devices on the periphery of the action, the anomaly indicators may go unobserved (Hess & Sharps, 2006, Sharps, Hess, Casner, Raney, & Jones, 2007). The potential consequences of this phenomenon in operational environments are extensive. This effect is readily observed in combat training situations, as well as in the laboratory.

In realistic field training evolutions, it is not uncommon to observe even seasoned officers so focused on a potential assailant or on a developing violent situation, that they completely ignore environmental and behavioral indications of alternate threats, even when those threats are in plain sight (Sharps, Newborg, Glasere, Hayward, & Scholl, 2010). Such errors of observation were shown in an experimental police training course (Sharps & Hess, 2008). Participants were asked to make quick decisions based upon their reactions to pictures of street scenes depicting a potentially violent situation, in which an “assailant” was seen aiming a handgun at a female “victim.” Most of the participants (88%) indicated that they would fire on the assailant. In another condition, the “assailant” was armed with a benign power screwdriver which he may have been non-violently holding toward the “victim.” Again, the majority (85%) of participants indicated their decision to kill the assailant. In other words, under quick-response constraints, participants did not notice the change, and could not distinguish a power tool from a handgun.

Missed detections such as these are highly disadvantageous for appropriate decision-making and performance in a combat environment. If a warfighter cannot process or retrieve accurate memories of the environment, they will be much less likely to notice important anomalies indicating potential threats.

Formal Perceptual Training in the Military

Currently implemented threat-detection instruction involves training in rote recognition of various types of explosive devices, then exposing trainees to practice environments containing mock explosives (typically IEDs). However, recent research

efforts have shown that training for combat threat detection can be significantly enhanced through the use of cognition-based protocols integrated with existing field-training methods (Hess & Sharps, 2008; Murphy, 2009).

This recent research recognizes that the nature of “irregular” combat threats poses a training challenge. Threats within a combat environment are, by design, not meant to be found, or to be so obvious that they distract attention from the real threat. Furthermore, as coalition forces learn to counter specific types of threats, insurgents quickly adapt (Eles, 2009). This cycle of deception and adaptation places pressure on training systems to keep up with lessons learned in order to offer the most robust programs possible.

Continually adapting operations also require specific skills by the enemy: the exploitation and coordination of many people, and opportunities to stage the attacks. Thus, a successful attack is difficult because assailants typically produce recognizable cues or indicators, both physical and behavioral, which might alert responding warfighters. A key principle of perceptual skills training, then, is preparing warfighters to effectively process information while under stress, in order to improve cognition and decision-making (Carroll, Milham, & Champney, 2009). Warfighters must have the ability to identify a range of threats, including IED’s, snipers, and suspicious behaviors which could indicate the presence of such threats.

Several threat detection programs have been implemented by the Services that only include the basic memorization-type education mentioned above. More contemporary, cognitive-based programs exist outside the military (such as in law enforcement and sports fields). Additional programs within and outside the military realm

are currently undergoing development and experimentation and incorporate visual perceptual skills training. This section provides examples of current programs, and a larger-scale summary is provided in Table 1.

Table 1

Threat Detection and Perceptual Skills Training Summary

Program	Length	Description	Empirical Outcomes ¹	Perceptual Skills ²	Detection Rehearsal ³	Availability ⁴	Cost ⁵	Gaps
Tactical Site Exploitation	5 days	Education on basic IED information, provided via picture slideshows, video from theater. Practice lanes provided. Taught by certified instructors.	✘	✘	✓	++++	\$\$	Does not include perceptual skills for improved detection, no experimental outcome data.
Home Made Explosives Training	1 day	Education on commonly available chemicals, provides experience with realistic smells, textures, and appearance.	✘	✘	✓	+	\$\$\$	Does not include perceptual skills for detection, no experimental outcome data.
Combat Hunter	5-10 days	Combines classroom and field education in perceptual skills related to combat tracking and combat profiling. Field practice.	✓	✓	✓	+++	\$\$\$\$	Offers minimal resilience education, no feedback, half of “gold standard” perceptual skills.
ROC-IED training	2 hours	Computer-based self-training program, offers brief overviews in IED and explosives basics, understanding enemy networks, and situational awareness skills.	✓	✓	✘	++++	S	Does not include skill rehearsal or feedback capabilities.
SMOKE training	1 hour	Cognition-based training via lecture on search and detection techniques for IEDs. Integrated with field-based methods.	✓	✓	✘	NA	\$	Does not include skill rehearsal or feedback. New program unavailable to the community.
Electronic Facial Identification Technique	Unknown	Video-based trainer with images of realistic environments. Familiarize with appearance of combat indicators in variety of contexts. Instructor-led.	✘	✓	✓	(?)	\$\$\$	Virtual rehearsal only. No empirical outcome data.
IED Awareness Simulator	Unknown	Interactive virtual environment to practice procedures while IED scanning in a variety of contexts.	✘	✓	✘	NA	\$\$\$	Main program information not available. No empirical outcome data.

Note. ¹ ✓ indicates empirical outcomes are available, ✘ indicates empirical outcomes not available. ² ✓ indicates perceptual skills are included in training, ✘ indicates perceptual skills are not included. ³ indicates threat detection rehearsal is included in training, ✘ indicates threat detection rehearsal is not included. ⁴ Based on the breadth, + indicates narrowest availability, ++++ indicates widest availability, ✘ indicates not available. ⁵ \$ indicates least expense, \$\$\$\$ indicates highest expense. (?) indicates “unknown.”

Tactical Site Exploitation (TSE)

The National Training Center produced an initial IED search capability in 2008 that included the construction of a small Middle-Eastern village complex consisting of four houses that are used for formal five-day IED search training courses. Trainees are educated on the most common specific types of IEDs (appearance, construction materials, and timing devices), common methods of deployment, and environmental indicators. This education is provided via picture slideshows and video from theater, and is taught by certified TSE instructors.

The CENTCOM Commander stated in March 2008 that “each maneuver battalion will have a squad-size element trained in search,” and the Services are presently working toward that goal. Since then, TSE capabilities have expanded to seven additional locations across the military. No experimental outcome data are available for effectiveness assessment.

Combat Hunter

This Marine training course combines classroom and field education in perceptual skills related to combat tracking and combat profiling. Developed in 2007 by civilian and military subject-matter experts in their respective fields, this course aims to train Marines to maintain situational awareness through skills such as visual search, anomaly detection, pattern recognition, tactical cunning and patience, and mental simulation in ambiguous, dynamic environments. In general, Combat Hunter aims to train improved situational awareness and sensemaking (Schatz, Reitz, Fautua, & Nicholson, 2010). The Combat Hunter course appears to represent the best implementation of perceptual training.

Lessons may be learned from this curriculum, and in addition, further improvements to it could be investigated. Therefore, combining this training with instruction on perceptual resilience could yield added benefits.

Formal Stress Tolerance Training in Practice

Recently, a strong demand has been expressed throughout the Services to expand stress tolerance training efforts. In April 2010, Sgt. Maj. Preston, the Army's senior enlisted advisor, testified that "what keeps [me] awake at night is stress on the force" (Leipold, 2010: para. 1), and the latest Marine Corps *Vision and Strategy 2025* (2010) names "mental toughness," a construct including psychological resilience, among its critical competencies. Because of this demand, a variety of predeployment training programs have been developed and implemented with the goal of insulating warfighters from the development of psychological distress. Such programs aim to improve stress tolerance, or the ability to maintain effective functioning in a high-stress environment (Driskell & Johnston, 1998).

Despite significant resources being invested into these training programs, there is a dearth of scientific evidence to support their efficacy. Additionally, these programs are often disjoint, cross-sectional, and delivered haphazardly (Taylor, Schatz, Marino-Carper, Carrizales & Vogel-Walcutt, 2011). As a preliminary step towards addressing these issues, this section outlines the efforts currently in use by the Armed Services, as well as those recommended by related communities. A brief sample of programs is provided in this section, and a more full-scale summary is provided in Table 2.

Table 2

Predeployment Stress Training Summary.

Program	Length	Description	Empirical Outcomes ¹	Skill Rehearsal ²	Delivery Method ³	Availability ⁴	Cost ⁵	Gaps
Sustainment Resilience	1 hour pre- and post-deployment	Group briefing, includes family members	✓	✗	+	+++	\$	Minimal effectiveness in preventing chronic mental illness, lecture format, presented by mental health professionals, no skills trained or reinforced
Army Center for Enhanced Performance (ACEP)	1 academic year	Voluntary individual and group training integrated with academics	✓	✓	++	+	\$	No empirical data regarding effectiveness related to stress coping
Comprehensive Soldier Fitness (CSF)	Varies throughout career	Individual assessment/training, group briefing, unit NCOs provide continuous support	✗	✓	++	+++	\$\$	No empirical data regarding effectiveness related to stress coping
General Surgeon's Stress Concept	16 hour training, 20 hour review, counseling	Small group delivery by unit Psychologist	✗	✓	+++	++	\$\$	No empirical data regarding effectiveness related to stress coping
Operational Stress Control and Readiness (OSCAR)	Continuous throughout deployment	Specialists educate via sessions during deployment. NCOs provide support	✗	(?)	++	++	\$	No empirical data regarding effectiveness related to stress coping; vague methodology
Survival, Evade, Resistance, Escape (SERE)	21 days	Field stress exposure	✗	✗	++	++++	\$\$\$	Does not include education on stress coping techniques; specific coping data lacking
Navy SEAL training	6 months	Classroom training/field stress exposure	✗	✓	+++	+	\$\$\$	No empirical data regarding effectiveness related to stress coping
Squad Immersive Training Environment (SITE)	Varied based on needs	Group training in immersive environment	✗	✓	+++	+	\$\$\$\$	High cost; limited availability; no empirical data related IIT and stress coping
Stress Resilience in Virtual Environments (STRIVE)	30, 10 min. VR sessions	Virtual reality based individual training	✗	✓	+++	++	\$\$\$	New project, currently not available to community

Note. From Taylor, Schatz, Marino-Carper, Carrizales, & Vogel-Walcutt (2011). ¹ ✓ indicates empirical outcomes are available, ✗ indicates empirical outcomes not available. ² ✓ indicates skill rehearsal is included in training, ✗ indicates skill rehearsal is not included. ³ Based on the effectiveness of delivery method, + indicates least effective, +++ indicates most effective. ⁴ Based on the breadth of availability, + indicates narrowest availability, ++++ indicates widest availability, ✗ indicates not available. ⁵ \$ indicates least expense, \$\$\$\$ indicates highest expense. (?) indicates "unknown."

Resilience Vs. Inoculation Training

Two classes of stress tolerance foundations are commonly used as the basis of a training program. The first, resilience training, seeks to prepare personnel by fostering the development of coping strategies, emphasizing acquisition of skills through education and practice (Driskell & Johnston, 1998). In contrast, stress inoculation efforts strive to habituate personnel to acute stressors by exposing them to highly-stressful, yet controlled, settings, which helps develop confidence in the use of coping skills (Meichenbaum, 2007). Although resilience and inoculation can be conjointly employed, they represent different approaches to stress tolerance development.

Resilience Training In Practice

Resilience is the “ability to withstand, recover, grow, and adapt” under challenging circumstances (Bates et al., 2010: 21), and resilience training programs attempt to foster this by teaching coping skills and fostering adaptive perspectives. Providing education and training about stress may benefit warfighters in several ways: “(a) it enables the individual to form accurate expectations regarding the stress environments, thereby increasing predictability, (b) it decreases the distraction involved in attending to novel sensations and activities in the stress environment; and (c) it allows the individual to identify and avoid performance errors that are likely to occur in the stress environment” (Driskell & Johnston, 1998: 193).

The most recent MHAT executive report identifies the need to “develop, revise, evaluate, and integrate resiliency and life-skills training... in order to increase Soldiers’ skills in meeting the psychological demands of combat” (MHAT VI, 2010: pp. 3).

Towards this end, several military programs have been implemented that incorporate resilience training, and this section reviews those active programs.

Sustainment Resilience Training. In response to the negative stigma sometimes associated with mental health treatment-seeking, the U.S. government has implemented a one-hour educational course for all military personnel and their families, known collectively as the Sustainment Resilience program (formerly referred to as “Battlemind”). The Sustainment Resilience program is delivered in a group setting prior to deployment; it offers a review of the basic signs and symptoms of post-deployment mental illness, and it encourages family members to support treatment-seeking. Personnel returning from combat deployment also receive a similar post-deployment briefing prior to reintegration (Walter Reed Army Institute of Research, 2008).

The MHAT V report indicated a negative trend between Battlemind and reports of depression, anxiety or acute stress during deployment. Among those who attended Battlemind training prior to deployment, 15.5% reported mental health problems, compared to 23% among those who did not attend Battlemind (MHAT V, 2008). They note, however, that these data are not a result of a systematic or controlled study.

In the only empirical investigation on the effectiveness of Battlemind/Sustainment Resilience, 1060 U.S. Soldiers completed the standardized post deployment reintegration training. At a 4-month follow-up assessment, these troops reported fewer symptoms of PTSD, depression, and sleep disturbances as compared to Soldiers who did not receive the reintegration training (Adler, Bliese, McGurk, Hoge, & Castro, 2009).

Army Center for Enhanced Performance (ACEP). The U.S. Military Academy at West Point developed a Performance Enhancement Program that uses systematic psychological training to build mental and emotional strength, with the intent to maximize combat skills performance. This voluntary year-long program integrates systematic psychological training into regular coursework and follows an educational “sports psychology” approach rather than a clinical model. Cadets receive individual training and group courses that center on five foundational areas: building confidence, goal setting, attention control, energy management, and integrating imagery (www.acep.army.mil; Zinsser, 2004). The program expanded in 2007, having now established sites at eight U.S. Army bases.

Although outcomes regarding the main objectives of the ACEP program have yet to be assessed, one research team addressed the program’s effectiveness in terms of self-esteem. A sample of 27 cadre members showed increased self-esteem scores on participant-rated measures post training completion compared to baseline scores (Hammermeister, Pickering, & Ohlson, 2009).

Non-military Resilience Training. It is important to recognize that a variety of resilience training programs have been validated outside the military environment. Resilience training in education, medicine, and public speaking are especially popular. For example, a 2003 study provided basic group-based resilience training to college students prior to an examination. Compared to the control group, participants of the training group exhibited a lower endocrine stress response (measured via cortisol levels) and lower self-reported stress after the exam (Gaab, Blattler, Menzi, Pabst, Stoyer, &

Ehlert, 2003). Studies that are based in fields outside the military promote the use of resilience training in various environments. However, because they are not designed for military participants, they are difficult to generalize directly to high-stress military settings and are discussed here simply as an example of successful resilience training programs.

Inoculation Training in Practice

Stress exposure, or “inoculation,” is a cognitive behavioral technique in which the training is adapted to individual conditions, which may range from situational stress conditions to chronic events requiring long-term adaptation (Meichenbaum, 2007). Such training can include habituation to stressors that are controllable and uncontrollable, intermittent and recurrent, or current and past.

Implementation of stress inoculation training, both within and outside the military should include three phases: (1) an educational phase, (2) a skills acquisition phase, and (3) an application phase (Meichenbaum, 2007). This process of gradual stress exposure is intended to desensitize individuals to the negative effects of extreme stress, thus improving operational performance and decreasing the possibility of psychological trauma (Wiederhold, Bullinger, & Wiederhold, 2006; Driskell & Johnston, 1998).

Several military programs are available that incorporate inoculation or exposure training. Although some active training environments are not explicitly designed to train stress inoculation, they can still serve as appropriate testing grounds in which to measure stress responses. For example, the U.S. Survival, Evasion, Resistance, Escape (SERE) training provides an adequately realistic (based on physiological and performance data)

stressful exposure environment that could immediately integrate stress coping skill rehearsal (Taylor et al., 2007; Morgan et al., 2000, 2002). This section provides a brief example of active military inoculation programs. While stress inoculation is, effectively, integrated throughout many military training activities, the programs listed here specifically target (at least in part) stress tolerance training.

Navy SEAL Training. U.S. Navy SEAL trainees undergo six months of intense physical and mental training in the BUD/S (Basic Underwater Demolition/Seals) program. Especially during “Hell Week,” BUD/S training pushes trainees to extreme limits through sleep deprivation, physical discomfort and pain, combat diving and swimming with oxygen deprivation, and using explosives (www.navseals.com, 2010). A newly designed classroom phase trains SEALs to monitor their psychological performance and maximize “mental toughness” skills. This phase provides adaptive, focused education on stress management in terms of increasing performance in very specific environments. Mental toughness skills are then integrated throughout the remainder of the program. Because this addition to the course is relatively new, no empirical data have been published in regard to its effectiveness.

Squad Immersive Training Environment (SITE). A newly-developed program, SITE, is planned for implementation in Fiscal Year 2012. Utilizing the already available Infantry Immersive Trainer (IIT), SITE is intended to offer an immersive toolkit that enables squads to train across a range of missions, meeting targeted training objectives from the predeployment training package. For the SITE program, the IIT’s realistic virtual environment will serve, in part, as a stress inoculation training environment,

designed to expose Marine riflemen to the sights, sounds, and smells of urban warfare settings while enhancing decision-making abilities under the stress of combat. IIT environments include role players, virtual characters, auditory and olfactory stimulation, and simulated explosives.

As of September 2009, no systematic data regarding stress training have been collected from the IIT. However, an investigation in the overall quality of the IIT found that training groups reported the facility to be more valuable than traditional training. An expert group reported that, compared to more traditional approaches, the IIT facility was “extremely useful” (NRAC, 2009).

Chapter Summary: Integrating Perception and Resilience

The fields of general training, perceptual skills, and stress resilience all possess research literature that recommends individual “best practices” to implement in training. It is hypothesized that integrating the best practices from perceptual skills training programs and stress resilience training programs into a novel military-based “perceptual resilience” program will increase the ability to detect threats in a stressful environment. In the following sections, the independent recommendations from general training, perceptual skills training, and stress resilience training domains are reviewed in order to inform the components of the perceptual resilience training program protocol. Based on the reviewed recommendations, a comprehensive list of trainable threat detection, perceptual, and stress tolerance skills was outlined, as illustrated in Table 3.

Table 3

Recommended Integrated Training Skills

Skills	Justification
<u>General Training</u>	
1. Practice with varying levels of difficulty	1. Practice with a difficult-to-detect stimulus leads to the development of more effective global search strategies and better transfer to alternative environments than easy-to-detect stimuli (Doane, Alderton, Sohn, & Pellegrino, 1996).
2. Provide feedback	2. Practice with immediate results feedback has shown to positively impact perceptual training performance (Jastorff, Kourtzi, & Giese, 2006; Wright & Fitzgerald, 2001).
<u>Visual Perception</u>	
1. Practice with interactive stimulus components	1. Perceptual skills training and rehearsal adapted from sport psychology methods (e.g. Burroughs, 1984; Farrow, Chivers, Hardingham, & Sachse, 1998; Farrow & Abernathy, 2002; Ward et al., 2008; Fadde, 2010; and Fadde & Klein, 2010).
2. Present varying levels of difficulty in stimuli	
3. Rehearse for short periods of time with rest	
4. Provide continuous performance feedback	
5. Provide the opportunity to ask questions	
<u>Stress Tolerance</u>	
1. Mental Resilience	1. Educating warfighters on the physiological and cognitive effects of stress significantly increases performance under heightened arousal (e.g. De Becker, 2009; Williams, 2002).
2. Education	2. The “holy grail” for firearms instructors is teaching the effects of arousal on performance (Williams, 2004).
3. Goal-setting	3. Establishing performance goals prior to a task has positive impacts on acute anxiety and concentration (Burton, 1988).
4. Mental Imagery	4. Motivational mental imagery reduces anxiety prior to and during competition (Vadocz & Hall, 1997).
5. Positive Self-Talk	5. Positive self-talk reduces state anxiety (Van Raalte, Brewer, Rivera, & Petitpas, 1994).
6. Combat Breathing	6. Combat breathing reduces heart rate and blood pressure and improves cognitive abilities (e.g. Minturn et al., 2001).

General Training

Researchers interested in establishing the best general training techniques have outlined empirically validated basic principles for designing a training protocol (e.g. Cannon-Bowers, Rhodenizer, Salas, & Bowers, 1998; Cannon-Bowers & Salas, 1998; Stout, Bowers, & Nicholson, 2009). The following section outlines some of these general principles that are relevant for perceptual resilience training.

Present Varying Levels of Difficulty

Revisiting similar material at different times in rearranged context presented at varying levels of difficulty is essential for advanced skill acquisition (Spiro, Feltovich, Jacobson, Coulson, 1991; Caserta, 2007). Trainees should be presented with training scenarios which include a variety of situations and difficulty (e.g., quantity/complexity of distracters, complexity of target, level of occlusion and camouflage over the target, and the visual similarity of the target to training examples). For example, pattern recognition skills are best developed when first learned in a minimum stimulus environment, as it provides the greatest degree of cue saliency (Kass, Herschler, & Companion, 1991). Once trainees are familiar with the threat features, distracters could be added to the environment with the target (e.g., a realistic, cluttered scene). After basic training, practice with a difficult-to-detect stimulus leads to the development of more effective global search strategies and better transfer to alternative environments than easy-to-detect stimuli (Doane, Alderton, Sohn, & Pellegrino, 1996). Increasingly difficult training scenarios should include well-hidden targets that are difficult to discriminate from the background.

Feedback

Practice with immediate results feedback has been shown to positively impact perceptual training performance (Jastorff, Kourtzi, & Giese, 2006; Wright & Fitzgerald, 2001). It is necessary to ensure trainees receive feedback with respect to positive and negative performance in order to be aware of areas in need of improvement. For instance, in a threat-detection task, trainees could be given post-performance feedback on the percentage of critical areas scanned, percentage of targets detected, and locations of targets missed, then be given the opportunity to complete a new detection task.

Diversity of Trained Stimuli

In order to achieve long-term maintenance and transfer of training, researchers recommend several methods. First, training should promote the use of prototypical matching, rather than template matching, in target detection. If a broad range of stimuli are included during perceptual training, a higher transfer rate and degree of maintenance may be achieved.

This theory was tested in a luggage screening experiment where participants were trained to locate specific knives in an x-ray image of baggage (McCarley, Kramer, Wickens, Vidoni, & Boot, 2004). Participants displayed improved target detection skills after training, but detection performance declined when novel items were introduced. The researchers suggested that if the items presented in training were more varied, performance outcomes may have been higher.

A later study tested this theory (Brunstein & Gonzalez, 2010) in a test of visual search performance that included exposure to novel situations. This time, luggage

screening training included categories of targets rather than presenting many specific items. A few examples from diverse categories were presented in order to increase the use of prototypical matching. In this case, results indicated improvement after training of novel item identification.

Experience/Repetition

Finally, researchers suggest that the “most important moderator” of stress is training, and that practice is essential (e.g. Thompson & McCreary, 2006; Salas, Priest, Wilson & Burke, 2006). In an Army IED detection study, the warfighters who performed the best were those with the most experience (Kavanagh, 2005). Additionally, studies involving members of the Army Green Berets and Navy SEALs (who arguably possess the most experience under stress than any other warfighter), have found that in threatening situations Special Forces members experience same increases in cortisol as any other warfighter, but their levels drop off faster than less experienced troops. Skills learned in perceptual resilience training courses need to be integrated into as many other aspects of a warfighter’s training cycle as possible. The more practice warfighter’s can have with trained skills in a safe environment, the more salient and effective the skills will be in a stress-filled operational environment.

Visual Perceptual Skills Training

In addition to general training recommendations, more specific knowledge and skills related to visual perceptual abilities have been empirically validated as having the potential to increase cognition and perception. These empirical findings demonstrate that perceptual performance is best predicted by trainable, rehearsable skills rather than by

individuals' physiological qualities, such as visual acuity or peripheral vision range (Caserta, 2007). However, effective perceptual training guidelines are not well verified (Caserta & Singer, 2007). "Surprisingly, just a handful of researchers have examined the nature of activities that are specifically responsible for performance improvement, and even fewer have translated the methods used and strategies acquired during such activities into meaningful training programs" (Ward et al., 2008, p. S73).

Only recently has experimental research on cognitive perceptual skills training begun to lend to some universally adaptable training structures. These structures are not based in military field settings, but are founded in sports psychology research. However, utilizing methods such as these in military contexts merits further testing, as this training structure could potentially mitigate the effects of stress by strengthening perceptual threat detection skills.

One of the most popular training programs in sport psychology research was developed by Burroughs (1984), and later refined by Fadde (2010), to aid baseball batters discriminate between types of pitches. A batter must decide in a matter of 250 milliseconds, on average, whether or not to swing at a pitch. To train discrimination skills, this training program centers around the use of interactive videos of various types of pitches being thrown by a professional pitcher. Discrimination difficulty is varied by showing different portions of the pitch, rather than the pitch from start to release. This variation provides the batting participants visual perceptual rehearsal in discriminating pitches based on a breakdown of the components of each pitch, rather than the more difficult task of viewing the pitch as a whole. Additionally, the participants receive

continuous, immediate feedback regarding their performance (i.e., whether or not they called the correct type of pitch). Several studies utilizing this training program have shown significantly improved performance in batting abilities (or tennis shot-return abilities, as in one adapted study) with participants who participated in the training compared to control participants (e.g., Burroughs, 1984; Farrow, Chivers, Hardingham, & Sachse, 1998; Farrow & Abernathy, 2002; Ward et al., 2008; Fadde, 2010; and Fadde & Klein, 2010).

Skills to Train Stress Tolerance

The act of simply educating warfighters on the physiological and cognitive effects of stress has shown to significantly increase performance under heightened arousal (e.g. De Becker, 2009; Williams, 2002). The importance of mental resilience is stressed by Gavin De Becker (2008), in his book Just 2 Seconds, Using Time and Space to Defeat Assassins:

Professional protectors already know a lot about maintaining physical readiness, but it's the mind that must be first properly prepared, the mind that controls the hands, arms, eyes, and ears. There are strategies available to help prepare warriors, based upon knowing how the body responds to lethal combat, what happens to your blood flow, your muscles, judgment, memory, vision, and hearing when someone is trying to kill you. (p. 37)

In this vein, a study on the use of psychological performance techniques was performed with Canadian police officers who rated their opinions on the relative importance of factors in front-line policing success. The officers reported that physical

readiness contributed to 28% of their success, technical readiness contributed to 32%, and mental readiness contributed to 40% (McDonald, 2006). In order to increase mental resilience, several strategies have been identified that can be integrated into training, such as education, goal-setting, mental imagery rehearsal, positive self-talk, and Combat Breathing (Honig & Sultan, 2004).

Education

According to researchers, the “holy grail” for firearms instructors is teaching the effects of arousal on performance (Williams, 2004). When stress awareness and stress training is promoted in a way that is meaningful and immediately relevant to warfighters, without engaging negative stereotypes that can undermine the important information inherent in this type of training, the benefits of these techniques are more immediately pertinent.

It is recommended, then, that mental resilience training should involve integration of psychological coping principles into dynamic military training environments, delivered by trainers with technical and operational experience and credibility. In this way, the lessons and training points associated with mental readiness are more intrinsically applicable because they are experienced in operationally relevant contexts (Nodine, Mello-Thomas, Kundel, & Weinstein, 2002; Asken, Grossman, & Christensen, 2010).

Goal-setting

In a study with young competitive swimmers, establishing performance goals prior to the start of a task was shown to have significant positive impacts on acute

anxiety, self-confidence and concentration (Burton, 1988). It is recommended that warfighters similarly express performance goals prior to a combat mission.

Mental Imagery Rehearsal

The effects of using mental imagery were assessed in the ability to enhance self-efficacy beliefs and performance on a competitive muscular endurance task (Feltz & Riessinger, 1990). The researchers found that the participants who used mental imagery prior to the task had higher efficacy and performance scores than control participants. Additionally, a study with competitive roller skaters showed that motivational mental imagery was able to significantly reduce state anxiety and increase self-confidence prior to and during competition (Vadocz & Hall, 1997).

Positive Self-Talk

Similar to mental imagery techniques, junior tennis players reported that negative self-talk was associated with losing and “bad” performance (Van Raalte, Brewer, Rivera, & Petitpas, 1994). Study results also showed that positive self-talk reduced state anxiety and increased self-confidence. In an Army study of IED detection, researchers found that warfighters who were successful at detecting bombs in simulations tended to think of themselves as “predators,” rather than “prey.” According to researchers, this frame of mind may in itself reduce anxiety (Murphy, 2009).

Combat Breathing

The use of diaphragmatic breathing for relaxation, or “Combat Breathing” has been shown to significantly reduce physiological symptoms of stress that also relate to cognitive abilities (e.g. Bernardi et al., 2002; Lehrer et al., 2003; Joseph et al, 2005).

Relaxation breathing techniques are easily implemented in any environment, and produce instant positive physiological effects. Under high stress conditions, combat breathing has been shown to reduce heart rate, blood pressure, and perspiration, as well as improve cognitive abilities by increasing oxygen flow to the brain (e.g. Minturn et al., 2001).

Summary of Training Recommendations

Based on the reviewed recommendations, a comprehensive list of trainable threat detection, perceptual, and stress tolerance skills was outlined. It was hypothesized that the integration of skills from each area will provide the most effective training to mitigate errors in operational threat detection. These skills lent to the development of a training program, which made up the foundation of the experimental methodology.

CHAPTER 3: EXPERIMENTAL METHODOLOGY

The previously presented literature supports the need to assess a novel perceptual resilience training program that integrates best practices and recommendations from perceptual skills training and stress resilience training programs, and if it can affect performance under stress. Specifically, this study compared task performance scores and self-reported acute stress among three groups of participants who received different combinations of perceptual skills and stress resilience training prior to completing a stressful task. Gaining access to military participants for research studies is typically difficult due to administrative and institutional review board (IRB) restrictions and stringent time constraints. These difficulties can lead to steep financial and labor costs imposed on collecting research data. Therefore, training programs are often designed and tested initially in a laboratory utilizing more accessible participant samples from the civilian community. This is a lower-cost option for researchers to present a polished training program for testing in the restrictive military environment. Such is the case for the study presented here; as this perceptual resilience training program is newly developed, it was deemed that testing in a laboratory with civilian participants was the most appropriate method to inform recommendations for future military-based testing. Therefore, a laboratory study was designed to assess the five research questions and corresponding hypotheses listed in Chapter 1. The intent of this study was to provide

basic empirical research as a foundation toward the future development of a perceptual resilience program that could ultimately be delivered to military personnel.

Pilot Study: Comparing Methods for Stress Induction in the Laboratory

Social scientists have recognized for decades the importance of studying human behavior under stress, but inducing stress on research participants is historically a controversial procedure. Initial methods (forcing participants to behead mice, or belittling child participants, for example), while highly effective and realistic, were physically and psychologically dangerous and unethical (e.g., Johnson, 1939; Landis, 1924). More contemporary strategies involve extreme physical exertion (e.g., Lundberg, 1995), drug injections (e.g., Bushman, Hope, & Payne, 1970), or cold-water immersion (e.g., Muza, Young, Bogart, & Pandolf, 1988). Although these approaches are safer and more ethical, they too have practical drawbacks. This experimental gap provided the need to first identify and evaluate methods for safely and ethically inducing low-to-moderate levels of stress, in manner appropriate for basic laboratory research.

Four common methods were identified: white noise bursts, distractors, time pressure, and cognitive workload. Each of these methods triggers acute (short-term) stress responses, but do not appear to induce enough stress to affect long-term physical or mental health. However, their relative degrees of effectiveness have not been compared. A comparison of techniques in a structured environment was necessary to develop the methodology of the main study.

Towards this end, a small-scale empirical study was performed that compared the four popular methods mentioned above. Specifically, the study assessed participants'

physiological and self-reported stress level during and immediately after exposure to various combinations of the four stressors. The stressors chosen for this experiment were selected due to previous studies that showed potential for success. While these methods have undergone limited independent testing, no comparative analyses have been previously conducted.

Noise

The use of intermittent unpredictable bursts of white noise has previously been shown to increase acute arousal in laboratory settings. Coren and Mah (1993) established that physiological (electromyographic) responses to unpredictable bursts of noise steadily increase over time. Davidson and Smith (1991) showed parallel effects with electrodermal activity. In addition to physiological response, some research has shown increased self-reported cognitive load when a task was accompanied by bursts of noise (Sweller, 1999; Mayer, 2002). The specific method used for this study was loud intermittent white noise bursts throughout the experimental task. Loud bursts of noise are a potentially realistic laboratory stressor for military settings, as it relates to common stressors in operational environments (unpredictable gunfire, explosions, vehicle noise, etc.).

Distraction

External distraction is often used to increase arousal during a task (especially in sport literature) and has been shown to increase self-reported workload in low-risk situations, such as auto racing simulations (e.g. Janelle, Singer, & Williams, 1999). The specific distractor used in this study was a 1941 recording of a murder mystery radio

show that included a multitude of sound effects, music, and variations in voice inflection. The recording was played for the duration of the experimental task. This specific method was chosen as a potentially realistic stressor in military settings, as war fighters must learn to focus amidst a multitude of non-threatening distractors (talking in a marketplace, ringing phones, etc.).

Time Pressure

Imposing time restraints is another common method for increasing arousal in participants. Previous research has shown decreases in judgment (Rothstein, 1986), decision-making skills (Svenson, Edland, & Slovic, 1990), and ability to focus (Russo & Rosen, 1975) when allotted limited time to complete a task. For this study, participants were given an unreasonably short period of time to complete the experimental task, thus intending to create a feeling of urgency. Again, this is a stressor commonly faced in an operational environment by war fighters who must make high-risk decisions in limited timeframes.

Cognitive Workload

Imposing a high workload on a task can significantly increase perceived stress and physiological arousal (Warm, Matthews, & Finomore, 2008). Increasing workload can be achieved by adding unnecessary secondary tasks to a primary task of interest. In this study, participants responded to verbal trivia questions every 45 seconds during the experimental task. As the other methods, having to deal with a high level of cognitive workload is a stressor that every war fighter faces when attending to more than one task at a time.

Study Methodology

A brief overview of the pilot study methodology and analysis is provided in the following sections. Appendix A provides more detailed information regarding these procedures.

In order to compare these stress induction methods, a total of 15 participants (6 males, 9 females) were recruited for this small-scale within-subjects study. After reviewing the informed consent, participants completed baseline assessments of their incoming state and trait stress levels, and their resting heart rates were captured. Participants then performed a common experimental task (specifically a paper-based spatial abilities tests) during which they were exposed to one or more of the four stressors. After each trial, participants completed several self-report assessments that measured current stress levels and perception of task workload. Participants returned each day for a week and completed only a single trial per day; this provided reset periods between each exposure.

Data Assessment

Due to the exploratory nature of the study, descriptive statistics were used to compare post-test scores between trials within each condition. In order to assess the effectiveness of each external stressor, the Multiple Resources Questionnaire (MRQ; Boles & Adair, 2001) and NASA-Task Load Index (NASA-TLX; Hart & Staveland, 1988) were administered at the conclusion of each trial (the Main Study Methodology section below provides a more detailed discussion of these measures). Based upon both the MRQ and NASA-TLX means trends, it appeared that Time Pressure and Workload

were the most effective external stressors, Noise was a moderately effective stressor, and Distraction was the least effective.

Pilot Study Conclusions

Based on the assessment of the data, several conclusions were drawn. First, a commonly used technique for inducing stress in the lab, the use of distractions, did not appear to effectively increase realistic stress levels in participants. This technique was consistently appraised as the least stressful method, even when paired with other stressors. In fact, anecdotally, participants described the distraction method (the vintage radio show) as enjoyable rather than stressful to listen to while completing the experimental task. Therefore, more research on this method is warranted. Perhaps the use of a different type of distractor (other than the vintage radio show used here) may show more of an effect on increasing stress. Also, including more participants overall may provide the opportunity to indicate a stronger result. However, for the purposes of informing the experimental design for the main study, the use of distraction will not be used as a stress-inducing technique.

The three remaining stressors – noise, time pressure, and workload – all appeared to have potential as effective ways to induce stress in the lab. Depending on the outcome measure, each of these stressors (and in various combinations) was rated as the most stressful. Therefore, it was determined that a combination of these three stressors would be used during the main study's experimental task. It did not appear, however, that the use of all four stressors was necessary, as the participants in Condition One (who

experienced all four stressors at once) did not indicate higher levels of stress than participants in Conditions Two or Three.

Also important to note are the physiological (Heart Rate Variability) data outcomes. It appeared that participants' heart rates were not effectively increased by any of the stressors tested in this study. It is possible that the methods used here were not stressful enough to cause a realistic biological response in a laboratory setting. Unfortunately, this is a common difficulty when testing stress responses in the lab and is important to note when drawing conclusions. Because of these results, it was determined that the financial and labor costs associated with using a heart-rate monitoring device too greatly outweighed any potential benefits. It was decided, therefore, not to use HRV as an assessment measure in the main study.

Finally, it was determined that more specific and robust self-report measures of stress were necessary to use in the main study beyond the NASA-TLX and MRQ. Traditionally, these measures assess workload, and don't necessarily capture participants' true acute stress levels. Therefore, it was determined that the Stress Appraisal Measure (SAM) and State-Trait Anxiety Index - State (STAI-S) would be added as self-report outcome measures in the main study. It was also determined that additional baseline measures were necessary to review as potential control variables; therefore, the Connor-Davidson Resilience Scale (CD-RISC) and State Trait Anxiety Index – Trait (STAI-T) were added to the existing baseline Perceived Stress Scale assessment.

Main Study

The pilot study informed the main experimental study's methodology. Specifically, the most effective external stressors from the pilot study—noise, time pressure, and distraction—formed the external stressor for the main study's experimental task. The main study's overall goal was to compare performance and post-task stress between groups of participants who completed basic declarative knowledge training, a novel perceptual skills training program, and/or a novel stress resilience training program. Three experimental conditions were created: a control condition, a perceptual training condition, and a perceptual resilience training condition (i.e., perceptual training plus stress resilience training).

Main Study Methodology

Setting

The study took place at the University of Central Florida's Institute for Simulation and Training lab in Orlando, FL. A designated lab space offered a wide range of testing capabilities, and was arranged appropriately for confidential, individual testing.

Ensuring Participant Safety and Confidentiality

The experimental protocol and all materials for the main study were submitted for approval to IRB committees at the University of Central Florida and Virginia Commonwealth University (approval letters are included in Appendix K). IRB guidelines for participant safety and confidentiality were strictly followed by the research team. All researchers who had interactions with participants or participant data held current CITI training certifications, as required by both university IRB's.

Participants

An a priori power analysis was performed in order to determine an appropriate sample size. The determination was based on an expected two-tailed data analysis with ANOVA using three conditions, effect size = .15, and $\beta = .70$. Results of the Power analysis indicated the need for 20 participants per condition, for a total of 60 (Faul, Erdfelder, Buchner, & Lang, 2009).

Therefore, a convenience sample of 60 participants were recruited from a local advertisement (included in Appendix F) posted on Craigslist.com (35 males, 25 females; Age $M = 27.7$). Inclusion criteria stated that participants had to be at least 18 years of age, have normal color vision, and no previous military experience. No other restrictions applied, and no “vulnerable” individuals were recruited for this study. Participants were reimbursed \$20 cash after completing the study.

Main Study Experimental Procedure

Participants completed the study individually in different time slots. The study began with reading the informed consent form (included in Appendix C), and participants were given the opportunity to ask questions and provide verbal consent to participate. After consent, the participants were provided baseline assessments measuring demographics, perceived stress based on events within the last week, current stress, and propensity for stress resilience. These baseline measures provided the participant’s “normal” state in order to compare changes post-training. These specific measures are defined in more detail below.

Basic Declarative Knowledge Discrimination Training

After completing the baseline assessments, all participants completed basic object discrimination training via a PowerPoint presentation (derived from military vehicle discrimination recommendations by O’Kane, Biederman, Cooper, & Nystrom, 1997; and Keebler, Jentsch, & Hudson, 2011). This training was intended to aid the participants in discriminating between enemy and friendly military vehicles during the experimental task. Participants were shown pictures and descriptors in order to learn basic distinguishing characteristics of enemy and friendly tanks, jeeps, helicopters, and transport vehicles (a sample is included in Appendix G). There was no rehearsal component in this training program.

Each participant was then randomly assigned to one of three possible conditions ($n = 20$ per condition). For ease of discussion, each group was designated a concise label (i.e., E1, E2, and Control). One experimental group completed implicit perceptual skills training (the perceptual skills-only group; E1), a second experimental group completed the implicit perceptual skills training plus stress resilience training (the perceptual resilience group; E2), and the third group condition completed no additional training (Control). Twenty participants were assigned to each condition. These conditions are described in more detail in the following sections and in Table 4.

Perceptual Skills Training Conditions

Two thirds of the participants (in conditions E1 and E2; $n = 40$) completed two 20-minute perceptual skills training programs that involved military vehicle rehearsal

Table 4

Main Study Design Overview

O₁ Pretests	X₁ Training	X₂ Training	X₃ Training	O₂ Task	O₃ Posttests
<u>All Conditions</u>	<u>All Conditions</u>	<u>Control Group (Control)</u>		<u>All Conditions</u>	<u>All Conditions</u>
·Demographic ·Survey	Vehicle Discrimination (Declarative Knowledge)	Placebo Task	Placebo Task	Experimental Task	·NASA Task Load Index (NASA-TLX)
·Perceived Stress Scale (PSS)		<u>Experimental Group 1 (E1)</u>		Reaction Time Task Score	·State-Trait Anxiety Index, State Scale (STAI-S)
·Connor-Davidson Resilience Scale (CD-RISC)		Perceptual Skills Training	Placebo Task		·Stress Appraisal Measure (SAM)
·State-Trait Anxiety Inventory, ·Trait Scale (STAI-T)		<u>Experimental Group 2 (E2)</u>			
		Perceptual Skills Training	Stress Resilience Training		

(a sample is included in Appendix H). This training was based on methods adapted from Fadde's (2010) baseball pitch visual perceptual skills training program, described previously. For the experimental training program, a total of 264 photographs of tanks, jeeps, helicopters, and transport vehicles (all realistic photographs taken in military settings) were displayed on a computer screen. The pictures varied in discrimination difficulty (e.g. distinguishing features occluded by objects, vehicle facing a different direction than was presented in the basic declarative knowledge training, etc.). According to Fadde (2010), these differences promote advanced visual perceptual learning and rehearsal, rather than rote memorization.

Participants were provided a standard computer keyboard and shown to press a specific key to indicate a “friendly” vehicle, and a different key to indicate an “enemy” vehicle. Each picture remained on the screen for 4 seconds, and then advanced to a feedback screen that showed for 3 seconds whether the answer was correct or incorrect. Halfway through the training, the participant was given the opportunity to ask questions and review the vehicle discrimination indicators with the researcher. The participant then completed the second half of the perceptual skills training program. Task performance (via percent correct and reaction time) was recorded for both perceptual skills training programs. Participants in the control condition ($n = 20$) were given a placebo task (i.e. review handouts that described general details of various military vehicles) that was equal in length to the perceptual skills training session (included in Appendix I).

Stress Resilience Training Condition

One third of the participants (in condition E2; $n = 20$) completed training via an interactive PowerPoint presentation that provided instruction on specific stress reduction techniques (a sample is included in Appendix J). The 35-minute presentation included videos of a “stress resilience training session” between the researcher and a research assistant “trainee,” and demonstrated five commonly-used stress-reduction techniques. The participants were encouraged to “picture themselves” as the trainee in the video, and to use the techniques during the experimental task. The five techniques discussed in the training included the following:

Stress education. In the training video, the researcher educated the trainee on the fight or flight response, and its physiological and cognitive effects.

Goal setting. In the training video, the researcher and the trainee discussed establishing performance goals prior to the start of a task. After the video, the participant was asked to write down three goals for the experimental task.

Mental imagery rehearsals. In the training video, the researcher and trainee discussed using motivational mental imagery before and during a stressful task. After the video, the participant was asked to spend five minutes performing mental imagery specific to the experimental task.

Positive self-talk. In the training video, the researcher and trainee discussed using positive self-talk during a stressful task. After the video, the participant was reminded to use this technique during the experimental task.

Combat Breathing. In the training video, the researcher and trainee discussed the ways that Combat Breathing can positively affect the negative symptoms of stress that were covered in the beginning of the training. The researcher demonstrated the proper technique for using Combat Breathing effectively, and practiced the technique with the trainee. After the video, the participant was asked to practice the technique with the researcher.

Participants who did not receive the stress resilience training (in conditions E1 and Control) were given a placebo task (i.e. review handouts that described general details of various human body systems) that was equal in length to the stress resilience training session (included in Appendix I).

Experimental Task

The experimental task was similar to the perceptual skills training program, but with video clips of military vehicles rather than static pictures. A total of 65 video clips of tanks, jeeps, helicopters, and transport vehicles were displayed on a computer screen for 10 seconds each. Participants were again provided a standard computer keyboard and shown to press a specific key to indicate a “friendly” vehicle and a different key to indicate an “enemy” vehicle. The video then advanced to a blank screen for three seconds, wherein the participant could no longer indicate a choice, and then advanced to the next video. No feedback was given during the experimental task. An external stressor consisting of intermittent bursts of loud white noise and verbal trivia questions (selected based on the results of the pilot study) was played via headphones for the duration of the task. Additionally, participants were told that in order to “pass” the test, they must complete the task in less than 10 minutes, and a digital timer was placed on the desk near the participant. Task performance (via percent correct and reaction time) was recorded during the experimental task.

After the test period, several self-report assessments were administered to the participants. These assessments measured current stress and perception of task workload. Once the assessments were completed, the participant was debriefed, paid, and excused by the researcher.

Testing Instruments

Demographics Questionnaire

General demographic questions were assessed for each participant. This questionnaire (included in Appendix D) included basic demographic information, such as age and gender, and also included additional questions relevant to the task, such as previous military experience and skills training. The demographic data for each participant was assessed in order to ensure that no significant confounds exist.

Perceived Stress Scale (PSS)

Cohen's (1983) Perceived Stress Scale is a widely used psychological instrument for measuring the perception of stress (included in Appendix D). This 10-item self-report assessment is a measure of the degree to which life situations are appraised as stressful. Test-retest reliability assessments in several large samples of college students show strong Cronbach's alpha correlations around .85 (Hewitt, Flett, & Mosher, 1992). Concurrent validity with the Maslack Burnout Inventory is also strong ($r = 0.65$; Hewitt, Flett, & Mosher, 1992).

Each item is assessed on a five-point Likert scale (ranging from 1 = "Never" to 5 = "Very Often"). Items are designed to measure how unpredictable, uncontrollable, and overloaded participants have found their lives in the last month. After reverse-scoring the appropriate items, higher scores (min = 10, max = 50) represent higher perceived stress. The PSS was presented to participants as a baseline measure.

NASA-Task Load Index (NASA-TLX)

Also as stated before with the pilot study measures, the NASA-TLX (Hart & Staveland, 1988) is a self-reported workload assessment that derives an overall workload score based on ratings across six one-item subscales (included in Appendix D). These subscales include mental demands, physical demands, temporal demands, own performance, effort, and frustration. The NASA-TLX is a highly-used measure in many fields, and has shown to be highly correlated with other measures of workload (e.g. Battiste & Bortolussi, 1988; Hill et al., 1992). Additionally, test-retest studies of this measure generally show correlations of at least .77 (Battiste & Bortolussi, 1988).

Each item is rated on a 10-point anchored line (defined by 1 = “Very low” at one end, and 10= “Very high” on the other), where the respondent indicates their answer anywhere along the line. After reverse-scoring the appropriate item, higher scores (min = 6, max = 60) reflect higher perceived workload. This questionnaire was administered after participants completed the experimental test.

Connor-Davidson Resilience Scale (CD-RISC)

In order to assess differences between participants’ propensity for stress resilience, the CD-RISC (Connor & Davidson, 2003) was administered at baseline (not available in appendices due to copyright). Concurrent validity with several measures was shown to be strong (Kobasa Hardiness Scale, $r = 0.83$; PSS, $r = 0.76$; Sheehan Disability Scale, $r = 0.62$; Connor & Davidson, 2003). Internal reliability was also strong with a Chronbach’s $\alpha = 0.89$ for the full scale, as was the test-retest reliability with an ICC = 0.87 (Connor & Davidson, 2003).

This 25-item self-report questionnaire is rated on a five-point Likert scale with responses ranging from 0 = “Not true at all” to 4 = “True nearly all of the time.” Higher scores (min = 0, max = 100) reflect a greater propensity for stress resilience.

State-Trait Anxiety Index (STAI)

This 40-item self-report questionnaire (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1970) is divided into two sections relating to state and trait anxiety (included in Appendix D). All questions are rated on a four-point Likert scale, with responses ranging from 1 = “Not at all” to 4 = “Very much so.” Both STAI subscales were found to be positively correlated with the Anxiety Sensitivity Index (Peterson & Reiss, 1987), and the Conjugate Lateral Eye Movements test (De Jong, Merckelbach & Muris, 1990). These results reinforce the convergent validity of the STAI for use in research. The Anxiety Scale Questionnaire and Manifest Anxiety Scales show positive correlation with the STAI Trait subscale (.73 and .85), which is strong enough to show reliability, but independent enough to be useful in its own anxiety determination (Spielberger, Reheiser, Ritterband, Sydeman, and Unger, 1995).

The trait (STAI-T) anxiety subscale measures general feelings of apprehension, tension, nervousness, and worry during the recent past. Higher scores (min = 20, max = 80) indicate higher trait anxiety. This subscale was used as a baseline measure to assess between participants. The state (STAI-S) anxiety subscale evaluates how participants felt during a specific task, assessing the level of stress experienced. Higher scores (min = 20, max = 80) indicate higher state anxiety. This subscale was used as a posttest measure to assess within-subject scores after the task.

Stress Appraisal Measure (SAM)

This 24-item self-report measure (Peacock & Wong, 1990) assesses six subscales of acute stress relating to a specific task (included in Appendix D). The subscales measure participants' appraisals of constructs that include threat, challenge, centrality, controllable-by-self, controllable-by-others, uncontrollable, and stressfulness. Internal consistency within each of the six subscales was reviewed by the researchers across three large-sample studies. Each subscale resulted in alphas of at least .75 (Peacock & Wong, 1990).

Questions are presented using a five-point Likert scale, with responses ranging from 1 = "Not at all" to 5 = "A great amount." Higher scores (min = 24, max = 120) indicate higher acute stress. This questionnaire was administered as a posttest after the experimental detection task and within-subjects scores were assessed.

Performance

Performance on the perceptual skills training and experimental task (as percentage correct scores and reaction times) were collected and compared between the three conditions.

Statistical Analyses

First, the data were cleaned by checking for normality, outliers, and significant demographic confounds between the participants within each condition using a series of mixed-method ANOVAs and post-hoc pairwise comparisons. No adjustments for normality were necessary, no significant outliers were detected, and no significant

demographic confounds were identified, as illustrated in Table 5. Therefore, all data collected were retained from all 60 participants.

Table 5
Demographics and Pre-test Outcomes Overview

Dependent Variable	Perceptual Skills Only Group	Perceptual Resilience Group	Control Group	Significance
Age	$M = 27.9$ $SD = 11.9$	$M = 28.3$ $SD = 10.7$	$M = 28.2$ $SD = 8.3$	$p = .993$
Video Game Time (hours/month)	$M = 1.1$ $SD = 0.30$	$M = 1.2$ $SD = 0.41$	$M = 1.1$ $SD = 0.31$	$p = .620$
Attention Games (hours/month)	$M = 1.8$ $SD = 0.43$	$M = 1.5$ $SD = 0.51$	$M = 1.6$ $SD = 0.49$	$p = .158$
Previous Stress Tolerance Training	$M = 1.1$ $SD = 0.32$	$M = 1.1$ $SD = 0.21$	$M = 1.2$ $SD = 0.41$	$p = .299$
Military Vehicle Recognition Expertise	$M = 4.8$ $SD = 1.7$	$M = 3.8$ $SD = 1.1$	$M = 4.6$ $SD = 2.5$	$p = .719$
Average PSS score	$M = 27.1$ $SD = 8.2$	$M = 24.0$ $SD = 6.7$	$M = 26.2$ $SD = 6.6$	$p = .381$
Average STAI-T score	$M = 41.7$ $SD = 13.7$	$M = 38.1$ $SD = 11.1$	$M = 40.3$ $SD = 12.6$	$p = .650$
Average CD-RISC score	$M = 98.4$ $SD = 11.8$	$M = 100.7$ $SD = 14.4$	$M = 98.2$ $SD = 17.0$	$p = .824$

After the data cleaning, a variety of statistical procedures were employed to assess each of the five research questions and their corresponding hypotheses. The following section provides a brief overview of the statistical design for this study.

RQ1. In what ways does a perceptual skills training program affect threat detection abilities when under stress, compared to status quo training?

The independent variable of interest (training type) consisted of two categorical levels, perceptual skills-only training (E1) and basic declarative knowledge training (Control). In order to test Research Question One, the experimental task performance data from the E1 and Control group were analyzed using five between-subjects Analyses of Variance (ANOVAs) for the following continuous dependent variables: average overall task time, average per-stimulus reaction time, total correct responses, total incorrect responses, and total response omissions. Significant outcomes were determined by reported p -values (set at a standard .05), which were based on the F -ratio. Cohen's d was also reported as an indicator of the strength of the relationship between the independent and dependent variables (effect size).

RQ2. In what ways does a perceptual resilience training program affect threat detection abilities when under stress, compared to perceptual skills training and status quo training?

The independent variable of interest (training type) consisted of three categorical levels, perceptual resilience training (E2), perceptual skills-only training (E1), and basic declarative knowledge training (Control). In order to test Research Question Two, the experimental task performance data from the three groups were analyzed using five between-subjects ANOVAs and post-hoc pairwise comparisons (t -tests) for the following continuous dependent variables: average overall task time, average per-stimulus reaction time, total correct responses, total incorrect responses, and total response omissions. Significant outcomes were determined by reported p -values (set at a standard .05), which were based on the F -ratio and t -value. Cohen's d was also reported as an indicator of the

strength of the relationship between the independent and dependent variables (effect size).

RQ3. Do threat detection abilities differ between perceptual skills-only training and perceptual resilience training when under normal stress conditions?

The independent variable of interest (training type) consisted of two categorical levels, perceptual resilience training (E2) and perceptual skills-only training (E1). In order to test Research Question Three, the perceptual skills training task performance data from the E1 and E2 groups were analyzed using five between-subjects ANOVAs for the following continuous dependent variables: average overall task time, average per-stimulus reaction time, total correct responses, total incorrect responses, and total response omissions. Significant outcomes were determined by reported p -values (set at a standard .05), which were based on the F -ratio. Cohen's d was also reported as an indicator of the strength of the relationship between the independent and dependent variables (effect size).

RQ4. In what ways does a perceptual resilience training program affect self-reported workload when under stress, compared to perceptual skills training and status quo training?

The independent variable of interest (training type) consisted of three categorical levels, perceptual resilience training (E2), perceptual skills-only training (E1), and basic declarative knowledge training (Control). In order to test Research Question Four, the self-reported workload data (the continuous dependent variable) from the three groups were analyzed using one between-subjects ANOVA and post-hoc pairwise comparisons

(*t*-tests). Significant outcomes were determined by reported *p*-values (set at a standard .05), which were based on the *F*-ratio and *t*-value. Cohen's *d* was also reported as an indicator of the strength of the relationship between the independent and dependent variables (effect size).

RQ5. In what ways does a perceptual resilience training program affect self-reported acute stress and state anxiety, compared to perceptual skills training and status quo training?

The independent variable of interest (training type) consisted of three categorical levels, perceptual resilience training (E2), perceptual skills-only training (E1), and basic declarative knowledge training (Control). In order to test Research Question Five, the self-reported acute perceived stress and state anxiety data (the continuous dependent variables) from the three groups were analyzed using two between-subjects ANOVAs and post-hoc pairwise comparisons (*t*-tests). Significant outcomes were determined by reported *p*-values (set at a standard .05), which were based on the *F*-ratio and *t*-value. Cohen's *d* was also reported as an indicator of the strength of the relationship between the independent and dependent variables (effect size).

CHAPTER 4: ANALYSES AND RESULTS

An empirical, experimental research study was carried out as a first step toward developing a perceptual resilience program that could ultimately be delivered to military personnel. Specifically, this study compared task performance scores, self-reported acute stress, and self-reported workload among three groups of participants who received different combinations of perceptual skills and stress resilience training prior to completing a stressful task. It was hypothesized that integrating the best practices from general training, perceptual skills, and stress resilience literature into the novel military-based perceptual resilience program would increase participants' abilities to detect threats in a stressful environment.

For all five research questions, the independent variable of interest was the type of training each participant completed (perceptual resilience, perceptual skills-only, and status quo declarative knowledge-only). Dependent variables of interest for each research question were measured before, during, and after the experimental task. Descriptive and inferential statistics were employed to assess the effects of the independent variables on the dependent variables. The following sections provide a description of the statistical outcomes for each research question.

Statistical Outcomes

Research Question One Analysis

RQ1. In what ways does a perceptual skills training program affect threat detection abilities when under stress, compared to status quo training?

H1: Participants in the perceptual skills-only training condition (E1) will exhibit better task performance under stress on a visual search threat detection task than participants in the Control (no additional training) condition.

Participants from the perceptual skills-only (E1) and Control (no additional training) groups completed a computer-based visual discrimination task that was comprised of distinguishing between “friendly” and “enemy” military vehicles while under stress. Performance indicators for each participant were measured during the experimental task, including: 1) total time to complete the experimental task, 2) average reaction time per individual stimulus, 3) correct discrimination responses, 4) incorrect discrimination responses, and 5) omitted responses (i.e., did not respond in the allotted time). Results from five between-subjects ANOVAs indicated support for Hypothesis One on most of the performance measures. It appeared that the E1 training group did, in fact, exhibit better task performance than the Control group in terms of average overall total task time, average per-stimulus reaction time, average correct discrimination responses, average incorrect discrimination responses, and average omitted responses. Table 6 provides an overview of the descriptive statistics related to Hypothesis One.

Table 6

Research Question One Descriptive Statistics

Dependent Variable	E1 (Perceptual Skills)	Control (No training)	Sig. E1 vs. Control	Effect Size (Cohen's <i>d</i>)
Average Total Task Time (in ms)	<i>M</i> = 459,188.5 <i>SD</i> = 37,631.8	<i>M</i> = 506,836.9 <i>SD</i> = 39,051.6	<i>p</i> = .000**	<i>d</i> = .34
Average Per-Stimulus Reaction Time (in ms)	<i>M</i> = 2,957.4 <i>SD</i> = 570.2	<i>M</i> = 3,679.3 <i>SD</i> = 591.7	<i>p</i> = .000**	<i>d</i> = .34
Average Correct Responses	<i>M</i> = 50.4 <i>SD</i> = 3.8	<i>M</i> = 48.6 <i>SD</i> = 5.0	<i>p</i> = .196	--
Average Incorrect Responses	<i>M</i> = 13.7 <i>SD</i> = 2.6	<i>M</i> = 12.1 <i>SD</i> = 3.2	<i>p</i> = .103	--
Average Omitted Responses	<i>M</i> = 2.0 <i>SD</i> = 3.2	<i>M</i> = 5.3 <i>SD</i> = 4.7	<i>p</i> = .011*	<i>d</i> = .28

Note. * indicates $p < .05$, ** indicates $p < .01$

For average total task time, participants in group E1 performed significantly faster ($M = 459,188.5$ ms, $SD = 37,631.8$ ms), overall, than the Control participants ($M = 506,836.9$ ms, $SD = 39.051$ ms), $F(1,39) = 15.44$, $p = .000$. Table 7 provides a summary of ANOVA outcomes, and Figure 3 provides a graphical comparison of the average total task time data.

Table 7

ANOVA Summary for E1 and Control on Average Total Task Time

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	22703700225.6	1	22703700225.6	15.44	.000*
Error (Within Subjects)	55882522260.9	38	1470592691.1		
Total	78586222486.5	39			

Note. * indicates significance at $p < .001$ value.

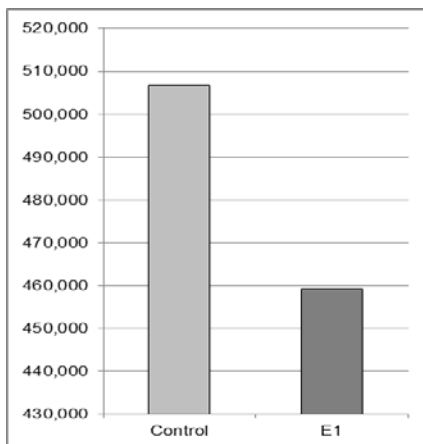


Figure 3. Average Total Task Time (in ms) for Groups E1 and Control

In terms of average per-stimulus reaction time, participants in group E1 again performed significantly faster ($M = 2,957.4$ ms, $SD = 570.2$ ms), overall, than the Control participants ($M = 3,679.3$ ms, $SD = 591.7$ ms), $F(1,39) = 15.44$, $p = .000$. Table 8 provides a summary of ANOVA outcomes, and Figure 4 provides a graphical comparison of the average per-stimulus reaction time data.

Table 8

ANOVA Summary for E1 and Control on Average Per-stimulus Reaction Time

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	5212118.0	1	5212118.0	15.44	.000*
Error (Within Subjects)	12828378.1	38	337588.9		
Total	18040496.1	39			

Note. * indicates significance at $p < .001$ value.

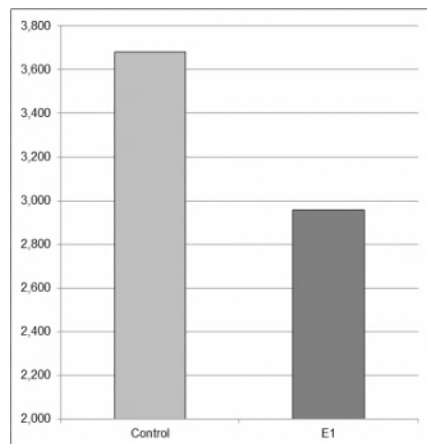


Figure 4. Average Per-stimulus Reaction Time (in ms) for Groups E1 and Control

In addition to time performance, task scores were also analyzed. For correct responses, participants in group E1 did not score significantly higher on the experimental task ($M = 50.4$, $SD = 3.8$), than the Control participants ($M = 48.6$, $SD = 5.0$), $F(1,39) = 1.73$, $p = .196$. However, the means show a non-significant trend in this direction. Table 9 provides a summary of ANOVA outcomes, and Figure 5 provides a graphical comparison of the average correct responses.

Table 9

ANOVA Summary for E1 and Control on Average Correct Responses

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	34.2	1	34.2	1.73	.196
Error (Within Subjects)	751.8	38	19.8		
Total	786.0	39			

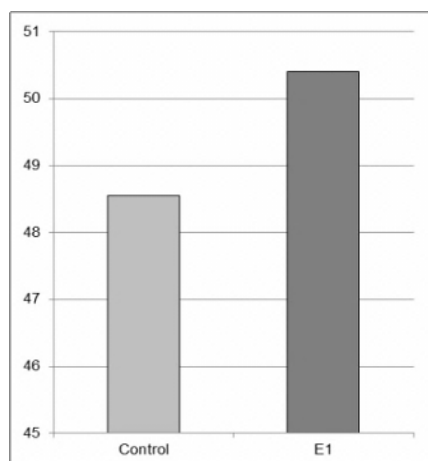


Figure 5. Total Correct Responses for Groups E1 and Control

Incorrect responses were divided in two categories – traditional incorrect and omissions (i.e. no response). Participants in group E1 ($M = 13.7$, $SD = 2.6$) did not significantly differ from the Control group ($M = 12.1$, $SD = 3.2$) in average total incorrect responses on the experimental task, $F(1,39) = 2.80$, $p = .103$. Table 10 provides a summary of ANOVA outcomes, and Figure 6 provides a graphical comparison of the average incorrect responses.

Table 10

ANOVA Summary for E1 and Control on Average Total Incorrect Responses

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	24.0	1	24.025	2.80	.103
Error (Within Subjects)	326.4	38	8.588		
Total	350.4	39			

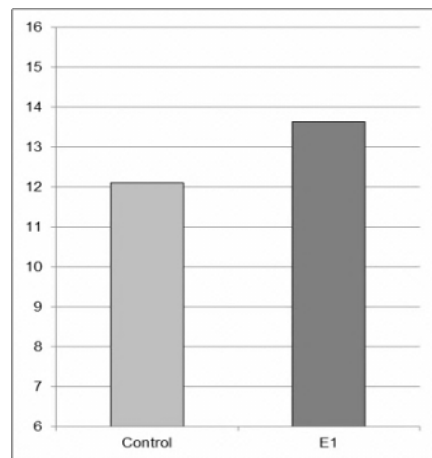


Figure 6. Total Incorrect Responses for Groups E1 and Control

Although there were no differences indicated in traditional correct or incorrect responses, participants in the Control group omitted responses ($M = 2.0$, $SD = 3.2$) significantly more often than participants in the E1 training group ($M = 5.4$, $SD = 4.7$), $F(1,39) = 7.10$, $p = .011$. Table 11 provides a summary of ANOVA outcomes, and Figure 7 provides a graphical comparison of the average total omissions data.

Table 11

ANOVA Summary for E1 and Control on Average Total Omissions

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	115.6	1	115.6	7.10	.011*
Error (Within Subjects)	617.5	38	16.3		
Total	733.1	39			

Note. * indicates significance at $p < .05$ value.

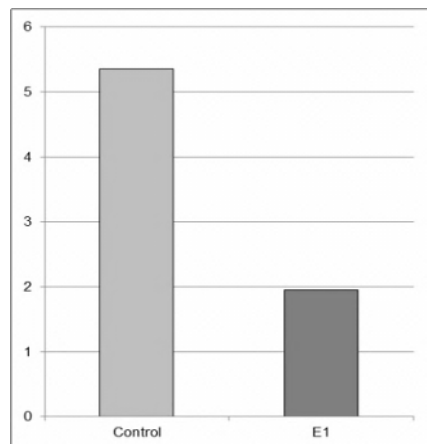


Figure 7. Total Omitted Responses for Groups E1 and Control

Research Question Two Analysis

RQ2. In what ways does a perceptual resilience training program affect threat detection abilities when under stress, compared to perceptual skills training and status quo training?

H2: Participants in the perceptual resilience training condition (E2) will exhibit better task performance under stress on a visual search threat detection task than participants in the perceptual skills-only training condition (E1), who will perform better than participants in the Control (no additional training) condition.

Participants in the perceptual resilience training group (E2) completed the same stressful computer-based visual discrimination task as the E1 and Control participants. Just as with the E1 and Control groups, performance indicators for each of the E2 group participants were measured during the task, including: 1) total time to complete the task, 2) average reaction time per stimulus, 3) correct responses, 4) incorrect responses, and 5) omitted responses. Results from five between-subjects ANOVAs and corresponding post-hoc comparisons indicated partial support for Hypothesis Two. The E2 training group did

significantly differ from the E1 training group in terms of overall task time and per-stimulus reaction time. However, the E2 training group did not differ from the E1 group on percentage scores. The E2 group performed significantly better than the Control on all outcome variables. Table 12 provides an overview of descriptive statistics and post-hoc significance values related to Hypothesis Two.

Table 12

Research Question Two Outcomes Overview					
Dependent Variable	E1 (Perceptual Skills Training)	E2 (Perceptual Skills + Resilience Training)	Control (No additional training)	Sig., Effect (Cohen's) E2, Control	Sig., Effect (Cohen's) E2, E1
Average Total Task Time (in ms)	$M = 459,188.5$ $SD = 37,631.8$	$M = 365,317.9$ $SD = 23,257.2$	$M = 506,836.9$ $SD = 39,051.6$	$p = .001^{**}$ $d = .42$	$p = .022^*$ $d = .21$
Average Per-Stimulus Reaction Time (in ms)	$M = 2,957.4$ $SD = 570.2$	$M = 1,535.1$ $SD = 303.9$	$M = 3,679.3$ $SD = 591.7$	$p = .001^{**}$ $d = .42$	$p = .022^*$ $d = .21$
Average Correct Responses	$M = 50.4$ $SD = 3.8$	$M = 51.8$ $SD = 3.4$	$M = 48.6$ $SD = 5.0$	$p = .014^*$ $d = .25$	$p = .278$ $d = --$
Average Incorrect Responses	$M = 13.7$ $SD = 2.6$	$M = 12.7$ $SD = 2.8$	$M = 12.1$ $SD = 3.2$	$p = .534$ $d = --$	$p = .282$ $d = --$
Average Omitted Responses	$M = 2.0$ $SD = 3.2$	$M = 1.3$ $SD = 1.5$	$M = 5.3$ $SD = 4.7$	$p = .000^{**}$ $d = .45$	$p = .561$ $d = --$

Note. * indicates $p < .05$ value, ** indicates $p < .01$ value

In terms of average total task time, participants in group E2 performed significantly faster ($M = 365,317.9$ ms, $SD = 23,257.2$ ms) than participants in group E1 ($M = 459,188.5$ ms, $SD = 37,631.8$ ms, respectively), who performed significantly faster than the Control participants ($M = 506,836.9$ ms, $SD = 39,051.6$ ms), $F(2,58) = 10.04$, $p = .000$. Table 13 provides a summary of ANOVA outcomes, and Figure 8 provides a graphical comparison of the average total task time data.

Table 13

ANOVA Summary for E1, E2 and Control on Average Total Task Time

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	27015317533.4	2	13507658766.7	10.04	.000*
Error (Within Subjects)	78003362242.2	56	1344885555.9		
Total	105018679775.6	58			

* indicates significance at $p < .001$ value.

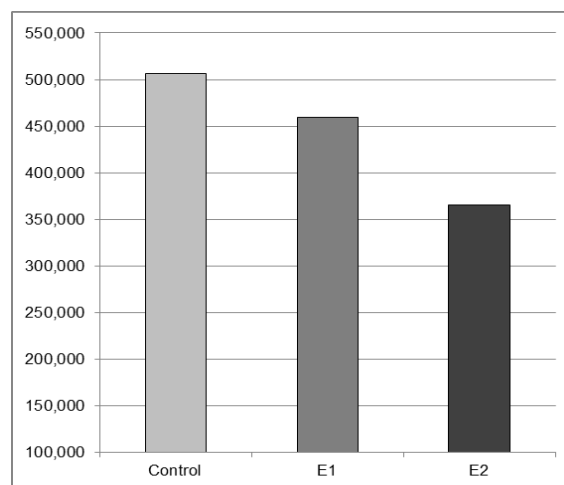


Figure 8. Average Total Task Time (in ms), for Groups E2, E1, and Control

In terms of average per-stimulus response time, participants in group E2 again performed significantly faster ($M = 1,535.1$ ms, $SD = 303.9$ ms) than participants in group E1 ($M = 2,957.4$ ms, $SD = 570.2$ ms), who performed significantly faster than the Control participants ($M = 3,679.3$ ms, $SD = 591.7$ ms), $F(2,58) = 10.04$, $p = .000$. Table 14 provides a summary of ANOVA outcomes, and Figure 9 provides a graphical comparison of the average per-stimulus reaction time data.

Table 14

ANOVA Summary for E1, E2, Control on Average Per-stimulus Reaction Time

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	6201932.7	2	3100966.3	10.04	.000*
Error (Within Subjects)	17906669.3	56	308735.7		
Total	24108602.0	58			

Note. * indicates significance at $p < .001$ value.

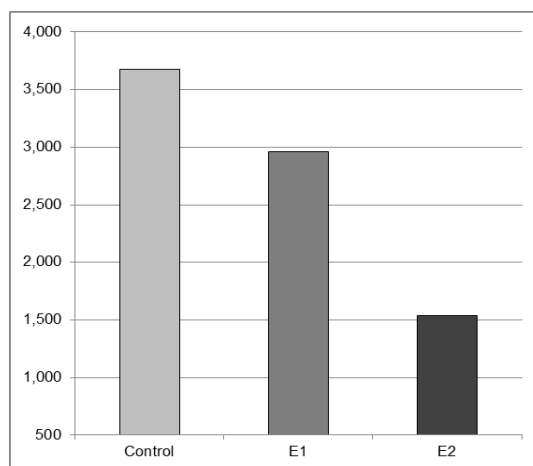


Figure 9. Average Per-stimulus Reaction Time (in ms), for Groups E2, E1, and Control

In addition to time performance, task scores were assessed between the three groups. Participants in groups E2 and E1 scored equally on the experimental task with more correct responses ($M = 51.8$, $SD = 3.4$; and $M = 50.4$, $SD = 3.8$, respectively), than the Control participants ($M = 48.6$, $SD = 5.0$), $F(2,58) = 3.22$, $p = .047$. The means trend suggested, however, that the E2 training group responded with a non-significantly higher

number of correct responses than the E1 training group. Table 15 provides a summary of ANOVA outcomes, and Figure 10 provides a graphical comparison of correct responses.

Table 15

ANOVA Summary for E1, E2 and Control on Average Correct Responses

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	109.3	2	54.6	3.22	.047*
Error (Within Subjects)	983.0	56	16.9		
Total	1092.3	58			

Note. * indicates significance at $p < .05$ value.

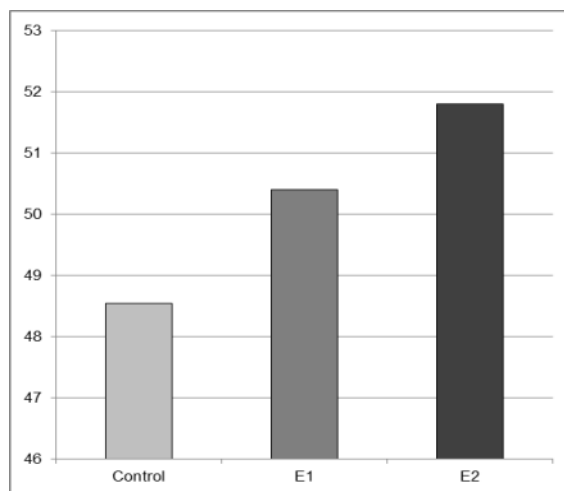


Figure 10. Total Correct Responses for Groups E2, E1, and Control

As with the Hypothesis One analysis, incorrect responses were divided in two categories – traditional incorrect and omissions (i.e. no response). No significant differences were indicated between any group (E1: $M = 13.7$, $SD = 2.6$; E2: $M = 12.7$, $SD = 2.8$; and

Control: $M = 12.1$, $SD = 3.2$) on average total incorrect responses on the experimental task, $F(2,58) = 1.47$, $p = .239$. Table 16 provides a summary of ANOVA outcomes, and Figure 11 provides a graphical comparison of the average incorrect responses.

Table 16

ANOVA Summary for E1, E2 and Control on Average Incorrect Responses

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	24.6	2	12.3	1.47	.239
Error (Within Subjects)	487.0	56	8.4		
Total	511.6	58			

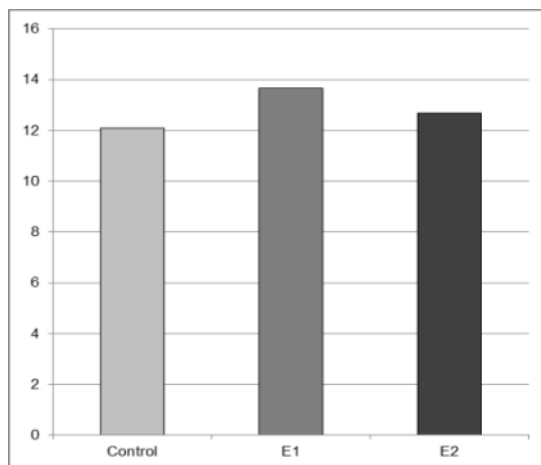


Figure 11. Total Incorrect Responses for Groups E2, E1, and Control

Although there were no differences indicated in traditional incorrect responses, participants in the Control group omitted responses ($M = 5.4$, $SD = 4.7$) significantly

more often than participants in the E2 and E1 training groups ($M = 1.3$, $SD = 1.5$; and $M = 2.0$, $SD = 3.2$ respectively), $F(2,58) = 8.30$, $p = .001$. This finding is discussed in more detail in the following chapter. The means trend suggests that the E2 training group performed better than the E1 training group. Table 17 provides a summary of ANOVA outcomes, and Figure 12 provides a graphical comparison of the average omissions data.

Table 17

ANOVA Summary for E1, E2 and Control on Average Omissions

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	189.5	2	94.8	8.30	.001*
Error (Within Subjects)	662.2	56	11.4		
Total	851.7	58			

* indicates significance at $p \leq .001$ value.

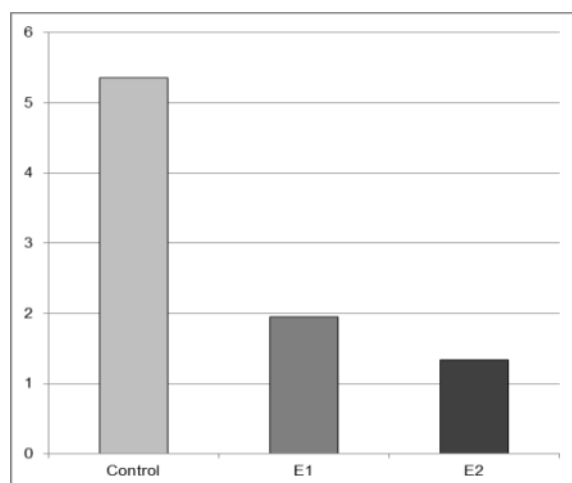


Figure 12. Total Omitted Responses for Groups E2, E1, and Control

Research Question Three Analysis

RQ3. Do threat detection abilities differ between perceptual skills-only training and perceptual resilience training when under normal stress conditions?

H3: When under normal stress conditions, participants in the perceptual skills-only (E1) and perceptual resilience training (E2) conditions will not differ in performance ratings.

It was important to note whether or not there were differences between the two experimental training groups when under normal stress conditions prior to group E2 completing the stress resilience program. Therefore, performance indicators for each participant in the E1 and E2 groups were measured during the perceptual skills training component, including: 1) average reaction time per stimulus, 2) correct responses, 3) incorrect responses, and 4) omitted responses. Results from five between-subjects ANOVAs indicated support for Hypothesis Three. The E1 and E2 training groups did, in fact, exhibit equal task performance in terms of reaction time and percentage scores when under normal stress conditions. This reinforces the effect of the perceptual resilience training outcomes, in that differences between the two training groups were only observed after group E2 completed the stress resilience program. Table 18 provides an overview of descriptive statistics related to Hypothesis Three.

In terms of average per-stimulus response time, participants in groups E1 ($M = 2,104.8$ ms, $SD = 501.4$ ms) and E2 performed equally ($M = 2,003.3$ ms, $SD = 498.2$ ms), $F(1,39) = .306$, $p = .583$. Table 19 provides a summary of ANOVA outcomes.

Table 18

Research Question Three Outcomes Overview

Dependent Variable	E1	E2	Sig. E1 vs. E2
Average Per-Stimulus Reaction Time (in ms)	$M = 2,104.8$ $SD = 501.4$	$M = 2,003.3$ $SD = 498.2$	$p = .583$
Average Correct Responses	$M = 203.1$ $SD = 17.6$	$M = 198.9$ $SD = 15.4$	$p = .216$
Average Incorrect Responses	$M = 30.2$ $SD = 5.1$	$M = 33.4$ $SD = 5.8$	$p = .256$
Average Omitted Responses	$M = 32.2$ $SD = 4.7$	$M = 30.4$ $SD = 5.5$	$p = .429$

Table 19

ANOVA Summary for E1 and E2 on Average Per-stimulus Reaction Time

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	88355.2	1	88355.159	.306	.583
Error (Within Subjects)	11255045.1	38	288590.899		
Total	11343400.2	39			

Participants in groups E1 ($M = 203.1$, $SD = 17.6$), and E2 ($M = 198.9$, $SD = 15.4$) also scored equally on the perceptual skills training task in terms of correct responses, $F(1,39) = 1.58$, $p = .216$. Table 20 provides a summary of ANOVA outcomes.

Table 20

ANOVA Summary for E1 and E2 on Average Correct Responses

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	20.4	1	20.4	1.58	.216
Error (Within Subjects)	502.0	38	12.9		
Total	522.4	39			

As in the analysis for Hypothesis One, incorrect responses were again divided in two categories – traditional incorrect and omissions. Participants in group E1 ($M = 30.2$, $SD = 5.1$) did not significantly differ from the E2 group ($M = 33.4$, $SD = 5.8$) in average total incorrect responses on the experimental task, $F(1,39) = 1.33$, $p = .256$. Table 21 provides a summary of ANOVA outcomes.

Table 21

ANOVA Summary for E1 and E2 on Average Incorrect Responses

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	9.9	1	9.9	1.33	.256
Error (Within Subjects)	291.2	38	7.5		
Total	301.1	39			

Finally, there were not any differences indicated in omitted responses between group E1 ($M = 32.2$, $SD = 4.7$) and E2 ($M = 30.4$, $SD = 5.5$), $F(1,39) = .639$, $p = .429$. Table 22 provides a summary of ANOVA outcomes.

Table 22

ANOVA Summary for E1 and E2 on Average Omissions

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	3.9	1	3.9	.639	.429
Error (Within Subjects)	237.6	38	6.1		
Total	241.5	39			

Research Question Four Analysis

RQ4. In what ways does a perceptual resilience training program affect self-reported workload when under stress, compared to perceptual skills training and status quo training?

H4: When under stress, participants in the perceptual resilience training condition (E2) will rate lower on measures of subjective workload than participants in the perceptual skills-only (E1) training and Control (no additional training) conditions.

In addition to performance indicators, participants from all three training groups reported their perceived workload levels by completing the NASA-TLX questionnaire at the conclusion of the stressful visual discrimination task. Results from a between-subjects ANOVA did not indicate support for Hypothesis Four; the E2 training group did not significantly differ from the E1 training group or the Control group on average NASA-TLX scores. Table 23 provides an overview of the descriptive statistics related to Hypothesis Four.

Table 23

Research Question Four Outcomes Overview

Dependent Variable	E1	E2	Control	Sig. E2 vs. Control	Sig. E2 vs. E1	Sig. E1 vs. Control
Average NASA-TLX score	$M = 30.1$ $SD = 10.04$	$M = 29.3$ $SD = 10.5$	$M = 25.8$ $SD = 10.6$	$p = .303$	$p = .808$	$p = .212$

All participants scored equally in terms of average perceived workload (E1: $M = 30.1$, $SD = 10.0$; E2: $M = 29.3$, $SD = 10.5$; and Control: $M = 25.8$, $SD = 10.6$), $F = (2,58) = .892$, $p = .416$. Table 24 provides a summary of ANOVA outcomes.

Table 24

ANOVA Summary for E1, E2 and Control on Average Perceived Workload

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	19220.7	2	9610.334	.892	.416
Error (Within Subjects)	603581.5	56	10778.240		
Total	622802.1	58			

Research Question Five Analysis

RQ5. In what ways does a perceptual resilience training program affect self-reported acute stress and state anxiety, compared to perceptual skills training and status quo training?

H5: When under stress, participants in the perceptual resilience training condition (E2) will rate lower on measures of subjective acute stress and state anxiety than participants in the perceptual skills-only training (E1) and Control (no additional training) conditions.

At the conclusion of the stressful experimental task, the participants from all three training groups also reported their levels of perceived stress by completing the SAM and STAI-S at the conclusion of the stressful visual discrimination task. Results from two between-subjects ANOVAs and corresponding post-hoc comparisons indicated support for Hypothesis Five; the E2 training group did significantly differ from the E1 training group and the Control group on both stress measures. Table 25 provides an overview of descriptive statistics and post-hoc significance values related to Hypothesis Five.

Table 25

Research Question Five Outcomes Overview

Dependent Variable	E1	E2	Control	Sig., Effect (Cohen's) E2 vs. Control	Sig., Effect (Cohen's) E2 vs. E1	Sig., Effect (Cohen's) E1 vs. Control
Average SAM score	$M = 74.7$ $SD = 10.7$	$M = 53.3$ $SD = 10.1$	$M = 82.8$ $SD = 11.2$	$p = .000^{**}$ $d = .48$	$p = .002^{**}$ $d = .43$	$p = .245$
Average STAI-S score	$M = 47.6$ $SD = 13.4$	$M = 34.67$ $SD = 12.0$	$M = 49.4$ $SD = 10.9$	$p = .034^*$ $d = .13$	$p = .037^*$ $d = .16$	$p = .687$

Note. * indicates $p < .05$, ** indicates $p < .01$

For the SAM, participants in group E2 ($M = 53.3$, $SD = 10.1$) appraised the experimental task as significantly less stressful than participants in the E1 training group ($M = 74.7$, $SD = 10.7$) and the Control group ($M = 82.8$, $SD = 11.2$), $F(2,58) = 1.021$, $p = .036$. No differences were indicated between the E1 training group and the control

group. Table 26 provides a summary of ANOVA outcomes, and Figure 13 provides a graphical comparison of the average perceived stress (on the SAM) data.

Table 26

ANOVA Summary for E1, E2 and Control on Average Stress - SAM

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	231.2	2	115.6	1.021	.036*
Error (Within Subjects)	6338.3	56	113.2		
Total	6569.6	58			

Note. * indicates significance at the $p < .05$ value

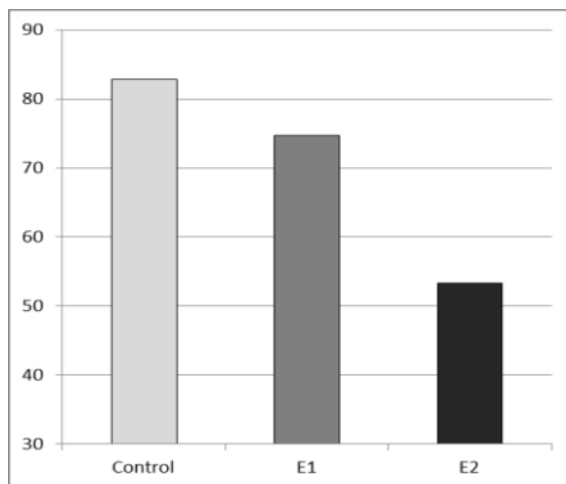


Figure 13. Average SAM Ratings for Groups E2, E1, and Control

Likewise, for the STAI-S, participants in group E2 ($M = 34.7$, $SD = 12.0$) reported significantly lower state anxiety immediately following the experimental task than participants in the E1 group ($M = 47.6$, $SD = 13.4$) and the Control ($M = 49.4$, $SD =$

10.9), $F(2,58) = .422$, $p = .030$. No differences were found between the E1 training group and the Control. Table 27 provides a summary of ANOVA outcomes, and Figure 14 provides a graphical comparison of the average perceived stress (on the STAI-S) data.

Table 27

ANOVA Summary for E1, E2 and Control on Average Stress - STAI-S

Source	SS	df	Mean Square	F value	Significance
Training Group (Between Subjects)	124.7	2	62.3	.422	.030*
Error (Within Subjects)	8273.7	56	147.7		
Total	8398.4	58			

Note. * indicates significance at the $p < .05$ value

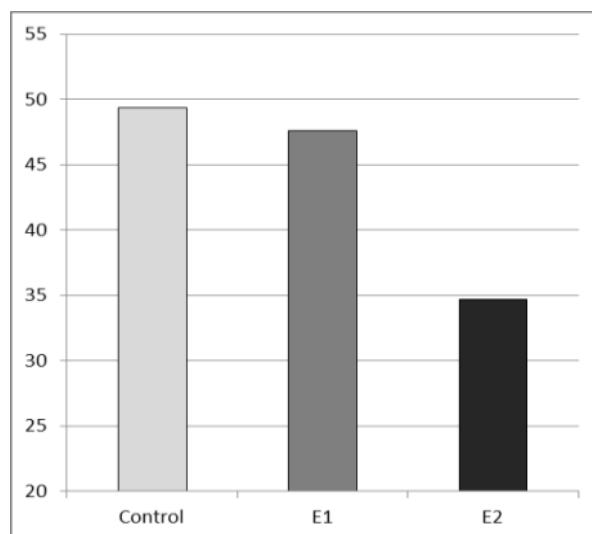


Figure 14. Average STAI-S Ratings for Groups E2, E1, and Control

Summary

In order to test the effectiveness of perceptual skills training and stress resilience training on visual perceptual skills, participants first completed one of three training programs: status-quo declarative knowledge training (i.e., the Control), perceptual skills training, or perceptual resilience training. At the conclusion of the training program, each participant completed a stressful computer-based visual discrimination task in which they were asked to respond to “friendly” and “enemy” military vehicles. During this task, performance data were collected in terms of total task completion time, average reaction time, correct responses, incorrect responses, and omitted responses. Immediately after completing the task, every participant indicated their perceived workload and appraised acute stress via three questionnaires.

The statistical outcomes from between-subjects ANOVAs indicated strong support for the experimental training program. In general, participants who completed the perceptual resilience training completed the task and reacted to visual stimuli more quickly than participants who completed perceptual skills-only training and no additional training beyond the declarative knowledge. Although the perceptual resilience trainees did not differ from the other trainees in terms of correct or incorrect responses, they did exhibit a lower tendency to omit responses. Participants in the perceptual resilience training group also did not differ from the other participants when assessing their workload on the experimental task. However, they did report lower levels of acute stress after the experimental task. The following chapter details the findings from each of the five research questions, and discusses the implications of these results.

CHAPTER 5: DISCUSSION AND RECOMMENDATIONS

Previous academic literature suggests that a combination of visual perceptual skills training and stress tolerance training, if completed pre-deployment, may help improve operational performance and therefore insulate warfighters against the development of mental health disorders. However, the efficacy of current predeployment resilience programs has not been well established. Additionally, visual perceptual skills training programs have shown success in sports psychology, and some have the potential for adaptation to military settings in order to increase operational performance, but this adaptation has not previously been tested. By combining these two instructional paradigms, this study sought to improve upon the effectiveness of existing stress resilience training approaches, translate lessons-learned regarding perceptual skills to the military domain, and overall to develop a training approach that may inform further development of a program that can ultimately enhance warfighters' perceptual performance under stressful conditions.

Although intended for delivery to military personnel downstream, this laboratory study was performed using civilian participants (a convenience sample) as a low-cost option to examine training foundations. The purpose of this foundational study was to provide recommendations for future development of a polished training program that can be tested in a more restrictive military environment. Therefore, the following sections

discuss specific key findings and implications for future military development, limitations within this study, and recommendations for next steps in the research process.

Key Findings and Implications

Finding 1: Trainees who complete perceptual skills training are able to perform stressful visual discrimination tasks faster than trainees who do not receive the training.

These results suggest that perceptual skills training and rehearsal had a significant effect on performance, especially in terms of total task time and per-stimuli reaction time. Although only measured in milliseconds, the noted effect sizes (Cohen's *d*) of .34 (total task time) and .28 (per-stimuli reaction time) indicated meaningful differences between the E1 group and the Control group.

This finding is of importance to military operational tasks, where faster decision-making (even only by several seconds) can literally mean the difference between life and death, as with obscured threats such as IEDs, for example. While advances in combat technology have helped improve threat detection, often the naked eye is still the best sensor for threats (Zorpette, 2008). Thus, training warfighters to improve their visual detection and identification skills is especially important to military training. This study's results do not necessarily indicate improved visual perceptual skills in terms of correctly identifying threats, as the training did not have a significant effect on overall vehicle discrimination performance scores. However, the data trend indicates that the perceptual skills training group may have had the opportunity to exhibit higher scores than the control given a more robust sample with more participants. Regardless, if a warfighter

can detect even potential threats more quickly, they are enabled to respond in a safer, more strategic manner.

In terms of future training development, this finding supports the inclusion of perceptual skills training and rehearsal into a program design. The training and rehearsal provided in this study was not only effective in improving response time, but also efficient. This portion of the program was trainee guided, so did not necessitate any instructor support, and only required a 45-minute time frame for the trainee to complete. All of the main components of the perceptual skills training were designed based on previous literature recommendations, many of which have been individually tested and shown to be effective in other settings (e.g., Burroughs, 1984; Farrow, Chivers, Hardingham, & Sachse, 1998; Farrow & Abernathy, 2002; Ward et al., 2008; Fadde, 2010; and Fadde & Klein, 2010). Therefore, the inclusion of these components in the future development of military-specific perceptual skills training is highly recommended.

1. Practice with interactive media depicting components of the desired stimulus.
2. Present varying levels of difficulty in discrimination for each trained stimulus.
3. Rehearse for short periods of time rotating with rest periods.
4. Provide continuous performance feedback.
5. Provide the opportunity to ask questions.

Finding 2: Trainees who do not complete perceptual skills training omit significantly more responses during stressful visual discrimination tasks than trainees who do complete perceptual skills training.

The significant difference in response omissions between the resilience-trained participants (E2) and the non-resilience-trained participants (E1 and Control) could indicate that the E1 and Control participants became overwhelmed, frustrated, or excessively stressed to the extent that they “shut down” several times throughout the course of the experimental task.

As discussed in Chapter Two, heightened arousal can cause a number of visual perceptual detriments. One of the most commonly-occurring impairments is on declarative memory, which includes acquisition and recall, in that stress negatively affects both the processing and retrieval of memories (Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996) as well as interpreting meaningful actions relative to meaningless ones (Decety et al., 1997) and recognizing novel stimuli (Habib & Lepage, 2000). These common detriments from stress may help to explain the so-called “shut-down” that consistently occurred with the E1 and Control participants during this study’s experimental task.

The potential consequences of this phenomenon in operational environments are extensive. Missed detections such as these are highly disadvantageous for appropriate decision-making and performance in a combat environment. If a warfighter cannot process or retrieve accurate memories of the environment, they will be much less likely to notice important anomalies indicating potential threats. This finding contributes support to the hypothesized need for the inclusion of stress resilience training in a military-based predeployment program, which will be discussed in more detail in the following sections.

Finding 3: Trainees who complete stress resilience training plus perceptual skills training exhibit superior performance on stressful visual discrimination tasks compared to trainees who do not receive stress resilience training. This is especially apparent in reaction time, where trainees who receive stress resilience training complete discrimination tasks faster and exhibit faster per-stimulus reaction time than the other trainees.

These results indicate that the stress resilience training had a significant and meaningful (based on effect sizes) positive effect on the participants for both response time and performance scores. The time-response differences between the groups were again enhanced by medium to large effect sizes (according to the behavioral sciences). The stress resilience training group also performed significantly better in terms of performance scores (correct responses) than the control group, and exhibited fewer omitted responses than either of the other groups.

As discussed in Chapter Two, most physiological functions are impaired when the body is experiencing stress. Longer eye saccades increase the chance of a visual tracking error (Wilson, Glue, Ball, & Nutt, 1993), or a target may be missed because of increased eye blinks (Volkman, Riggs, & Moore, 1980). Therefore, maintaining basic perceptual skills under stress is especially vital to warfighter safety and performance; if detriments to physiological functioning occur when performing a visual discrimination task, an inaccurate baseline is likely to be established, leading to errors in decision making. This finding, that even a succinct perceptual resilience training program with the specific

integrated components used here can be effective in improving operational performance, could be instrumental in the future development of predeployment training.

The combination perceptual resilience training presented in this study is a novel program compared to the currently deployed programs used in military training environments due to the integrated perceptual skills and stress resilience components. Therefore, this finding lends support for combined, operationally-specific training, versus the status quo.

Finding 4: Differences in performance between perceptual resilience training and perceptual skills-only training occur after perceptual resilience trainees complete the stress resilience portion of training.

It was important to note whether or not there were differences between the two experimental training groups when under normal stress conditions after groups E1 and E2 completed the perceptual skills training, but prior to group E2 completing the stress resilience program. Results indicated support for Hypothesis Three; the E1 and E2 training groups did, in fact, exhibit equal task performance in terms of overall task time, per-stimulus reaction time, and percentage scores when under normal stress conditions. This reinforces the effect of the perceptual resilience training outcomes, in that differences between the two training groups in terms of experimental task performance and post-task appraised stress were only observed after group E2 completed the stress resilience program. Because of this, we can more scientifically posit that the dependent variables of interest were positively affected by the stress resilience training component.

Finding 5: Perceived workload during stressful visual discrimination tasks does not differ between any of the three types of training.

This is an interesting finding, because some researchers consider workload a completely independent construct from stress (for an overview, see Hancock & Desmond, 2001). It appears that self-assessed measures of workload do not necessarily correlate with stress or anxiety, and may not be an appropriate measure for a perceptual resilience training program. This finding could indicate support for a theory that is beyond the scope of the current research, but warrants further inspection in the future.

Finding 6: After a stressful visual discrimination task, trainees who complete perceptual resilience training report lower acute stress and state anxiety than trainees who do not receive resilience training.

These results were supported by medium-large effect sizes (Cohen's d ; according to the behavioral sciences), which strengthen the argument that stress resilience training not only helps to increase performance, but also reduces acute stress ($d \approx .45$) and anxiety ($d \approx .15$) in a meaningful way. Reduced acute stress in an operational environment can mean a significant reduction in chronic mental health disorders in addition to increased threat detection skills. This finding also provides a first step toward empirically testing military predeployment stress tolerance programs.

In terms of future training development, this finding supports the inclusion of stress resilience training and rehearsal into a program design. The training and rehearsal provided in this study was not only effective in improving response time and task performance and decreasing acute stress, but it was also efficient (as with the

perceptual skills training component). This portion of the program was trainee guided, necessitated little instructor support for providing feedback and rehearsal, and only required a 40-minute time frame for the trainee to complete. As with the perceptual skills portion of the program, all of the main components of the stress resilience training component were designed based on previous literature recommendations, many of which have been individually tested and shown to be effective in other settings (e.g. De Becker, 2009; Williams, 2002; Williams, 2004; Burton, 1988; Vadocz & Hall, 1997; Van Raalte, Brewer, Rivera, & Petitpas, 1994; Minturn et al., 2001). Therefore, the inclusion of these lessons in the future development of military-specific stress resilience training is highly recommended.

1. Mental Resilience
2. Education
3. Goal-setting
4. Mental Imagery
5. Positive Self-Talk
6. Combat Breathing

While improving perceptual performance is the main focus of this effort, it is important to also note the potential effects a predeployment stress resilience training program could have on warfighters' mental health. As mentioned in Chapter One, 18% of Soldiers in Iraq reported moderate or severe levels of acute stress, with 7-21% of total military personnel returning from Iraq or Afghanistan meeting the criteria for Major Depression, Anxiety Disorder, or PTSD (MHAT, 2010). Additionally, recent figures

show that 66,934 active duty combat veterans were diagnosed with PTSD between 2000 and September 2010 (Fischer, 2010). At the current rate, approximately 20% of veterans are expected to develop symptoms of PTSD or major depression (Tanielian et al., 2008). In response to these increasing numbers, attention has begun to shift from treatment to prevention, and the Services have declared “mental toughness” as a major core competency. Predeployment training, such as the perceptual resilience program, may have the ability to insulate war fighters from the development of psychological distress by improving stress tolerance and effective functioning in a high-stress environment (Driskell & Johnston, 1998).

Study Limitations

As with all research projects, this study was completed with limitations. Most importantly, it would be beneficial to assess the perceptual resilience training program with a military sample. A downfall of laboratory research with a civilian convenience sample is that it is not possible to infer generalizability specifically to the military population. Therefore, this study can only provide possible implications regarding how the results may inform future military training design. Given this limitation, it is important to establish a polished training program that shows potential for improving trainee performance before utilizing a restrictive and costly military sample. This limitation was somewhat mitigated by using a participant sample recruited from Craigslist.com, which included more similar participants demographically to the military population than alternative easily accessible sampling groups (undergraduate college students, for example). After addressing the additional study limitations, it is projected

that a large-scale study similar to this initial project will be completed with a Marine sample.

In addition to using a generalizable sample, there were some methodological limitations that should be addressed in future assessment of the perceptual resilience program. First, the measures selected for the pilot study did not necessarily provide a robust conclusion for comparing laboratory-friendly stress induction methods. Validating best approaches to inducing realistic stress in the laboratory is still a problem that warrants ongoing discovery. The pilot study showed that none of the commonly-used strategies were capable of increasing participants' biological responses. If we cannot induce realistic stress, and measure outcomes such as acute stress appraisal or performance, we cannot truly draw conclusions that are generalizable to real-life situations. Although testing in the lab is an acceptable means to develop training programs, any training program that is tested in the lab and deemed feasible for use also needs to be tested in the field under realistically stressful conditions in order to make an argument in support of the program.

Finally, participants were paid \$20 cash at the completion of the study. Although this recruitment method was deemed non-coercive by both the UCF and VCU IRBs, the payment could have led to general internal validity detriments to the overall study outcomes. Because participants were self-selected from a classified website, some people may have decided to volunteer or not based on the monetary amount. This self-selection process could have led to quantifiable demographic differences between the people who chose to volunteer and those who did not. As with many validity concerns

with individual differences, this study utilized a sufficient number of participants based on an a-priori Power analysis, and included a randomization procedure to the three groups. Both of these practices help to defer self-selection biases among participants.

Additionally, the \$20 payment could have resulted in response bias, in that the participant may have become biased toward certain responses on self-report questionnaires in order to “please” the researchers in exchange for their payment. This concern was mitigated, in part, by measuring task performance variables, which are unlikely to be consciously biased in some way.

Recommendations for Future Research

In general, the outcomes of this study do not yet justify military implementation. However, further exploration into predeployment perceptual resilience training paradigms is warranted. Several recommendations for future perceptual resilience training research and design were presented in the Key Findings section of this chapter. These included recommendations for the inclusion of specific components drawn from general training, perceptual skills, and stress resilience literature.

In addition to the training design recommendations mentioned previously, this study justified the need for future research in related areas that could help further develop an effective training program. For example, it was outside the scope of this study to evaluate the effectiveness of various training delivery formats (e.g., live vs. virtual instruction, individual vs. group learning, length of training session, etc.). However, a future study should address this area by first drawing literature from alternate training

domains, and then implementing best practices and recommendations from the literature into a training design.

Also, a cost/benefit analysis of specific topics and skills within the perceptual resilience training lessons (education, goal setting, positive thinking, combat breathing, etc.) should be conducted, in order to determine which individual topics to include and which to leave out. It is unknown if the training program presented for this study reached maximum effectiveness based on the type of training delivery and/or the trained skills.

Finally, more empirical research on integrating perceptual skills and stress resilience into military training is warranted. Today's warfighters must possess adaptive perceptual skills that enable detection of threats across any number of environmental, cultural, and situational conditions. These same perceptual skills are known to deteriorate exponentially in stressful conditions. Currently implemented threat-detection instruction involves training in rote recognition of various types of explosive devices, then exposing trainees to practice environments containing mock explosives (typically IEDs). However, recent research efforts have shown that training for combat threat detection can be significantly enhanced through the use of cognition-based protocols integrated with existing field-training methods (Hess & Sharps, 2008; Murphy, 2009). More contemporary, cognitive-based programs exist outside the military (such as in law enforcement and sports fields), and have shown the ability to improve perceptual performance in trainees. Programs such as these should be explored, re-scoped, and tested in military settings.

In order to respond to the deleterious effects of stress on perceptual skills, the Services have called for the development of predeployment stress resilience training programs. Despite significant resources being invested into these training programs, there is a dearth of scientific evidence to support their efficacy. Additionally, these programs are often disjoint, cross-sectional, and delivered haphazardly (Taylor, Schatz, Marino-Carper, Carrizales & Vogel-Walcutt, 2011). The study presented here supports the need to more extensively research methods to effectively integrate stress resilience training in order to help mitigate decreases in perceptual functioning.

Dissertation Conclusion

Only recently have researchers begun to empirically address the cognitive processing components related to the effects stress, anxiety, and arousal on perceptual performance. As noted in Chapter 2, breakdowns in attention and awareness determine the timeliness of a warfighter's action on the objective. High cognitive workload leads to increased reaction time, and slower identification of threats. These impairments can result in a higher possibility of injuries and casualties in operational environments. The Services have issued two calls to researchers: 1) determine effective methods to increase warfighters' perceptual skills, and 2) determine effective methods for preventing stress-induced conditions.

This project provided an initial assessment of a novel training program that shows potential to address the Services' needs. The perceptual resilience trainees exhibited the ability to detect threats in a stressful environment more quickly and with more accuracy than other trainees. This increased perceptual ability may be directly due, in part, to the

decrease shown in the perceptual resilience trainees' self-reported acute stress. In other words, by decreasing warfighters' acute stress, we may be able to increase their threat detection performance. Increased threat detection performance leads to decreases in experiencing trauma, which, in turn, can prevent downstream chronic mental health disorders such as PTSD.

In addition to providing an initial response to the Services' call for mitigating perceptual detriments caused by stress, this project also addressed several of the research gaps presented earlier in this paper. Previously implemented military predeployment training programs have failed to produce structured, empirical testing in regard to the effectiveness of the program. This project was a step toward providing an empirical foundation that justifies the expense of these types of training, while also making recommendations for future research design. Additionally, this program addressed some of the potential drawbacks to current training programs' format and delivery. The perceptual resilience training integrated two related constructs, and presented the program utilizing methods recommended and founded by general training and education research. Once researchers can establish best practices in this training area, available military resources can focus on altering current programs or designing novel programs accordingly into effective training packages.

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APPENDIX A

Pilot Study Methodology and Analysis

APPENDIX A

Pilot Study Methodology *Setting*

The study took place at the University of Central Florida's Institute for Simulation and Training lab in Orlando, FL. A designated lab space offered a wide range of testing capabilities, and was arranged appropriately for confidential, individual testing.

Ensuring Participant Safety and Confidentiality

The protocol and materials for the pilot study were submitted for approval to the Internal Review Board (IRB) committee at the University of Central Florida (approval letters are included in Appendix K). IRB guidelines for participant safety and confidentiality were strictly followed by the research team. All researchers who had interactions with participants or participant data held current CITI training certifications, as required by the university IRB.

Participants

A total of 15 employees ($n = 6$ males, 9 females; Age $M = 30$) at the Institute for Simulation and Training were recruited for this pilot study. A recruitment email was sent to all employees, who volunteered by email or verbal response to the research team. Inclusion criteria stated that participants had to be at least 18 years of age. No other restrictions applied; although, no "vulnerable" individuals were recruited for this study.

Pilot Study Experimental Procedures

Each participant completed the study individually in different time slots. The study began with reading the informed consent form (included in Appendix B) and participants were given the opportunity to ask questions and provided verbal consent to participate. After consent, the participant completed baseline assessments measuring perceived stress based on events within the last week, current stress, and heart rate. These baseline measures provided the participant's "normal" state in order to compare changes post-training. These specific measures are defined in more detail below.

The participant was then randomly assigned to one of three experimental conditions (five participants per condition). Group One received all four external stressor methods in one session. Group Two received one external stressor at a time over four trials. Group Three received combinations of two external stressors at a time over six trials. For the multi-trial conditions, each trial was completed at least 12 hours apart, in order to provide sufficient recovery time between trials.

After randomization, the researcher provided instructions for completing a basic spatial abilities test, and the participant continued on to the test. Once the participant began the test, the external stressor(s) began and continue for the duration of the test. Participants were allowed 20 minutes to complete the test packet, but completion of the test in this time was nearly impossible.

After the test period, several self-report assessments were administered to the participants. These assessments measured current stress and perception of task

workload. Once these assessments were completed, the participant was debriefed by the researcher. (Table A-1 provides an experimental overview).

Table A-1

Experimental Procedures for Pilot Study

O ₁	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	O ₂
Baseline Measures	External Stressors (Presented in random order across trials for conditions 2 and 3)						Post Measures
<u>All Conditions</u>	<u>Condition 1:</u> Noise + Distraction + Workload + Time Pressure						<u>All Conditions</u>
- Demographic Questionnaire							- NASA Task Load Index (NASA TLX)
- Perceived Stress Scale (PSS)							- Multiple Resources Questionnaire (MRQ)
- Heart Rate Variability (HRV)	<u>Condition 2:</u> Noise	<u>Condition 2:</u> Distraction	<u>Condition 2:</u> Workload	<u>Condition 2:</u> Time Pressure			
	<u>Condition 3:</u> Noise + Distraction	<u>Condition 3:</u> Noise + Workload	<u>Condition 3:</u> Noise + Time Pressure	<u>Condition 3:</u> Distraction + Workload	<u>Condition 3:</u> Distraction+ Time Pressure	<u>Condition 3:</u> Workload + Time Pressure	
<i>Experimental Task: Spatial Abilities Test During-Task Measures: Test Performance & HRV</i>							

Testing Instruments

Demographics Questionnaire

General demographic questions were assessed for each participant. This questionnaire included basic demographic information, such as age and gender, and also included additional questions relevant to the task, such as previous stress management or skills training (included in Appendix D). The demographic data for each participant was assessed in order to ensure that no significant confounds existed.

Perceived Stress Scale (PSS)

Cohen's (1983) Perceived Stress Scale is a widely used psychological instrument for measuring the perception of stress (included in Appendix D). This 10-item self-report assessment is a measure of the degree to which life situations are appraised as stressful. Each item is assessed on a five-point Likert scale (ranging from 1 = "Never" to 5 = "Very Often"). Items are designed to measure how unpredictable, uncontrollable, and overloaded participants have found their lives in the last month. After reverse-scoring the appropriate items, higher scores (min = 10, max = 50) represent higher perceived stress. The PSS was presented to participants as a baseline measure.

NASA-Task Load Index (NASA-TLX)

The NASA-TLX (Hart & Staveland, 1988) is a self-reported workload assessment that derives an overall workload score based on ratings across six one-item subscales (included in Appendix D). These subscales include mental demands, physical demands, temporal demands, own performance, effort, and frustration. Each item is rated on a 10-point anchored line (defined by 1 = "Very low" at one end, and 10 = "Very high" on the other), where the respondent indicates their answer anywhere along the line. After reverse-scoring the appropriate item, higher scores (min = 6, max = 60) reflect higher perceived workload. The NASA-TLX is a commonly-used measure in many fields, and has shown to be highly correlated with other measures of workload (e.g. Battiste & Bortolussi, 1988; Hill et al., 1992). This questionnaire was administered after participants completed the experimental test.

Multiple Resources Questionnaire (MRQ)

The MRQ (Boles, 2001) is a self-report instrument for measuring subjective workload on a specific task (included in Appendix D). It was developed as an alternative to the NASA-TLX, so a comparison of outcomes between the two tests is warranted. The MRQ is a 17-item questionnaire, with responses ranging on a 5-point Likert scale (ranging from 1 = “Not at all” to 5 = “Extreme”). After reverse-coding the appropriate items, a higher score (min = 17, max = 85) indicates more internal resources necessary to complete the specified task. The MRQ was presented to participants after the experimental test.

Heart Rate Variability (HRV)

Heart rate monitoring has been utilized for decades as a reliable, real-time stress indicator (Lazarus, Speisman, & Mordkoff, 1963). This physiological measure was assessed at baseline, and changes from baseline were monitored throughout the experimental test period. Monitoring heart rate is unobtrusive and inexpensive, and is positively correlated (adjusted R^2 around .25) with self-reported stress levels (Vrijkotte, van Doornen, & de Geus, 2000).

An Advanced Brain Monitoring ECG machine was used for this study. This machine includes three electrode sensors to be placed on the sternum (center of the chest), right clavicle, and left clavicle. These sensors were placed by the participant.

Performance

Performance on a basic spatial abilities test (in the form of a percentage score) was determined for each participant (included in Appendix E). The spatial abilities test

was designed by the researcher, and was sufficiently difficult, so as not to achieve a ceiling effect on performance scores. The spatial abilities test was broken into six parts, so participants received different questions during each testing session. A higher test score percentage indicates greater performance.

Pilot Study Analyses

First, the data were cleaned by checking for outliers and significant demographic confounds between the participants within each condition using a series of mixed-method ANOVAs and post hoc pairwise comparisons. No significant outliers were detected, nor were any significant demographic confounds identified, as illustrated in Table A-2. Therefore, all data were retained from all 15 participants.

Table A-2

Pilot study Demographics and Pre-test Outcomes Overview

Dependent Variable	Condition 1	Condition 2	Condition 3	Significance
Age	<i>M</i> = 32.2 <i>SD</i> = 8.2	<i>M</i> = 26.4 <i>SD</i> = 5.7	<i>M</i> = 31.4 <i>SD</i> = 16.2	<i>p</i> = .672
Attention Games (hours/month)	<i>M</i> = 1.8 <i>SD</i> = 1.1	<i>M</i> = 2.0 <i>SD</i> = 1.4	<i>M</i> = 0.4 <i>SD</i> = .55	<i>p</i> = .074
Military Experience	<i>M</i> = 0 <i>SD</i> = 0	<i>M</i> = 0 <i>SD</i> = 0	<i>M</i> = 0 <i>SD</i> = 0	<i>p</i> = 1.00
Average PSS score	<i>M</i> = 13.2 <i>SD</i> = 4.8	<i>M</i> = 12.6 <i>SD</i> = 4.9	<i>M</i> = 14.1 <i>SD</i> = 5.4	<i>p</i> = .900

Due to the exploratory nature of the pilot study, plus a lack of sufficient degrees of freedom for the Condition Three data ($n = 5$, six trials), only descriptive statistics were

used to compare post-test scores between trials within each condition. An overview of outcomes from each condition is provided here, starting with the multi-trial conditions (Two and Three).

Condition Two

Participants in Condition Two completed four trials that consisted of one external distractor per trial. In order to control for differences in general daily stress, the Perceived Stress Scale was administered and analyzed for each trial. However, based on a repeated-measure ANOVA, no significant differences existed between the Perceived Stress Scale mean scores for each trial, $F(1, 4) = 32.25, p = .687$. Therefore, it was not necessary to adjust post-test scores for effects of the PSS. Table A-3 includes mean scores and standard deviations across trials.

Table A-3

Baseline PSS Score Means, Standard Deviations by Trial for Condition Two

Trial	Noise	Distraction	Time Pressure	Workload
<i>M</i>	12.4	13.6	12.8	11.6
<i>SD</i>	7.4	6.1	4.1	3.1

In order to assess the effectiveness of each external stressor, the MRQ and NASA-TLX were administered as post-tests at the conclusion of each trial. The means were compared for each trial on these two measures. Based upon the MRQ means trends, it appears that Time Pressure and Workload were the most effective external stressors ($M = 39.4, SD = 9.8; M = 39.0, SD = 8.2$, respectively), Noise was a moderately effective

stressor ($M = 36.6$, $SD = 6.6$), and Distraction was the least effective ($M = 31.8$, $SD = 10.0$). Figure A-1 and Table A-4 include a comparison of mean MRQ scores and standard deviations across trials.

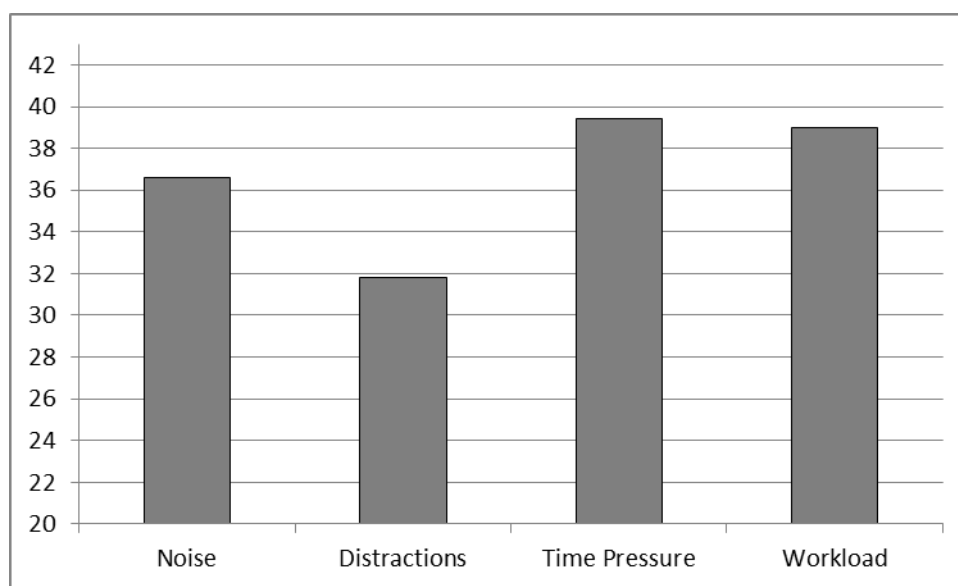


Figure A-1. MRQ Score Means and Standard Deviations by Trial for Condition Two.

Table A-4

MRQ Score Means, Standard Deviations by Trial for Condition Two

Trial	Noise	Distraction	Time Pressure	Workload
<i>M</i>	36.6	31.8	39.4	39.0
<i>SD</i>	6.6	10.0	9.8	8.2

Somewhat similarly, based upon the NASA-TLX means trends, it again appears that Time Pressure was the most effective external stressor ($M = 38.4$, $SD = 2.9$). Workload and Noise were moderately effective stressors ($M = 34.6$, $SD = 7.3$; and $M =$

35.6, $SD = 3.8$, respectively), and Distraction was again the least effective ($M = 29.6$, $SD = 11.1$). Figure A-2 and Table A-5 include a comparison of mean NASA-TLX scores and standard deviations across trials.

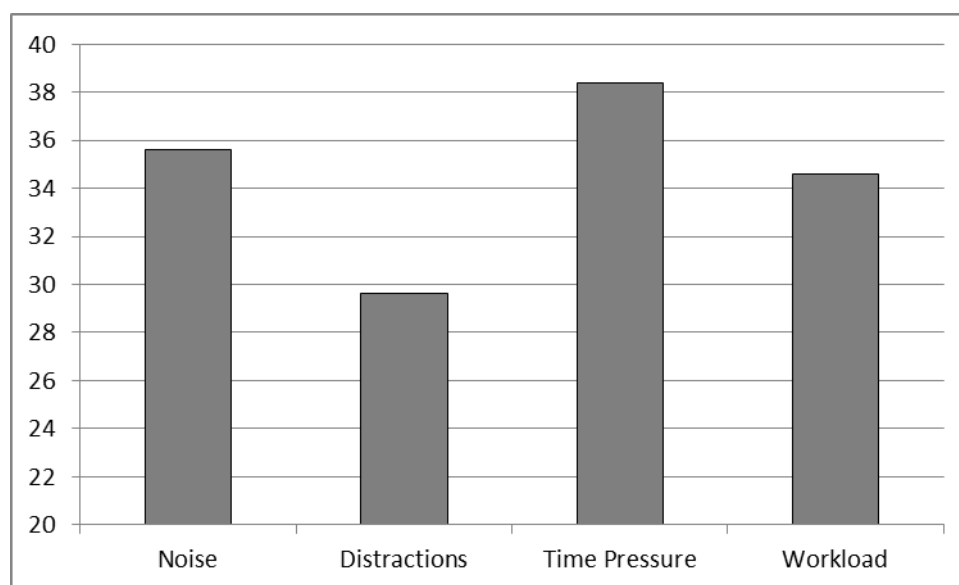


Figure A-2. NASA-TLX Score Means, Standard Deviations by Trial for Condition Two.

Table A-5

NASA-TLX Score Means, Standard Deviations by Trial for Condition Two

Trial	Noise	Distraction	Time Pressure	Workload
<i>M</i>	35.6	29.6	38.4	34.6
<i>SD</i>	3.8	11.1	2.9	7.3

Some measures were not effective in identifying potential differences between the trials for Condition Two participants. For the HRV measure, there did not appear to be any change from baseline to experimental average heart rate for any of the trials, as illustrated in Table A-6.

Table A-6

Average HRV Means, Standard Deviations by Trial for Condition Two

Trial	Noise Baseline	Noise Exp	Distraction Baseline	Distraction Exp	Time Pressure Baseline	Time Pressure Exp	Workload Baseline	Workload Exp
<i>M</i>	75.28	76.69	73.82	71.11	75.59	72.07	84.00	84.04
<i>SD</i>	15.05	15.99	7.23	9.01	21.03	17.43	16.19	16.83

Additionally, there did not appear to be any differences between the trials for any condition on the spatial abilities performance scores, as illustrated in Table A-7.

Table A-7

Spatial Abilities Score Means, Standard Deviations by Trial for Condition Two

Trial	Noise	Distraction	Time Pressure	Workload
<i>M</i>	54.8%	54.6%	53.0%	56.4%
<i>SD</i>	0.24	0.26	0.20	0.25

Condition Three

Participants in Condition Three completed six trials that consisted of combinations of two external distractors per trial. As in Condition Two, the Perceived Stress Scale was administered and analyzed for each trial, in order to control for differences in general daily stress. However, based on a repeated-measure ANOVA, no significant differences existed between the Perceived Stress Scale mean scores for each trial, $F(1, 4) = 28.54, p = .623$. Therefore, it was not necessary to adjust post-test scores

for effects of this baseline measure. Table A-8 provides mean scores and standard deviations across trials.

Table A-8

Baseline PSS Score Means, Standard Deviations by Trial for Condition Three

Trial	Noise + Distraction	Noise + Time Pressure	Noise + Workload	Distractions + Time Pressure	Distractions + Workload	Time Pressure + Workload
<i>M</i>	14.6	14.2	14.0	13.4	13.4	15.0
<i>SD</i>	4.5	4.7	6.9	6.2	7.3	6.3

In order to assess the effectiveness of each external stressor combination, the MRQ and NASA-TLX were administered as post-tests at the conclusion of each trial. The means were compared for each trial on these two measures. Based upon the MRQ means trends, it appears that the Noise + Workload condition was the most effective external stressor ($M = 28.8$, $SD = 9.6$), the Noise + Time Pressure and Time Pressure + Workload conditions were moderately effective ($M = 26.0$, $SD = 5.0$; and $M = 26.7$, $SD = 10.7$, respectively), and the three conditions using Distraction were the least effective stressors (Noise + Distraction $M = 23.4$, $SD = 7.6$; Distraction + Time Pressure $M = 24.1$, $SD = 9.6$; and Distraction + Workload $M = 24.6$, $SD = 7.3$). Figure A-3 and Table A-9 provide a comparison of mean MRQ scores and standard deviations across trials.

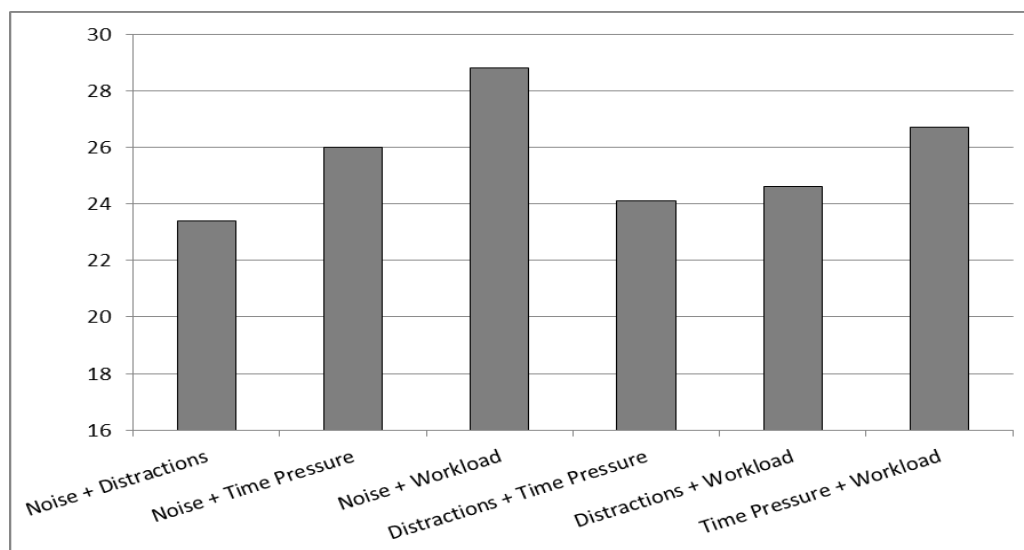


Figure A-3. MRQ Means and Standard Deviations by Trial for Condition Three.

Table A-9

MRQ Means, Standard Deviations by Trial for Condition Three

Trial	Noise + Distraction	Noise + Time Pressure	Noise + Workload	Distractions + Time Pressure	Distractions + Workload	Time Pressure + Workload
<i>M</i>	23.4	26.0	28.8	24.1	24.6	26.7
<i>SD</i>	7.6	5.0	9.6	9.6	7.3	10.7

Similarly, based upon the NASA-TLX means trends, it again appears that the Noise + Workload condition was the most effective external stressor ($M = 31.4$, $SD = 10.2$), the Noise + Time Pressure and Time Pressure + Workload conditions were moderately effective ($M = 30.4$, $SD = 5.5$; and $M = 29.2$, $SD = 9.9$, respectively), and the three conditions using Distraction were the least effective external stressors (Noise + Distraction $M = 26.4$, $SD = 10.1$; Distraction + Time Pressure $M = 22.2$, $SD = 8.0$; and

Distraction + Workload $M = 25.4$, $SD = 8.5$). Figure A-4 and Table A-10 provide a comparison of mean NASA-TLX scores and standard deviations across trials.

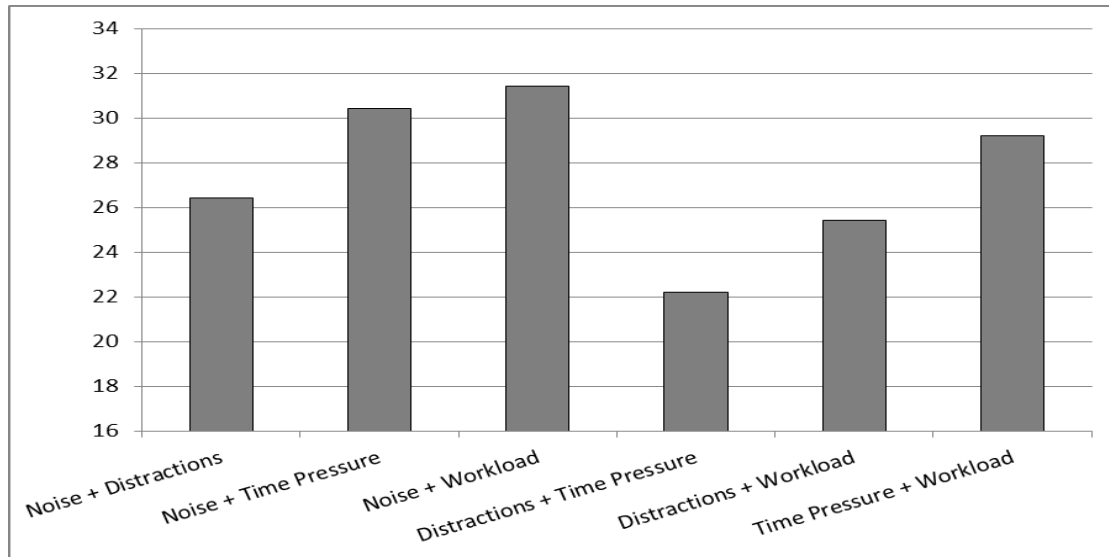


Figure A-4. NASA-TLX Means and Standard Deviations by Trial for Condition Three

Table A-10

NASA-TLX Means, Standard Deviations by Trial for Condition Three

Trial	Noise + Distraction	Noise + Time Pressure	Noise + Workload	Distractions + Time Pressure	Distractions + Workload	Time Pressure + Workload
<i>M</i>	26.4	30.4	31.4	22.2	25.4	29.2
<i>SD</i>	10.1	5.5	10.2	8.0	8.5	9.9

Some measures were not effective in identifying potential differences between the trials for Condition Three participants. For the HRV, there did not appear to be any change from baseline to experimental heart rate for any of the trials, as illustrated in Table A-11.

Table A-11

Average HRV Means and Standard Deviations by Trial for Condition Three

Trial	Noise + Distraction Baseline	Noise + Distraction Experiment	Noise + Time Pressure Baseline	Noise + Time Pressure Experiment	Noise + Workload Baseline	Noise + Workload Experiment
<i>M</i>	76.1	74.9	74.3	75.3	72.4	73.7
<i>SD</i>	8.1	8.2	9.2	8.6	9.4	7.6
Trial	Distractions + Time Pressure Baseline	Distractions + Time Pressure Experiment	Distractions + Workload Baseline	Distractions + Workload Experiment	Time Pressure + Workload Baseline	Time Pressure + Workload Experiment
<i>M</i>	75.7	76.3	75.3	74.9	79.3	76.8
<i>SD</i>	7.7	11.5	13.7	13.5	6.0	7.7

Additionally, there did not appear to be any differences between the trials for any condition on the spatial abilities performance scores, as illustrated in Table A-12.

Table A-12

Spatial Abilities Means, Standard Deviations by Trial for Condition Three

Trial	Noise + Distraction	Noise + Time Pressure	Noise + Workload	Distractions + Time Pressure	Distractions + Workload	Time Pressure + Workload
<i>M</i>	70.4%	67.2%	69.4%	70.5%	66.0%	61.6%
<i>SD</i>	0.07	0.18	0.04	0.13	0.13	0.13

Condition One

Participants in Condition One completed one trial that consisted of all four external distractors during the course of the experimental task. In order to assess the effectiveness of inducing stress in Condition One participants, scores on the outcome measures were compared to the most stressful trial in Conditions Two and Three. It did not appear that Condition One participants experienced any higher self-reported stress than Condition Two or Three participants, as illustrated in Table A-13.

Table A-13

Outcome Measure Score Means, Standard Deviations by Condition

Trial	MRQ Condition One	MRQ Condition Two (Time Pressure)	MRQ Condition Three (Noise + Workload)	NASA-TLX Condition One	NASA-TLX Condition Two (Time Pressure)	NASA-TLX Condition Three (Noise + Time Pressure)
<i>M</i>	38.4	39.4	28.8	39.2	38.4	31.4
<i>SD</i>	5.6	9.9	9.6	3.1	2.9	5.5

APPENDIX B

Informed Consent Form – Pilot Study

APPENDIX B

Informed Consent Form – Pilot Study

Perceptual Performance in U.S. Warfighters: Assessing the Effects of Resilience Training on Visual Skills – PILOT STUDY**Informed Consent**

Principal Investigator(s): *Sae Schatz, Ph.D.*

Sub-Investigator(s): *Andrea Taylor, M.S.*

Sponsor: *Office of Naval Research*

Investigational Site(s): *University of Central Florida, Institute for Simulation & Training*

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study which will include about 15 people. You have been asked to take part in this research study because you are over 18 years old and capable of completing the task. The person doing this research is Dr. Sae Schatz of UCF's Institute of Simulation and Training.

What you should know about a research study:

Someone will explain this research study to you.

A research study is something you volunteer for.

Whether or not you take part is up to you.

You should take part in this study only because you want to.

You can choose not to take part in the research study.

You can agree to take part now and later change your mind.

Whatever you decide it will not be held against you.

Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study is to compare physiological and self-reported workload and arousal in participants completing a spatial abilities test. We are comparing some commonly-used methods in order to design more realistic laboratory settings.

What you will be asked to do in the study: You will complete the study in one, four, or six short sessions, by yourself without any other participants. You will begin the study by reading the informed consent form and you will be given the opportunity to ask questions and provide verbal consent to participate. You will then be asked to complete several short questionnaires about yourself.

After the questionnaires, you will be asked to place heart rate monitoring pads on your chest, and given privacy to do this. The heart rate monitor is non-invasive and does not cause any pain.

You will then be given instructions on how to complete a basic spatial abilities test. You will have 20 minutes to complete the test. Your heart rate will be measured during the test period. You do not have to answer every question or complete every task. You will not lose any benefits if you skip questions or tasks.

Once the testing is complete, you will fill out a few more questionnaires and remove the heart rate monitor. The researcher will talk to you about the study, and you will have the opportunity to ask questions.

Location: Partnership II Room 305, 3100 Research Parkway, Orlando, FL 32826.

Time required: We expect that you will be in this research study for one hour on one, four, or six days.

Funding for this study: This research study is being paid for by the Office of Naval Research.

Risks: There are no reasonably foreseeable risks or discomforts involved in taking part in this study. If at any time you feel uncomfortable you are free to withdraw from the research. Just tell the researcher you wish to stop.

Compensation or payment: There is no compensation or other payment to you for taking part in this study.

Confidentiality: We will limit your personal data collected in this study to people who have a need to review this information. We cannot promise complete secrecy.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you, talk to Andrea Taylor- ataylor@ist.ucf.edu or Dr. Sae Schatz- sschatz@ist.ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida,

Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

Your questions, concerns, or complaints are not being answered by the research team.

You cannot reach the research team.

You want to talk to someone besides the research team.

You want to get information or provide input about this research.

APPENDIX C

Informed Consent Form – Main Study

APPENDIX C

Informed Consent Form – Main Study

**Perceptual Performance in U.S. Warfighters: Assessing the Effects of Resilience Training on Visual Skills – MAIN STUDY****Informed Consent**

Principal Investigator(s): Sae Schatz, Ph.D., Jennifer Vogel-Walcutt, Ph.D.
Sub-Investigator(s): Andrea Taylor, M.S.

Sponsor: Office of Naval Research
Investigational Site(s): University of Central Florida
Institute for Simulation and Training (IST), Partnership II

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study which will include about 60 people from the Orlando area. You have been asked to take part in this research study because you are a willing volunteer and are 18 or older. The people doing this research are Drs. Sae Schatz, Jennifer Vogel-Walcutt, and Ms. Andrea Taylor, all of UCF IST.

What you should know about a research study:

Someone will explain this research study to you.
A research study is something you volunteer for.
Whether or not you take part is up to you.
You should take part in this study only because you want to.
You can choose not to take part in the research study.

You can agree to take part now and later change your mind.
Whatever you decide it will not be held against you.
Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study is to assess the effects of different types of training on visual performance. The military currently utilizes several training programs in an attempt to inoculate, insulate, evaluate, or treat potential or existing issues related to performance decrements. Recently developed programs involving predeployment training have been provided to some troops prior to entering an operational environment.

However, these programs suffer from several limitations. For example, the programs are restricted in scope, not integrated into specific operational tasks, and may involve techniques inappropriate for the intended demographic (e.g., U.S. Army Center for Health Promotion and Preventative Medicine, 2004; McCarroll et al., 2005; Miller & Rasmussen, 2010). Predeployment training could help address military performance decrements, but more research is still required to mitigate the current training limitations.

What you will be asked to do in the study: You will complete the study individually in different a time slot from other participants. After reading this informed consent form, you will be given the opportunity to ask questions and provide verbal consent to participate. After consent, you will provide baseline assessments measuring perceived stress based on events within the last week, current stress, and propensity for stress resilience. These baseline measures will provide your “normal” state in order to compare changes post-training.

Next, you will complete some training. This training will aid you in the experimental task. You will be shown pictures and descriptors in order to learn how to distinguish between enemy and friendly tanks, jeeps, helicopters, and transport vehicles. After training, you will be provided a standard computer keyboard and shown to press specific keys to indicate “friendly” vehicle and “enemy” vehicles. Your performance on this task will be recorded. After the test period, several self-report assessments will be administered. Once these assessments are completed, you will be debriefed by the researcher and compensated for your time.

It is important to note that you do not have to answer every question or complete every task. You will not lose any benefits if you skip questions or tasks.

Location: Partnership II building, Room 305, 3100 Technology Parkway, Orlando, FL 32826

Time required: We expect that you will be in this research study for three (3) hours, which will all be completed in one session.

Funding for this study: This research study is being paid for by the Office of Naval Research.

Risks: There are no foreseeable risks or discomforts involved in taking part in this study.

Compensation or payment: Participants may expect to spend three hours performing experimental tasks, for which they may elect to receive either course credit for the amount of time they participate (at the discretion of your instructor), or, if not participating for course credit, cash payment at a rate of \$10.00 per hour. Maximum course credit will be 180 minutes, while maximum cash credit will be \$30.00. If you complete only part of the experiment, you will receive compensation for the time you have spent in the experiment.

Confidentiality: Your data in this research will only be identified by an assigned number. We will not document your name or any other personal identifying information. All the participant data will be aggregated and not reported on an individual participant basis. Performance scores, physiological data, and self-report questionnaires will only be identified by the assigned participant number, and will be stored in a locked cabinet or on a secure computer.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you, talk to Andrea Taylor via email at ATaylor@ist.ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

Your questions, concerns, or complaints are not being answered by the research team.

You cannot reach the research team.

You want to talk to someone besides the research team.

You want to get information or provide input about this research.

APPENDIX D

Study Questionnaires

Demographics

1. **Gender:** Male / Female

2. **Age:** _____

3. **How is your vision (circle one)?** Unimpaired Wear contacts Wear glasses

4. **Have you ever been diagnosed as colorblind?** Yes/No

5. **Do you typically play video games more than 8 hours in a week?** Yes/No

5b. If yes, what games? _____

6. **Do you like to play games that require attention like chess?** Yes/No

6b. If yes, how many hours/month, on average, do you play this game? _____

7. **Have you ever taken a course/lecture/seminar about stress management?** Yes/No

7b. If yes, please describe: _____

8. **How would you rate your expertise in identifying types of tanks?**

No expertise at all	Very little expertise	Some expertise	Moderate expertise	Expert
1	2	3	4	5

9. **How would you rate your expertise in identifying types of military transport vehicles (jeeps, trucks, etc.)?**

No expertise at all	Very little expertise	Some expertise	Moderate expertise	Expert
1	2	3	4	5

10. **How would you rate your expertise in identifying types of helicopters?**

No expertise at all	Very little expertise	Some expertise	Moderate expertise	Expert
1	2	3	4	5

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

2. In the last month, how often have you felt that you were unable to control the important things in your life?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

3. In the last month, how often have you felt nervous and “stressed”?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

5. In the last month, how often have you felt that things were going your way?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

7. In the last month, how often have you been able to control irritations in your life?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

8. In the last month, how often have you felt that you were on top of things?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

9. In the last month, how often have you been angered because of things that were outside of your control?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Never	Almost Never	Sometimes	Fairly Often	Very Often
0	1	2	3	4

Multiple Resources Questionnaire

The purpose of this questionnaire is to characterize the mental processes used in the task you just performed. Below are the names and descriptions of several mental processes. Please read each carefully so that you understand each process.

Important:

All parts of a process definition should be satisfied for it to be judged as having been used. For example, recognizing geometric figures presented visually should **not** lead you to judge that the "Tactile figural" process was used, just because figures were involved. For that process to be used, figures would need to be processed tactilely (i.e., using the sense of touch).

Auditory emotional process -- Required judgments of emotion (e.g., tone of voice or musical mood) presented through the sense of hearing.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Auditory linguistic process -- Required recognition of words, syllables, or other verbal parts of speech presented through the sense of hearing.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Facial figural process -- Required recognition of faces, or of the emotions shown on faces, presented through the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Facial motive process -- Required movement of your own face muscles, unconnected to speech or the expression of emotion.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Manual process -- Required movement of the arms, hands, and/or fingers.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Short term memory process -- Required remembering of information for a period of time ranging from a couple of seconds to half a minute.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Spatial attentive process -- Required focusing of attention on a location, using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Spatial categorical process -- Required judgment of simple left-versus-right or up-versus-down relationships, without consideration of precise location, using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Spatial concentrative process -- Required judgment of how tightly spaced are numerous visual objects or forms.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Spatial emergent process -- Required "picking out" of a form or object from a highly cluttered or confusing background, using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Spatial positional process -- Required recognition of a precise location as differing from other locations, using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Spatial quantitative process -- Required judgment of numerical quantity based on a nonverbal, nondigital representation (for example, bargraphs or small clusters of items), using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Tactile figural process -- Required recognition or judgment of shapes (figures), using the sense of touch.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Visual lexical process -- Required recognition of words, letters, or digits, using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Visual phonetic process -- Required detailed analysis of the sound of words, letters, or digits, presented using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Visual temporal process -- Required judgment of time intervals, or of the timing of events, using the sense of vision.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

Vocal process -- Required use of your voice.

No Usage	Light Usage	Moderate Usage	Heavy Usage	Extreme Usage
0	25	50	75	100

MRQ Global Rating Questionnaire

We would also like to characterize the task in terms of "global" demand on the person performing it. Below are the names and descriptions of several global dimensions. Please read each carefully so that you understand the dimension.

Overall demand -- Required overall demand on the performer.

No Demand	Light Demand	Moderate Demand	Heavy Demand	Extreme Demand
0	1	2	3	4

Time demand -- Required time pressure on the performer, including pressure to perform continuously without lapse of attention.

No Demand	Light Demand	Moderate Demand	Heavy Demand	Extreme Demand
0	1	2	3	4

Mental demand -- Required mental and perceptual demand on the performer.

No Demand	Light Demand	Moderate Demand	Heavy Demand	Extreme Demand
0	1	2	3	4

Stress demand -- The anxiety, confusion, and frustration experienced by the performer.

No Demand	Light Demand	Moderate Demand	Heavy Demand	Extreme Demand
0	1	2	3	4

STAI QUESTIONNAIRE

STAI Form Y-1 (Trait)

DIRECTIONS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel **right now**, that is, **at this moment**. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied.....	1	2	3	4
9. I feel frightened.....	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery.....	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried.....	1	2	3	4
18. I feel confused.....	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

STAI QUESTIONNAIRE
STAI Form Y-2 (State)

DIRECTIONS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you **generally** feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be.....	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested.....	1	2	3	4
27. I am "calm, cool, and collected.....	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them.....	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy.....	1	2	3	4
31. I have disturbing thoughts.....	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content.....	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person.....	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns.....	1	2	3	4

The Stress Appraisal Measure (SAM)

© 1989

Edward J. Peacock & Paul T.P. Wong

This questionnaire is concerned with your thoughts about various aspects of the situation identified previously. There are no right or wrong answers. Please respond according to how you view this situation right NOW. Please answer ALL questions. Answer each question by CIRCLING the appropriate number corresponding to the following scale.

1	2	3	4	5
Not At All	Slightly	Moderately	Considerably	Extremely

- =====
1. Is this a totally hopeless situation? 1 2 3 4 5
 2. Does this situation create tension in me?..... 1 2 3 4 5
 3. Is the outcome of this situation uncontrollable by anyone? 1 2 3 4 5
 4. Is there someone or some agency I can turn to for help if I need it? 1 2 3 4 5
 5. Does this situation make me feel anxious? 1 2 3 4 5
 6. Does this situation have important consequences for me? 1 2 3 4 5
 7. Is this going to have a positive impact on me? 1 2 3 4 5
 8. How eager am I to tackle this problem? 1 2 3 4 5
 9. How much will I be affected by the outcome of this situation? 1 2 3 4 5
 10. To what extent can I become a stronger person because of this problem? 1 2 3 4 5
 11. Will the outcome of this situation be negative? 1 2 3 4 5
 12. Do I have the ability to do well in this situation? 1 2 3 4 5
 13. Does this situation have serious implications for me?..... 1 2 3 4 5
 14. Do I have what it takes to do well in this situation? 1 2 3 4 5

15. Is there help available to me for dealing with this problem? 1 2 3 4 5
16. Does this situation tax or exceed my coping resources? 1 2 3 4 5
17. Are there sufficient resources available to help me in dealing with this situation? 1 2 3 4 5
18. Is it beyond anyone's power to do anything about this situation? 1 2 3 4 5
19. To what extent am I excited thinking about the outcome of this situation? 1 2 3 4 5
20. How threatening is this situation?..... 1 2 3 4 5
21. Is the problem unresolvable by anyone? 1 2 3 4 5
22. Will I be able to overcome the problem? 1 2 3 4 5
23. Is there anyone who can help me to manage this problem? 1 2 3 4 5
24. To what extent do I perceive this situation as stressful? 1 2 3 4 5
25. Do I have the skills necessary to achieve a successful outcome to this situation? 1 2 3 4 5
26. To what extent does this event require coping efforts on my part? 1 2 3 4 5
27. Does this situation have long-term consequences for me? 1 2 3 4 5
28. Is this going to have a negative impact on me? 1 2 3 4 5

APPENDIX E

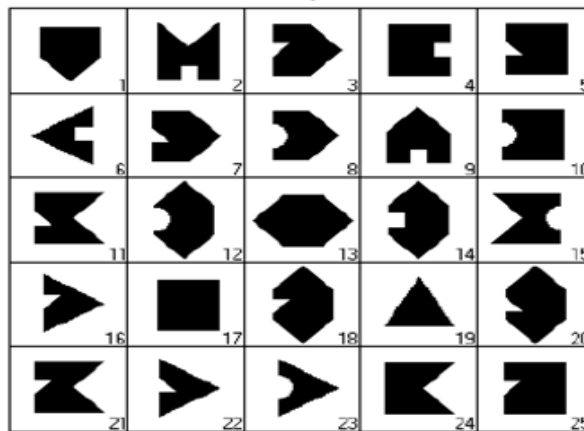
Spatial Abilities Test (Sample)

APPENDIX E

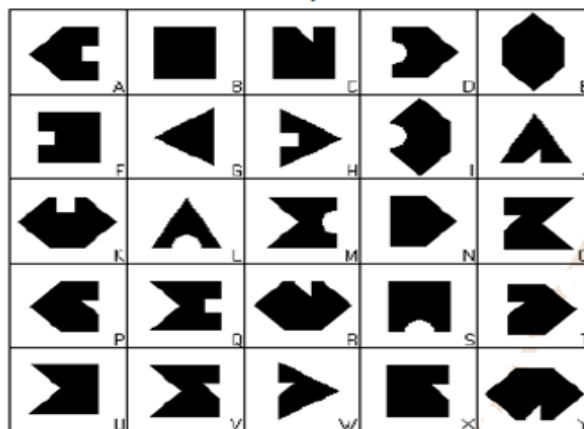
Spatial Abilities Test (Sample)

The shapes in Group 1 and Group 2 are identical, although some of them may be rotated. Which shape in Group 2 corresponds to the shapes (1 to 25) in Group 1?

Group 1



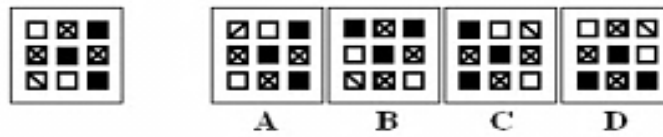
Group 2



- | | | | | |
|-----|-----|-----|-----|-----|
| 1) | 2) | 3) | 4) | 5) |
| 6) | 7) | 8) | 9) | 10) |
| 11) | 12) | 13) | 14) | 15) |
| 16) | 17) | 18) | 19) | 20) |
| 21) | 22) | 23) | 24) | 25) |

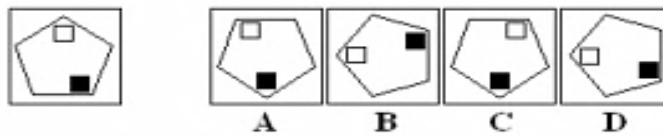
In the figures shown below, one of the shapes (A-D) is identical to the first figure but has been rotated.

26) Which figure is identical to the first?



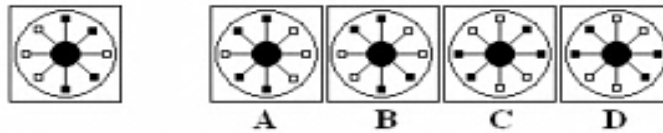
A B C D

27) Which figure is identical to the first?



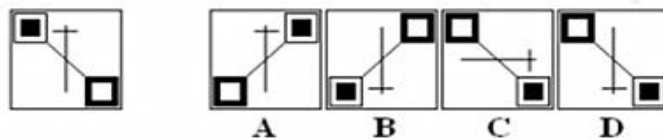
A B C D

28) Which figure is identical to the first?



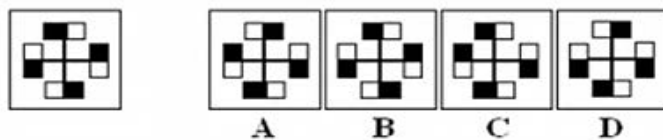
A B C D

29) Which figure is identical to the first?



A B C D

30) Which figure is identical to the first?



A B C D

APPENDIX F

Participant Solicitation Craigslist Advertisement

APPENDIX F

Participant Solicitation Craigslist Advertisement

Posted in the “Jobs” section of Craigslist:

Volunteers Needed for Research Study (UCF)

A research study at the University of Central Florida’s Research Park is seeking volunteers for a 2.5-hour study. The purpose of this study is to assess the effects of different types of training on visual performance. The study involves individually filling out questionnaires, taking part in a short computer-based training session, and performing a computer-based military-themed visual task.

Participants will be compensated a total of \$25 after completing the entire 2.5-hour study (or \$10/hour for each completed hour).

Requirements:

Age 18+

Fluent English

No previous military training/ROTC/etc.

Still interested?

1. First, email Andrea at ISTRResearch2@gmail.com
2. In the email, indicate days and times you are available for a 2.5-hour time slot, and any questions you have.
3. Andrea will respond to your request with an email confirmation of your date/time and driving directions.
4. Arrive on time!
5. You can cancel or reschedule your appointment by emailing Andrea at ISTRResearch2@gmail.com. Give as much notice as possible.

Thank you!

Study Location:

Partnership II building

3100 Technology Parkway, Orlando, FL 32826

APPENDIX G

Declarative Knowledge Discrimination Training (Sample)

APPENDIX G

Basic Declarative Knowledge Discrimination Training (Sample)

**Distinguishing Between
Enemy and Friendly Vehicles**

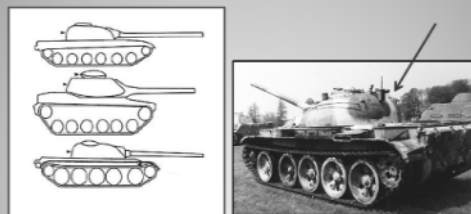
This presentation will show you some quick ways to tell an enemy from a friendly vehicle.

Later today, you will be asked to quickly decide if a vehicle is enemy or friendly, so learning the visual cues is very important.

You do not need to learn the names of the vehicles, just the features that distinguish enemy from friendly.

Tanks

Enemy tanks all have a rounded turret in the back, like these.



Enemy Tanks

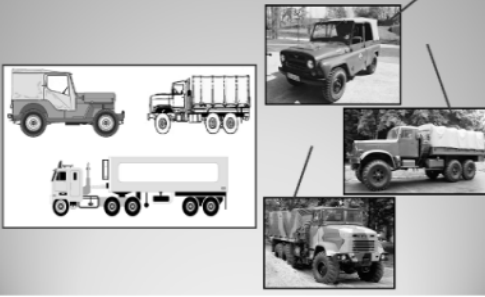
Friendly tanks have irregularly shaped turrets in the back, like these.



Friendly Tanks

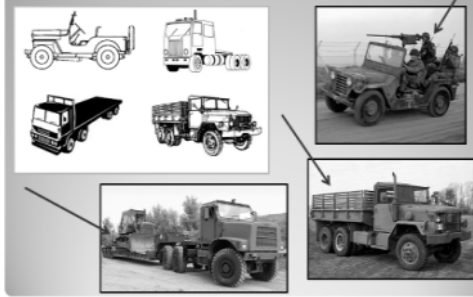
Jeeps and Transport Vehicles

Enemy vehicles all have covered beds, like these.



Enemy Jeeps and Transport Vehicles

Friendly vehicles all have open beds, like these.

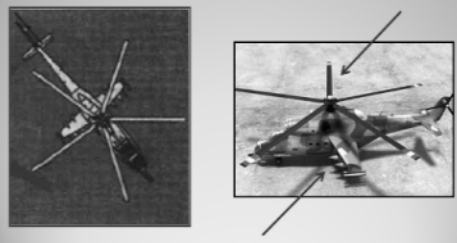


Friendly Jeeps and Transport Vehicles

Helicopters

Enemy helicopters all have five blades.

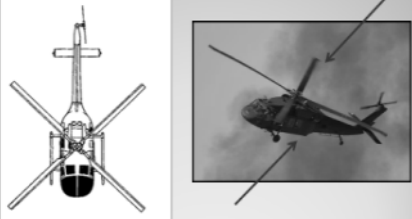
Also, you can see the "wings" (weapon attachments) on enemy helicopters, like this.



Enemy Helicopters

Friendly helicopters all have four blades.

Also, you can not see any "wings" (weapon attachments) on friendly helicopters, like this.



The left image is a top-down schematic of a helicopter, showing four blades extending from the rotor hub. The right image is a side-view photograph of a helicopter with four blades, and two arrows point to the blades to highlight their count.

Friendly Helicopters

Please let the researcher know if you have any questions. You can review this training until you feel comfortable.

APPENDIX H

Perceptual Skills Training (Sample)

APPENDIX H

Perceptual Skills Training (Sample)



You selected:
Enter – Friendly
CORRECT!



You selected:
Enter – Friendly
INCORRECT!

APPENDIX I

Placebo Task Handouts

APPENDIX I

Placebo Task Handouts

Enemy Tank (curved turret)

T-72



The T-72 is a main battle tank that entered production in 1970. It is developed directly from Obyekt-172, and shares partial features with the T-64A. The T-72 is one of the most widely produced post-World War II tanks, second only to the T-54/55 family, and the basic design has also been further developed as the T-90.



The T-72 is equipped with the 125 mm 2A46 series main gun, a significantly larger calibre than the standard 105 mm gun found in contemporary Western MBTs and still slightly larger than the 120 mm/L44 found in many modern Western MBTs. However, its armour penetration is not as great. The gun is capable of firing anti-tank guided missiles, as well as standard main gun ammunition, including HEAT and APFSD6 rounds.

Designer: Kirovskiy Mashinostroyeniye
Designed: 1967-1973
Manufacturer: Uralvagonzavod
Unit cost: \$1-2 million (in 2009)
Produced: 1971-present
Number built: 25,000+



Friendly Tank (irregular turret)

M-60



The M60, also known unofficially as the M60 Patton, is a first-generation main battle tank (MBT) introduced in December 1960. It was widely used by the U.S. and its Cold War allies, especially those in NATO, and remains in service throughout the world today despite being superseded by the M1 Abrams.

In 1957, plans were laid in the US for a tank with a 105 mm main gun and a redesigned hull offering better armor protection. The resulting M60 series largely resembles the M48 it was based on, but has significant differences. The M60 mounted a bore evacuated 105 mm main gun, compared with the M48's 90 mm, had a hull with a straight front slope where as the M48's hull was rounded, had three support rollers per side to the M48's five, and had road wheels constructed from aluminum rather than steel.



Manufacturer: Detroit Arsenal Plant, Chrysler
Produced: 1960-1987
Number built: Over 15,000 (all variants)
Variants: M560, M60A1, M60A2E1, M60A2E3, M60A1E4, M60A3, M60Super/AV, M60-2000/1205

Enemy Truck (covered bed)

KrAZ



On April 17th, 1958 the Central Committee of the Communist Party of the Soviet Union decided to build a plant for heavy-duty vehicle production in Kremenchug. Heavy-duty truck manufacture was transferred from the Zaporozhye automobile plant (ZAZ). By 1961, the plant exported over 500 hundred vehicles in 26 countries of the world such as Argentina, Afghanistan, Bulgaria, China, India, Vietnam, etc. KrAZ was awarded the Order of Lenin in January 1971 for completion of the five-year plan ahead of schedule and successful developments of new truck models. On January 15th, 1976 the plant became "Автомобильный завод".

In 2003 AvtoKRAZ opened vehicle assembly plants in Russia and Vietnam. In 2004 AvtoKRAZ was awarded an order for 2200 KrAZ vehicles to be delivered to Iraq.

In January 2006 the 800,000th truck was assembled at the KrAZ main assembly plant. In October of the same year IBC AvtoKRAZ won the first prize among 100 Ukrainian companies with the best rate of development.



Manufacturer: AvtoKRAZ
Produced: 1958-Present
Number built: Over 800,000 (all variants)
Military Variants: KrAZ-5133BE 4x4, KrAZ-6322 6x6 - 250 hp, 350 hp

Friendly Truck (open bed)

M 35



The M35 family of trucks is a long-lived vehicle initially deployed by the United States Army, and subsequently utilized by many nations around the world. A truck in the 2 1/2-ton weight class, it was one of many vehicles in U.S. military service to have been referred to as the "deuce and a half." While the basic M35 cargo truck is rated to carry 5,000 pounds (2,300 kg) off road or 10,000 pounds (4,500 kg) on roads, they have been known to haul twice as much as rated. Trucks in this weight class are considered medium duty by the military and Department of Transportation.

The M35 started out in 1949 as a design by the REO Motor Car Company as a 2 1/2 ton truck. The first vehicle in the family, the M34, was quickly superseded in military usage by the M35, the major difference being the M35's 10-tie configuration versus the M34's 6-tie "super-slinger" configuration. The M35 series was to be replaced by the Light Medium Tactical Vehicle. However, many United States National Guard and Reserve units continued to use them as the new family of vehicles was phased in. The M35 series was used by United States in Iraq during Operation Iraqi Freedom. The M35 Truck was not used by United States Marine Corps and currently issued M35 to the U.S. Army Service.

Designed: 1949
Manufacturer: REO, Kaiser, AM General
Produced: 1950-present



Enemy Jeep (covered bed)

UAZ 469



The UAZ-469 is an all-terrain vehicle manufactured by UAZ. It was used by paramilitary units in Eastern Bloc countries. The UAZ-469 was introduced in 1973, replacing the earlier GAZ-69. The UAZ-469 presented two great advantages: it was able to drive in virtually any terrain and it was very easy to fix. The UAZ-469 reached legendary status for its reliability and off-road ability. The vehicle was not available for purchase by the public, but many were sold as surplus to private owners.

Modifications include a base UAZ-469B with ground clearance of 220 mm, and a specialized military UAZ-469B, with ground clearance increased to 300 mm. Since 1985, due to new industry designation standards, they were renamed the UAZ-9151 and UAZ-91512. The currently manufactured UAZ Hunter is an updated version of old UAZ-469B.



Manufacturer: **УАЗ** (UAZ)
 Produced: 1973 - Present
 Engine: 2450 cc petrol, in-line 4-cylinder
 Transmission: 4-speed manual gearbox, 2-speed transfer shift, 4-wheel drive

Friendly Jeep (open bed)

Willys' Jeep



In 1939, the U.S. Army invited 135 companies to submit proposals for a new military vehicle to replace its aging fleet of motorcycles and Ford Model T trucks. Only three companies complied: Ford Motor Company, **Willys-Overland**, and American Bantam Car Company. **Willys** ultimately won the contract in July 1941. Ford agreed to build from **Willys** plans and Bantam built trailers for the **Willys** vehicle.

Of note, the Ford proposal in the design competition was called the "GP," which led to the name "Jeep." The name stuck to the small four-wheel-drive vehicle, even though Ford ended up building the **Willys** design.



The **Willys** Jeep was powered by a four-cylinder engine that could run at 4,000 RPM for 100 hours straight. The vehicle featured a fold-up cloth roof. The Jeep could run 60 miles per hour, climb a forty degree slope, turn around in a 30 foot circle, and tilt up to 30 degrees to either side without tipping over. It could even run under water, with special attachments for air intake and exhaust.



Over 300,000 Jeeps were built to fight in World War II. The **Willys** assembly line turned out one every 90 seconds. The vehicle was produced for the Army in continuously improved versions until 1981, when it was replaced by the Hummer.

Enemy Helicopter (5 blades, "wings")

MI-24 Hind



The MI-24 is a large helicopter gunship and attack helicopter with low-capacity troop transport with room for 8 passengers. It is produced by MI Helicopter Plant and operated since 1973 by over thirty nations.

Original Soviet pilots called the aircraft "Bryg tsak", or **crocodile** (Брыгацкодил). More common unofficial nicknames were "Crocodile" (Крокодил) due to the helicopter's camouflage scheme and "Glar" (Степко or Степан) because of the flat glass plates which surround the cockpit of the Mi-24.



The core of the aircraft was derived from the Mi-8 (NATO reporting name "Hip"); two top-mounted **Iskander** engines driving a mid-mounted 173 in five-blade main rotor and a three-blade tail rotor. The engine configuration gave the aircraft its distinctive double air intake. Original versions have an angular greenhouse-style cockpit. Model D and later have a characteristic tandem cockpit with a "double bubble" canopy. Other antenna components came from the Mi-8 "Haze." Two mid-mounted stub wings provide

weapon **Iskander** each offering three stations, in addition to providing lift. The load-out mix is mission dependent; Mi-24s can be tasked with close air support, anti-tank operations, or aerial combat.

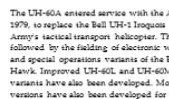


Friendly Helicopter (4 blades, no "wings")

Black Hawk



The UH-60 Black Hawk is a four-bladed, twin-engine, medium-lift utility helicopter manufactured by Sikorsky Aircraft. Sikorsky submitted the S-70 design for the United States Army's Utility Tactical Transport Aircraft System (UTTAS) competition in 1972. The Army designated the prototype as the UH-60A and selected the Black Hawk as the winner of the program in 1974, after a fly-off competition with the Boeing Vertol UH-120.

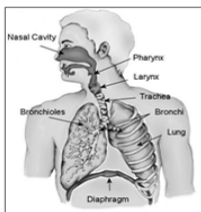


The UH-60s entered service with the Army in 1978, to replace the Bell UH-1 Iroquois as the Army's tactical transport helicopter. This was followed by the fielding of electronic warfare and special operations variants of the Black Hawk's Improved UH-60L and UH-60M utility variants have also been developed. Modified variants have also been developed for the U.S. Navy, Air Force, and Coast Guard. In addition to U.S. Army use, the UH-60 family has been exported to several nations. Black Hawks have served in combat during conflicts in Grenada, Panama, Iraq, Somalia, the Balkans, Afghanistan, and other areas in the Middle East.



Manufacturer: Sikorsky Aircraft Corp.
 Produced: 1974-Present
 Number built: >2,600
 Variants: Sikorsky SH-60 Seahawk, Sikorsky HH-60 Pave Hawk, Sikorsky HH-60 Jayhawk, Sikorsky S-70

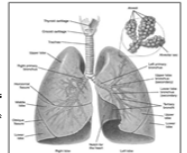
Respiratory System



The respiratory system is the anatomical system of an organism that introduces respiratory gases to the interior and performs gas exchange. In humans and other mammals, the anatomical features of the respiratory system include nostrils, lungs, and the respiratory muscles. Molecules of oxygen and carbon dioxide are passively exchanged, by diffusion, between the gaseous external environment and the blood. This exchange process occurs in the alveolar region of the lungs.

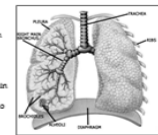
Respiration is achieved through the mouth, nose, trachea, lungs, and diaphragm. Oxygen enters the respiratory system through the mouth and the nose. The oxygen then passes through the larynx (where speech sounds are produced) and the trachea (which is a tube that enters the chest cavity). In the chest cavity, the trachea splits into two smaller tubes called the bronchi. Each bronchus then divides again forming the bronchial tubes. The bronchial tubes lead directly into the lungs where they divide into many smaller tubes which connect to tiny sacs called alveoli.

The average adult's lungs contain about 600 million of these spongy, air-filled sacs that are surrounded by capillaries. The inhaled oxygen passes into the alveoli and then diffuses through the capillaries into the arterial blood. Meanwhile, the waste-rich blood from the veins releases its carbon dioxide into the alveoli. The carbon dioxide follows the same path out of the lungs when you exhale.



Respiratory System - The Lungs

The lung is a magnificent organ that performs a multitude of vital functions every second of our lives. Breathing is the most essential of these functions. With each breath, the lungs take in oxygen and remove carbon dioxide.



The air (oxygen) we breathe enters the lungs via the main windpipe (trachea), which branches into two main tubes supplying the right and left lung, respectively. These tubes progressively branch 22 additional times to form more than 500,000 smaller tubes (bronchi, bronchioles) and more than 500 million air sacs (alveoli), which are only about 0.5 mm in diameter.

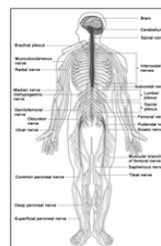
Thus, the surface area of the lungs is huge - larger than the surface of a person's skin. In fact, if all the airways and air sacs of a person's lungs were laid flat on the ground, they would cover more than 500 square yards, which is larger than the size of a tennis court. Because the walls of these air sacs are 1/50th the thickness of tissue paper and are bathed with millions of tiny blood vessels called capillaries, there is an easy and efficient exchange of oxygen and carbon dioxide between the body and the environment.

The lungs are also important in the body's defense against infection and other harmful environmental factors. While the nose is the first line of defense against inhaled harmful materials, the lungs provide the second line of defense. Inhaled particles (smoke, pollution) or infectious agents (bacteria, viruses) pass through the mouth or nose and lodge in the lungs.



Mucus, a sticky fluid produced in the lungs, can trap these inhaled agents and aid the lungs' protective white blood cells (macrophages, neutrophils) in the engulfment and destruction of bacteria and other harmful materials. Coughing is the best way to clear mucus and other materials from the lungs; however, the larger airways have tiny haggling cells called cilia that aid in this process. The cilia beat with a rhythm fast enough, and a force sufficient enough, to propel mucus and cells up the airways to be coughed out or swallowed. When a person smokes, the cilia are inactivated or destroyed, allowing thick mucus to accumulate and compromise lung defense.

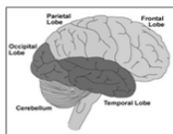
Nervous System



The nervous system is an organ system consisting of a network of specialized cells called neurons that coordinate the actions of an animal and transmit signals between different parts of its body. In most animals the nervous system consists of two parts, central and peripheral.

The central nervous system of vertebrates (such as humans) contains the brain, spinal cord, and retina. The peripheral nervous system consists of sensory neurons, clusters of neurons called ganglia, and nerves connecting them to each other and to the central nervous system. These regions are all interconnected by means of complex neural pathways. The entire nervous system, a subsystem of the peripheral nervous system, has the capacity, even when severed from the rest of the nervous system through its primary connection by the vagus nerve, to function independently in controlling the gastrointestinal system.

The brain is the center of the nervous system in all vertebrate and most invertebrate animals. Some primitive animals such as jellyfish and starfish have a decentralized nervous system without a brain, while sponges lack any nervous system at all. In vertebrates, the brain is located in the head, protected by the skull and close to the primary sensory apparatus of vision, hearing, taste, and smell.



Nervous System – The Brain



Brainstem - The lower extension of the brain where it connects to the spinal cord. Neurological functions located in the brainstem include those necessary for survival (breathing, digestion, heart rate, blood pressure) and for arousal (being awake and alert).

Cerebellum - The portion of the brain (located at the back) which helps coordinate movement (balance and muscle coordination). Damage may result in ataxia which is a problem of muscle coordination. This can interfere with a person's ability to walk, talk, eat, and to perform other skill-based tasks.

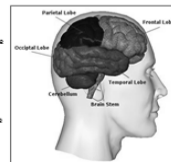
Frontal Lobe - Front part of the brain involved in planning, organizing, problem solving, selective attention, personality and a variety of "higher cognitive functions" including behavior and emotions.

Occipital Lobe - Region in the back of the brain which processes visual information. Not only is the occipital lobe mainly responsible for visual reception, it also contains association areas that help in the visual recognition of shapes and colors. Damage to this lobe can cause visual deficits.

Parietal Lobe - One of the two parietal lobes of the brain, located behind the frontal lobe at the top of the brain.

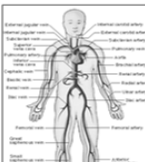
Parietal Lobe, Right - Damage to this area can cause topographical deficits (e.g. the patient may have difficulty finding their way around new, or even familiar, places).

Parietal Lobe, Left - Damage to this area may disrupt a patient's ability to understand spoken and/or written language.



Temporal Lobe - There are two temporal lobes, one on each side of the brain located at about the level of the ears. These lobes allow a person to tell one small from another and one sound from another. They also help in storing new information and are believed to be responsible for short-term memory.

Circulatory System



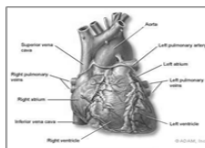
The circulatory system is an organ system that passes nutrients (such as amino acids, electrolytes and lymph), gases, hormones, blood cells, etc. to and from cells in the body to help fight diseases and help stabilize body temperature and pH to maintain homeostasis.

This system may be seen strictly as a blood distribution network, but some consider the circulatory system as composed of the cardiovascular system, which distributes blood, and the lymphatic system, which distributes lymph. Humans, as well as other vertebrates, have a closed cardiovascular system, meaning that the blood never leaves the network of arteries, veins and capillaries. The lymphatic system, on the other hand, is an open system.

Two types of fluids move through the circulatory system: blood and lymph. The blood, veins, and blood vessels form the cardiovascular system. The lymph, lymph nodes, and lymph vessels form the lymphatic system. The cardiovascular system and the lymphatic system collectively make up the circulatory system.

On average, your body has about 5 liters of blood continuously traveling through it by way of the circulatory system. The heart, the lungs, and the blood vessels work together to form the circle part of the circulatory system. The pumping of the heart forces the blood on its journey.

The body's circulatory system has three distinct parts: pulmonary circulation, coronary circulation, and systemic circulation. Each part must be working independently in order for them to all work together.



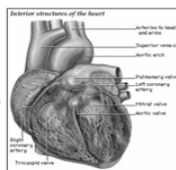
Circulatory System – The Heart



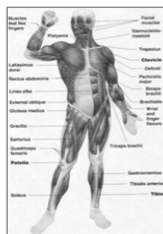
The heart is one of the most important organs in the entire human body. It is really nothing more than a pump, composed of muscle which pumps blood throughout the body, beating approximately 72 times per minute of our lives. The heart pumps the blood, which carries all the vital materials which help our bodies function and removes the waste products that we do not need. For example, the brain requires oxygen and glucose, which, if not received continuously, will cause it to lose consciousness. Muscles need oxygen, glucose and amino acids, as well as the proper ratio of sodium, calcium and potassium ions in order to contract normally. The glands need sufficient supplies of raw materials from which to manufacture the specific secretions. If the heart ever ceases to pump blood the body begins to shut down and after a very short period of time will die.

The heart is essentially a muscle (a little larger than the fist). Like any other muscle in the human body, it contracts and expands. Unlike skeletal muscles, however, the heart works on the "All-or-Nothing Law". That is, each time the heart contracts it does so with all its force. In skeletal muscles, the principle of "gradation" is present. The pumping of the heart is called the Cardiac Cycle, which occurs about 72 times per minute. This means that each cycle lasts about eight-hundredths of a second. During this cycle the entire heart actually rests for about four-tenths of a second.

The Heart works as a pump moving blood around in our bodies to nourish every cell. Used blood, that is blood that has already been to the cells and has given up its nutrients to them, is drawn from the body by the right half of the heart, and then sent to the lungs to be reoxygenated. Blood that has been reoxygenated by the lungs is drawn into the left side of the heart and then pumped into the blood stream.



Muscular System

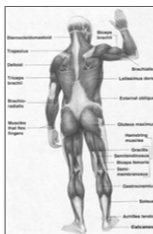


The muscular system is the anatomical system of a species that allows it to move. The muscular system in vertebrates is controlled through the nervous system, although some muscles (such as the cardiac muscle) can be completely autonomous.

There are three distinct types of muscles: skeletal muscles, cardiac or heart muscles, and smooth (non-striated) muscles. Muscles provide strength, balance, posture, movement and heat for the body to keep warm.

Upon stimulation by an action potential, skeletal muscles perform a contracted contraction by shortening each sarcomere. Actin and myosin fibers overlap in a contractile motion towards each other. Myosin filaments have club-shaped heads that project toward the actin filaments.

Larger structures along the myosin filaments called myosin heads are used to provide attachment points on binding sites for the actin filaments. The myosin heads pivot toward the center of the sarcomere, detach and then reattach to the nearest active site of the actin filament. This is called a ratchet type drive system. This process consumes large amounts of adenosine triphosphate (ATP).



APPENDIX J

Stress Resilience Training (Sample)

APPENDIX J

Stress Resilience Training (Sample)

Stress Resilience Training

Researcher: Press the space bar to continue.

It is possible to increase your performance on a difficult task by learning stress resilience skills.

For the next few minutes, you will learn more about stress resilience, what it entails, and techniques you can use during stressful tasks.

The task you will perform later today will include some external stressors. It is important to understand these stressors in order to effectively reduce their effects.

The external stressor in the environment will include having to multitask, distractions from the primary task, loud intermittent noises, and time pressure.

This training program includes video clips from a stress resilience training session. Follow along, and try to imagine yourself as the trainee.

Physiological Stress



For Review

Typical physiological reactions to stressors include:

- Increased heart rate
- Butterflies in the stomach
- Feeling “jittery”
- Sweaty, cold, or clammy palms
- Increased blinking
- Muscle tension, especially in the shoulders
- Increased breathing rate
- “Tingles” in face, hands, feet
- Forgetfulness

Emotional Stress

For Review

Typical emotional reactions to stressors include feeling:

- Pressured
- Frantic
- Insecure
- Discouraged
- Irritated
- Annoyed

Stress and Performance

Stress typically decreases performance, especially with tasks related to threat detection.

Your performance on the task may be affected in the following ways:

- Perception is narrowed
- Attention is focused on primary tasks while neglecting secondary tasks
- Tunnel vision
- Focus lock
- Decreased ability to detect patterns

Strategies: Goal Setting



Strategies: Goal Setting

For Review

Establish at least 3 specific goals for any stressful task.

Maintain focus on these goals throughout the task.

Realistically assess your success with meeting these goals at the end of each task.

Adjust goals as necessary for similar future tasks.

Start small.

Examples:

I will score at least an 80% on this test.

I will remain calm throughout the test.

I will practice Combat Breathing throughout the task.

Strategies: Goal Setting

For Review

Using the paper at your desk, write down three goals that you think would be useful when performing a stressful computer test.

You may press the space bar to continue when you are finished.

Strategies: Mental imagery rehearsal



Strategies: Mental imagery rehearsal

For Review

See yourself accomplishing your goals.

Use all your senses - listen to the distracting sounds around you, and see yourself tuning them out; hear yourself clicking the correct buttons; etc.

Do this for a few minutes before beginning a stressful task.

Strategies: Positive Self Talk

For Review

It is easy to fall into the "insecurity trap," especially when trying something new that you haven't practiced much.

Remind yourself that you are performing the best you can, and that you will get better with time.

Strategies: Combat Breathing



Strategies: Combat Breathing

With one simple technique, we can quickly and effectively counteract almost all physical side effects of stress.

- Sit up straight, feet flat on the floor.
 - Close eyes, inhale deeply through nose.
 - Feel stomach rise, ribs expand.
 - Hold, exhale slowly through mouth.
 - Important: Slow and controlled.
 - Fresh air is good.
 - Make sure you can hear yourself.
- Do this 3 times before a stressful task.
 - Continue (with eyes open) occasionally during the task.

Try it now with the researcher.

You may press the space bar to continue
when you are finished.

Please let the researcher know that you are finished, and if you have any questions about stress resilience.

APPENDIX K
IRB Approval Letters

APPENDIX K

IRB Approval Letters



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

Approval of Human Research

From: UCF Institutional Review Board #1
 FWA00000351, IRB00001138

To: Sae L. Schatz and Co-PI: Jennifer J. Vogel-Walcutt

Date: September 15, 2011

Dear Researcher:

On 9/15/2011, the IRB approved the following human participant research until 9/14/2012 inclusive:

Type of Review: UCF Initial Review Submission Form
 Expedited Review Category #7
 This approval includes an Alteration of the Consent Process and
 a Waiver of Written Documentation of Consent.

Project Title: Perceptual Performance in U.S. Warfighters: Assessing the
 Effects of Resilience Training on Visual Skills – MAIN STUDY

Investigator: Sae L. Schatz

IRB Number: SBE-11-07863

Funding Agency: Office of Naval Research, RDECOM-STC

Grant Title: Perceptual Training Systems and Tools

Research ID: 1051188

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

If continuing review approval is not granted before the expiration date of 9/14/2012, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

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

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

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

Signature applied by Joanne Muratori on 09/15/2011 12:24:12 PM EDT

A handwritten signature in black ink that reads 'Joanne Muratori'.

Institutional Review Board (IRB) Authorization Agreement

Institution Providing IRB Review (Institution A):

University of Central Florida
 FWA#: 00000351
 IRB Registration #: IRB00001138

Institution Relying on the Designated IRB (Institution B):

Virginia Commonwealth University (VCU)
 FWA #: 00005287

The Officials signing below agree that Virginia Commonwealth University may rely on the designated IRB for review and continuing oversight of the human subjects research described below: *(check one)*

This agreement applies to all human subjects research covered by Institution B's FWA.

This agreement is limited to the following specific protocol(s):

Name of Research Project: Perceptual Performance in U.S. Warfighters: Assessing the Effects of Resilience Training on Visual Skills – MAIN STUDY
Name of Principal Investigator: Sam Schatz, University of Central Florida
Research Associate: Andrea Taylor, VCU Graduate Student
Funding Agency: ONR and RDCOM

Other *(describe)*:

The review performed by the designated IRB will meet the human subject protection requirements of Institution B's OHRP-approved FWA. The IRB at Institution/Organization A will follow written procedures for reporting its findings and actions to appropriate officials at Institution B. Relevant minutes of IRB meetings and other relevant documents pertaining to the conduct of this study will be made available to Institution B upon request. The Institution B Research Associate remains responsible for ensuring compliance with Institution A's IRB determinations and with the Terms of its OHRP-approved FWA. This document must be kept on file by both parties and provided to OHRP upon request.

Specific Institution B Research Associate Responsibilities:

- 1) Complete any educational training required by the Institution A IRB and/or the Institution B IRB prior to initiating research covered under this Agreement.
- 2) Report immediately to the Institution A IRB any unanticipated problems involving risks to subjects or others in research covered under this Agreement.
- 3) Acknowledges that he/she is responsible for safeguarding the rights and welfare of each research subject, and that the subject's rights and welfare must take precedence over the goals and requirements of the research.

University of Central Florida

Signatory Official:

FWA Institutional Official (or designee) Signature: _____

Date: 10/17/11

Name: Thomas O'Neal

Title: Associate Vice President for Research & Commercialization

Virginia Commonwealth University

Signatory Official:

I agree to defer IRB review to Institution A.

FWA Institutional Official (or designee) signature: _____

Date: 10-17-11

Name: Francis L. Macrina, Ph.D.

Title: Vice President for Research

Responsible VCU Researcher:

I agree and accept the responsibilities under this agreement as outlined above.

Investigator Signature: _____

Date: 10/17/11

VITA

Andrea H. Taylor was born in Parkersburg, WV to Mark and Margaret Taylor. She currently resides in her longtime hometown of Orlando, FL where she works as a research professional under Department of Defense contracts. Andrea earned her Bachelor of Arts degree in psychology at the University of Central Florida in 2003, then her Master of Science degree in experimental psychology at the University of Texas at San Antonio in 2007. She has worked to develop her primary focus on stress research with a variety of populations for over 10 years. Her research interests also include statistical analysis, experimental design, and psychometrics.