7057

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	7.Oct.02	DISSERTATION

4. TITLE AND SUBTITLE
A RISK FACTOR MODEL PREDICTING THE RELATIONSHIP BETWEEN STRESS AND PERFORMANCE IN EXPLOSIVE ORDNANCE DISPOSAL (EOD) TRAINING

5. FUNDING NUMBERS

6. AUTHOR(S)
MAJ BATES MARK J

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
UNIFORMED SERVICES UNIV OF HEALTH SCIENC

8. PERFORMING ORGANIZATION REPORT NUMBER
CI02-767

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
THE DEPARTMENT OF THE AIR FORCE
AFIT/CIA, BLDG 125
2950 P STREET
WPAFB OH 45433

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Unlimited distribution
In Accordance With AFI 35-205/AFIT Sup 1

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

20030225 083

14. SUBJECT TERMS

15. NUMBER OF PAGES
230

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

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ABSTRACT

Stress is a common aspect of military operations. It therefore follows that training to work effectively under conditions of stress is an essential component of military training programs. The primary purpose of this proposed study is to identify specific risk and protective factors that predict the effects of stress responding on military operational performance. Because of the high levels of stress and resultant program attrition, the military's Explosive Ordnance Disposal (EOD) training program provides a unique opportunity to study the interaction between stress and performance, and to identify specific risk and protective factors.

The study recruited 500 students who were enrolled in EOD training. These students were enlisted personnel in the US military who volunteered to participate in the study at two points during the training program. Self-report assessments of potential risk factors were collected at the beginning of the training program and at one intermediate time point that is associated with the highest level of student attrition. These risk factors included general cognitive ability, inattention and impulsivity, problem solving, anxiety, personality dimensions, social relations, and stressful events. In addition, the study explored the role of the demographic, social desirability, and external stressor control variables. The risk factors and control variables were used to predict two measures of performance. The first measure of performance was the grade on the first practical test of the training program, a continuous outcome between 0-100. The second performance measure was program completion, which was a dichotomous outcome of successful or unsuccessful completion.

The statistical procedures included multivariate analyses to identify unique predictors of performance and interactional analyses to clarify how pairs of variables might be interacting to affect performance. A substantial number of variables were found to predict performance on a univariate level. However, only select demographic variables, trait inattention, and situationally experienced cognitive anxiety emerged as key predictors of performance in multivariate comparisons of predictors. The findings also suggested that trait problem-solving skills might act as a protective factor against the negative performance effects associated with trait inattention. Finally, even though trait inattention was found to be a risk factor for poorer performance, the findings also suggested that inattention could be associated with enhanced performance if paired with either situational variables of high utilization of problem solving skill or low cognitive anxiety experienced during a test.

Risk Factor Model Predicting the Relationship between Stress and Performance in Explosive Ordnance Disposal Training

By:

Mark J. Bates

Doctoral dissertation submitted to the Faculty of the Department of the Medical and Clinical Psychology Graduate Program of the Uniformed Services University of Health Sciences in partial fulfillment of the requirements for the degree of Doctor of Philosophy

ACKNOWLEDGEMENTS

Consistent with the spirit of this study's model of multivariate contributions, this project was only possible with the support of many people who were generous with their time, advice, assistance, and encouragement in different ways. I would like to thank all who have supported me, but this is not practically possible. Therefore, in no particular order, I've tried to list as many of the people who have helped me as I could remember. It is important to me to say thanks. Also, expressing my gratitude in writing is a way for me to never forget all the ways people have helped me and to remember to look for similar ways to help others.

Financial assistance for this research came from three sources: Air Force Surgeon General's Office, Air Education and Training Command, and the USUHS Graduate Education Office.

Many different levels of the EOD School and each service's EOD organization provided wide-ranging support. LCDR Brian Anderson initially championed the study proposal at Indian Head. Two successive Navy commanders ("skippers") of the EOD School supported the study including Capt McLawhorn who gave initial approval of the study proposal and Capt Fraser who provided close support throughout the study development, execution, and completion. Other members of the EOD school staff provided critical support of study implementation and coordination with the students' training schedule including Master Chief Leon Beck and Trish in the training office and Gunner Kurt Desque in the Core and Ground Divisions of Training. In addition, the liaison officers from each service and their staffs provided support gathering demographic data and helping me understand each service's unique policies. LtCol

Mittleman and LtCol Kirchmeier from the Air Force and Maj Bradley and LtCol Stefanovich, from the Army were especially helpful. Also, LCDR Lance Humphrey shared his dissertation research on the ASVAB scores of Navy EOD students.

An unrecognized group is the EOD students who volunteered to participate in the study during a challenging training program, the outcome of which would potentially have serious impact on their military careers.

LtCol Dombrowsky at AF/CESA, the "big daddy" of AF EOD, gave considerable support to the study in interactions involving both the EOD School and AETC.

Maj Anthony Copeland, LtCol Mallarne, and LtCol Roclevich from AETC were instrumental in providing financial assistance and involving me as a behavioral expert of stress and performance in the AETC Integrated Process Team meeting for reducing EOD student attrition.

Various agencies on Eglin AFB provided invaluable assistance. Ms. Jerri Dean, in the Defense Automated Printing Service at Eglin AFB, was the main point of contact for printing all the questionnaires used to collect data. Also, Mr. Tom Dilbert at Troy University coordinated use of testing facilities at the Eglin AFB education office.

The study would not have been the same without the two contractors: Maryann Makekau and Ed Keller, who ran the study at Eglin AFB. I am especially grateful for Maryann's social sensitivity in her work with both the EOD command and the students.

I have been impressed by the generosity of experienced researchers in discussing my research and offering suggestions. These researchers include Dr. D'Zurilla, (State University of NY, Stoney Brook, NY), Dr. Hegge (WRAMC), and Dr. Salas (Orlando,

FL). Also, thanks goes to researchers who gave me permission to use their inventories including Dr. Barkley and Dr. Burlingame.

Various members of the USUHS family provided important support. In the MPS front office, Trish helped me in multiple logistic issues including coordinating military orders for travel, reserving rooms for presentations, acquiring file cabinets for storing data, and generally telling me where to go and who to see in USUHS. Also, Natalie purchased psychological tests and managed my different accounts. In contracting, Sandra Silbergeld dispersed monthly payments to contractors and Terry Zimmerman helped me avoid some sticky contracting issues. Janet Anastasi in GEO provided support coordinating graduate education funding and generally keeping motivated. The REA staff was helpful with all IRB issues and special thanks are due to Dr. Levine (LtCol, ret.) who helped me understand intricacies of the IRB process (including seven changes to the study) and military research. LRC staff members quickly retrieved many of the special order articles found in the reference section. MDL folks were especially prompt and reliable in addressing last minute problems with projectors.

Dr. Kreuger helped in the development of the study in a military environment. Col Moe provided assistance in multiple areas including helping me develop appropriate briefings for flag level officers. Dr. Girasek provided important assistance on conducting focus groups. Dr. Deuster provided advice on stress research and research with military populations.

This study required a lot of statistical assistance. Dr. Wijo Kop bore the brunt of this load with multiple meetings and email correspondence. Also, Dr. Martha Faraday also helped with statistical guidance.

My committee provided invaluable assistance. From beginning to end, their involvement has been constructive and facilitative. One example is the way each committee member was willing to work with me to fit this longitudinal study in the five years allotted to military graduate students. My committee members include Dr. Mike Feuerstein (Committee chair), Dr. David Krantz, Dr. Law, and Dr. Robert Ursano. Dr. Chris Robinson was also a member of my original committee but was unable to stay on the committee because he was transferred to an overseas base.

My previous mentors, Dr. Cathy Colwell, Dr. Greg Meyer, Dr. Brad Schmidt, all have had a unique influence on my development as a psychologist.

A very special thanks goes to my advisor and mentor, Dr. Wendy Law, who helped me continually refocus on the development and application of the complex theoretical model that was developed for this study and who has greatly contributed to my growth as a researcher, clinician, and person.

My classmates at USUHS also provided important support. I am especially grateful for my friendships with Kim Kalupa, John Ashburn, Jeff Cook, Sandra King, Helen Santiago. I am also glad to have been part of the loyal team of AF students including Julie Story, Tracy Mead, Nate Galbreath, and Jay Stone. In addition, Grant Huang (now Dr. Huang) has always made available helpful resources from his work.

Lastly, I am very grateful for the constant support from my family (especially Mom, Dad, and my sister [redacted] and close friends [redacted]). Most importantly, I am grateful for the love and companionship of my children, [redacted] and [redacted] who do their best to understand my absences and make the most of the time that we do have together.

DEDICATION

This project is dedicated to LT Sandra King, my military classmate in the USUHS clinical psychology program. Sandra has been an exceptional Naval officer, clinician, and friend. Her depth of character, personal strength, and dedication is evident in everything she does and has been especially evident in how she has dealt with cancer. It is people like Sandra who make the USUHS clinical program and the military vital.

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LIST OF ABBREVIATIONS

ADHD	....	Attention Deficit Hyperactivity Disorder
AFQT	....	Armed Forces Qualifying Test (composite score of ASVAB)
APA	....	American Psychological Association
AS	....	Anxiety Sensitivity
ASVAB	....	Armed Forces Vocational Aptitude Battery
BPS	....	Biopsychosocial
CI	....	Confidence Interval
E	....	Enduring (temporal dimension)
EOD	....	Explosive Ordnance Disposal
DSM-IV	....	Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition
OR	....	Odds Ratio
PS	....	Problem Solving
R	....	Recent (temporal dimension)
S	....	Situational (temporal dimension)

INTRODUCTION

The relationship between stress and performance is a vital area of study, especially in the context of military operations where stress during performance is often unavoidable. A review of the many effects of stress from a historical and current perspective underscores the importance of focusing on multiple factors that are specific to the interaction between the person and situation in order to improve our understanding of the relationship between stress and performance. A desirable research environment for these purposes would include a relatively standardized situation that provides acute and potent naturalistic stressors and objective performance criteria. The U.S. military EOD training program provides such a research setting. Moreover, the EOD unit has requested this study for the purpose of reducing their student attrition rate, which has been reported to be as high as 32%. Therefore, the research is also truly an applied study.

Importance of Studying the Effects of Stress on Performance

In a review of applied studies of stress and performance, Salas and Driskell (1996) provide three compelling reasons for studying the effects of stress on performance. First, in the contemporary technology-based environment, stress is expected to have a greater than ever impact on performance because of the increased complexity, pace, and potential dangerousness of errors associated with modern occupational demands, which are often directly related to technological advances. Importantly, these same technological changes contribute to greater military capabilities, but often also create increased risks of performance errors and substantial costs attached to those errors.

Secondly, stress can impact performance in unique high-demand situations specific to certain occupations as well as in more common situations that are encountered regularly by all people. Several jobs that have been noted to share high-stress, high-demand performance environments include aviation, military operations, mining, diving, parachuting, bomb disposal, police work, fire fighting, and emergency medicine. Conversely, the performance of routine activities can be adversely affected by common stress-related environmental factors, such as noise, performance pressure, anticipatory threat, time pressure, task load, and group pressure.

Lastly, the effects of stress on individual performance can be significant and wide-ranging. These effects can be manifested physiologically, emotionally, cognitively, behaviorally, and socially. Physiological effects can include racing heart rate, hyperventilation, and trembling as well as more long-term development of stress-related medical disorders and diminished resistance to disease. Frequent emotional reactions to stress are fear, anxiety, frustration, and decreased motivation. Exposure to stress is also associated with several cognitive and behavioral responses such as restricted attention and/or search behavior, decreased vigilance and longer reaction times, and diminished problem-solving ability. Likewise, changes in social interactions may result, including losing the team perspective and decreasing constructive behaviors such as helping. Moreover, prolonged or unusually severe stressors can lead to the development of psychiatric conditions that are defined by specific patterns of these physiological, emotional, cognitive, behavioral, and social responses to stress (Roberts & Dotterway, 1995).

The USS Vincennes tragic shooting down of a civilian airliner in the Persian Gulf evidences an example of the devastating effects that stress can potentially have during the performance of military operations. In a short time span of 4 minutes, after unsuccessfully attempting to verify the identity of an approaching aircraft, the crew of the USS Vincennes made the decision to shoot down the aircraft. The aircraft was later found to be an Iranian airliner carrying 290 passengers and crewmembers. The accident investigative panel concluded that the USS Vincennes equipment was operating correctly and that the ship's crew, who were acting under extreme time pressures and operational stresses, contributed to the accident because of faulty decision-making.

In order to reduce the adverse effects of stress on cognitive performance, such as decision-making, it is important to understand the research developments specific to stress and performance. This review will summarize stress and performance research independently and then will examine the empirical findings involving the relationship between stress and performance.

Review of Stress Research

The word "stress" represents a phenomenon that is commonly referenced, difficult to define precisely, and ultimately very wide ranging and complex. Stress has been variably defined by many operational referents involving both antecedent (stressors) and consequent (response) effects. These include major life events, daily hassles, laboratory cold pressor tasks, and physical exertion tasks on the antecedent side, and physiological, emotional, cognitive, behavioral, and social outcomes on the response side of these events. This variety of meanings associated with the single theoretical construct

of "stress" poses a problem for research because, as Mischel (1969) asserted, theory construction requires the clarification of key concepts. In order to identify and define a unified construct of stress, it is important to understand the historical and current trends in stress theory.

Historical Approaches to Stress Research

Early stress theories were based on simple models that focused on either the environmental stimuli (stressors) that provoked the stress-related response or on the individual's actual physiological response to stressful stimuli (Cox, 1978). Over time, these two single-factor models were combined into a third, integrative model of "stress", which focused on the interactions between characteristics of the person and the environmental context as important contributions to the effects of stress on behavior (Fleming, Baum, & Singer, 1984). In addition to examining the practical factors associated with the person-environment interaction, stress researchers identified important conceptual issues that further enhanced understanding of the stress phenomenon. These conceptual issues involve the nature of the measurement tool (objective and subject-based measures of stress), the subfactor composition breakdown of higher-order factors (e.g., specific factors representing fears of cognitive, physical, and social symptoms within the general construct of anxiety sensitivity, the fear of symptoms associated with anxiety), the examination of different levels of functioning that could be affected by stress (physiological, psychological, social), the temporally-based contributions associated with the duration of person-environment interactions

(sustained/enduring, short-term/recent, acute/current), and the situational specificity of effects from stress (work, home, leisure).

Finally, another important development in identifying and defining the nature of the stress-performance relationship is the current shift towards systems-based and multiple resources perspectives that provide a larger framework for integrating a model of stress that is multi-factorial, multidimensional, and multi-determined across the various levels and dimensions of stress-related constructs. Thus, the field of stress research has moved from simple single factor approaches towards more comprehensive and sophisticated conceptualization of the construct "stress", permitting the consideration of the interactions of the many factors that appear to affect an individual's response to stress and the relationship between stress and performance.

Stimulus Based Approaches

Stimulus based approaches for characterizing stress have focused historically on the role of external stimuli in generating stress responses. In this research tradition, situational variables that are assumed to be aversive are labeled as stressors irrespective of whether exposure to those variables actually results in distress or discomfort (Stokes & Kite, 1994). These situational variables include a wide range of physical, environmental, and social events such as workload, time pressure, temperature extremes, noise, and life events. In fact, because many of these purported stressors are commonly present in military operations, a major emphasis in military stress research has focused on stimulus-based approaches for understanding stress-performance effects.

One notable example of this tradition is the work of two stress researchers, Holmes and Rahe, who studied the health effects of life events. In 1967, Holmes and Rahe created a checklist inventory, the Schedule of Recent Experiences (SRE), which measured the occurrence of life events. Life events were defined as situations that required social readjustment, which was determined by the degree of change that was demanded by a situation, irrespective of the desirability of that situation. Since the development of the SRE, many studies have found a connection between life events and a variety of physical and mental health problems (Brown & Harris, 1989; Dohrenwend & Dohrenwend, 1981).

Another example of a stimulus-based characterization of stress is from research on psychological workload. Psychological workload can be defined as the mental effort needed to perform a job, which is jointly determined by: (1) the number of demands that a task requires; (2) the pace of work or time pressure that a task requires; and (3) the degree of alertness or arousal required by the individual to perform (Repetti, 1993). In addition, the "job-demand/control" model of workload in occupational contexts (Karasek & Theorell, 1990) emphasizes the importance of an individual's level of control or autonomy in determining stress responses. This model suggests that control, which is frequently operationalized as a worker's ability to make decisions at work or to use his/her skills on a job, is a major form of coping with workload demands. Therefore, the model predicts that the joint effects of high demands and low control will lead to higher stress responses.

Response Based Approaches

Response based approaches in stress research have characterized the response that occurs as a result of stress, rather than the presumed stressful situations that generate the response. Stress responses can be widely conceptualized as representing changes in physiological, affective, cognitive, behavioral, and social functioning. However, physiological changes received the most emphasis in early response based approaches, with only recent attention being directed to other response domains.

In early stress research, the physiological impact of stress was investigated primarily from a medical perspective and contributed to the conceptualization and understanding of the nature and characterization of physiological stress responses. Walter Cannon was one of the first scientists to describe physiological arousal as a general characteristic of an organism's response to various stressors. He suggested that the body reacts to stressors in a functional way that maintains homeostasis, in a "coordinated physiological process, which maintain most of the steady states in the organism" (Cannon, 1939, p. 333). Cannon's basic premise that the body and mind work together to seek a homeostatic state can be traced back to Cannon's exposure to Claude Bernard's ideas about the body's "milieu internale" and has been incorporated in many subsequent theories of stress. Cannon (1914) also proposed that release of epinephrine had the adaptive value of providing "power in the attack and in the defense or flight" (p. 275), thus first characterizing the "fight or flight" role of the stress response (Cannon, 1914).

Whereas Cannon's model focused primarily on the role of catecholamines and of epinephrine in particular, an alternative stress response model emphasized the enhanced

activity of the hypothalamic-pituitary-adrenal (HPA) axis. Selye (1936 & 1956) defined the stress response as a general adaptation syndrome (GAS) of nonspecific physiological reactions caused by noxious stimuli. His GAS model of stress postulated that an organism's physiological response to stress progresses through three stages, reflecting an initial alarm reaction, a mid-duration resistance phase, and an end-stage of physiological exhaustion. These three stages illustrated the paradoxical nature of stress responding, in that the physiological systems that are activated by stress can protect and restore the body's resources during short time frames but can damage the body's ability to function after prolonged activation. In this model, Selye identified short and long-term costs associated with stress responses. In the short run, the organism would sustain a metabolic cost, consuming energy resources in order to manage stress. However, after chronic HPA axis activation associated with protracted responses to stress, the body was likely to experience more harmful effects. Selye called these adverse effects the universal triad, which included enlarged adrenal glands, shrunken thymus gland, and bleeding ulcers.

Following these initial classical studies in which physiological responses to stress were identified and described, research concerning stress responses also became an area of psychological inquiry, partly as a result of the recognition of the profound effects of combat stress on soldier operational performance. Researchers began to propose the primary role of psychological factors, such as fearfulness, in the genesis and expression of stress responding. For example, in a study of the combat-related psychological disabilities of Air Force crews, Grinker and Speigel (1945) observed that, "Never in the history of the study of human behavior has it been so important to understand the psychological mechanisms of 'normal' individuals in situations of stress" (p. vii).

In fact, the interest in war-related stress responses contributed to a growing controversy in the stress field between physiological and psychological explanations of stress responses. An early example of this distinction can be found in research that attempted to explain the symptoms associated with different forms of traumatic events. One type of trauma-related stress response was the unexplained symptoms found in railway accident victims. These symptoms were termed "railway spine", reflecting organic theories such as Erichsen's (1882) proposal that these symptoms were caused by concussion or sudden twisting that resulted in damage to the spinal cord. However, Page (1883) countered with a psychological explanation, that the symptoms were at least partly caused by emotional distress. Similarly, during WWI, a debate ensued to explain causes of shell shock, so named because the symptoms were believed to be the result of the concussion of artillery shells. After reviewing 589 cases from WWI, Southward (1919) concluded that the majority of cases had psychological origins.

Conceptual Issues Impacting Stress Research

Stress research has advanced from the early general emphases on single factors (stimuli versus responses, and physiological versus psychological) to more detailed identification and examination of complex conceptual issues impacting stress, independent of whatever general theoretical approach was most preferred. Two categories of conceptual issues that impact the stressor and response relationship have been identified and are thus important to consider when designing and evaluating stress research. These categories include the identification of stress-related factors and the relationship between stress-related factors.

Identification of Stress-Related Factors

Issues specific to the identification of stress-related factors include the selection of measurement tools (objective and subjective reports), the relationship with mental and physical distress, the identification of more specific lower-order components of general factors found to represent both stress moderators and responses (e.g., specific factors representing fears of cognitive, physical, and social symptoms within the general construct of anxiety sensitivity, the fear of symptoms associated with anxiety), the level of functioning examined in relation to stress (physiological, psychological, and social), the temporal-proximity and duration of exposure to stressors or stress conditions (enduring, recent, acute), and the degree of situational specificity within which the stress response occurs.

Objective Versus Subjective Measurement

A fundamental distinction can be made between objective and subjective measures of stress responses. This distinction is important because objective and subjective measures of the same stress response have been found to be independent of each other and to demonstrate independent relationships with other aspects of the stress process. The measurement of arousal illustrates the lack of agreement that can sometimes occur between objective and subjective measures of the same construct. Studies have shown that subjects' reports of perceived arousal correspond poorly with direct measures of their actual arousal levels (Bernstein, Borkovec, & Coles, 1986; Hodgson & Rachman, 1974). Objective measures of arousal are commonly referred to as physiological indices whereas subjective measures are often called somatic anxiety.

Relationship with Mental and Physical Distress

Stress is theoretically related to a wide variety of conditions reflecting mental distress. Stress is probably most commonly associated with common forms of emotional distress including anxiety, sadness, and anger. Stress is also implicated in the development and maintenance of mental disorders. Mental disorders have been conceptualized as a response to an extreme stressor (e.g., by clinical criteria, catastrophic events may result in Post Traumatic Stress Disorder; APA, 1994), a response to cumulative stressors (e.g., life events are a risk factor for Depression; Paykel, 1979), a correlate of ineffective stress coping responses (e.g., problem solving deficits in Depression; Nezu & et al., 1986), and a cause of increased stress responding (e.g., Social Phobia results in increased reported stress levels in social situations; Marks, 1969).

Stress is also typically associated with a variety of symptoms associated with physical distress. Some of these symptoms are associated with panic such as accelerated heart rate, sweating, hot and cold flashes, trembling, dizziness, chest pain, abdominal distress, and choking sensation. Stress is also implicated as an important factor in the development and/or maintenance of a number of adverse physical symptoms and conditions. These conditions include headaches, temporomandibular disorders, sleep disturbances, and irritable bowel syndrome.

Multifactor Composition of Anxiety and Other Stress-Related Constructs

Stress theory has become more precise by determining the factorial composition of stress-related constructs. One example is anxiety, which is often conceptualized as an extension of the "fight or flight" stress response (Barlow, 1988). Researchers have found

that even though the hallmark feature of anxiety is a fearful affect (Lazarus, 1993b), anxiety can be most accurately described in terms of three distinct systems reflected in behaviors, cognitions, and somatic responses (Lang, 1968; Rachman, 1978). In addition, these three systems are often desynchronous because each system's reaction to a stressor is often independent of the reactions of the other two systems (Lang, 1968; Rachman, 1978). Likewise, research has found that stress management techniques can have differential effects on the various systems that characterize the general construct of anxiety (McCann, Woolfolk, & Lehrer, 1987; Schwartz et al., 1978). Therefore, stress research can increase the explanatory power of models involving higher order constructs by investigating the properties and roles of their subfactors.

Dimensional Continuum of Stress-Related Constructs

Non-static aspects of stress and related features can impact findings reported by research because many stress-related factors (constructs) can be conceptualized as phenomena that are expressed along a continuum. This notion of a continuous distribution provides one means for integrating findings from stress and clinical research. There is evidence that some mental disorders and their characteristics are associated with stress and that their primary characteristics may exist on a continuum across normal, subclinical, and clinically diagnosable levels.

Ratey and Johnson (1997) describe evidence for subclinical manifestations of several mental disorders including depression, attention deficit disorder, and obsessive-compulsive disorder. They propose subclinical expressions of these mental disorders represent "shadow syndromes", which can significantly impact a person's responses to

stress and level of functioning. Empirical evidence supports the role of subclinical levels of mental disorders and their associated features. One example comes from research using the State-Trait Anxiety Inventory (STAI). Although the STAI scale can be used to differentiate clinical and non-clinical populations (Spielberger, 1983), the STAI can also be used to predict impaired performance in testing situations with non-clinical subjects along a continuum (Bedell & Marlowe, 1995).

Levels of Functioning

The multiple levels perspective proposes that an accurate measure of stress responses needs to include all pertinent areas of functioning. The biopsychosocial (BPS) approach, which is commonly used in health psychology research, is an example of a multiple levels approach in which an individual's response can be characterized at the physiological (bio), cognitive/emotional/behavioral (psycho) and interpersonal (social) levels. A major premise of the BPS model is that an adequate model of health should address the full range of human functioning including biological, psychological, and social levels of functioning and the various interactions among these dimensions (Engel, 1977). This perspective encourages the identification of a wide range of sub-clinical and clinical stress responses.

Temporal Proximity

In addition to the BPS model's emphasis on multiple levels of response (e.g., biological, psychological, and social) that should be evaluated when examining effects of stress, there are also different temporal proximities that should be considered. Leigh

(1981) created a medical patient evaluation grid (PEG) to demonstrate that each BPS response level could be evaluated in relation to three independent temporal contexts: background (stable/enduring), recent (time limited), and current (situational). For example, when evaluating the psychological functioning of a patient with a medical condition, background elements might include early experience and personality characteristics, recent aspects of psychological functioning might include mood and personality change, and current factors might include mental status and expectations about the medical condition and treatment.

Spielberger's (1966) distinction between trait and state anxiety is a classic example of a temporal proximity distinction. Spielberger defined trait anxiety as a "disposition that predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening and to respond to these with state anxiety disproportionate in intensity to the magnitude of the objective danger" (p. 17). In contrast, state anxiety is defined as "subjective, consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system" (p. 17). Based on the temporal features of Leigh's PEG system, a trait would be characterized as an enduring background variable and a state as a current situational variable.

Other differences between traits and states also can be applied to the distinction between enduring and situational temporal contexts. Fridhandler (1986) provided four criteria for differentiating between traits and states: temporal duration, continuous versus reactive manifestation, concreteness versus abstractness, and personal causality versus situational causality. First, and as already discussed, the most generally used distinction

is that traits represent temporally enduring features of the individual and states reflect more transient conditions. Second, traits are not expected to be continuously manifested, but rather are likely to manifest in reaction to some instigating event. In contrast, states are continuously expressed for as long as they are being acutely experienced. Third, traits (e.g., self-confident disposition) must be inferred because traits represent theoretical constructs that are not directly measurable. In contrast, states can be directly accessed through introspection or observation (e.g., self-confident beliefs in a specific context). Finally, traits are presumed to be the product of distal and complex person-specific causal factors. In contrast, states are conceptualized as being a reflection of immediate situational factors and as mediating the effects of these factors on behavior.

In a review of personality research that had been conducted over 50 years, Mischel (1968) concluded that situational factors predicted behavior better than most trait variables. Subsequent research has also indicated that behavior is more strongly associated with situational factors than trait-like variables. For instance, McCrae (1984) found that stress management coping behavior varied according to the situational context. Likewise, situation-specific variables have been found to be better predictors than trait-like measures of test anxiety (Sarason & Stoops, 1978). Therefore, there is evidence for the value of considering both trait and state factors in psychological models.

Relationships Among Stress-Related Factors

The nature of the relationships among stress-related factors is equally important to the identification of these factors. These conceptual developments can be categorized as

focusing on the interactions between person and context variables or the homeostatic relationships among all the variables within a system.

Person-Context Interactions

The models of person-context relationships emphasize the importance of pre-existing factors in interaction with contextual (situational) factors. These pre-existing factors represent either traits or cognitive beliefs. Contextual interactions with each of these factors emphasize the importance of considering the interaction between person and state variables, however they propose different types of interactions between the person and state factors. The trait/state interactional models propose that the state factors act as stimuli that activate a latent trait factor. In contrast, the transactional model proposes that situational factors are appraised by pre-existing beliefs to determine responses.

Trait and State Factors. The interaction between trait and state variables has been proposed to be an essential aspect of describing psychological phenomena such as the stress response. For example, Mischel and colleagues (Mischel, Ebbesen, & Zeiss, 1973) proposed personality psychology should focus on interactions between traits and state conditions because the influence of traits on behavior often depends upon state conditions. Others have similarly suggested that traits are interactive constructs because they represent a tendency to respond to certain, but not all, situational stimuli in characteristic ways (Lykken, McGue, Tellegen, & Bouchard, 1992; Tellegen, 1981). This opinion is also consistent with Allport's (1937) earlier statement that "traits are often aroused in one type of situation and not in another; not all stimuli are equivalent in

effectiveness" (p. 331). Therefore, the role of trait and state factors may not be clear unless their interaction is considered.

Transactional Model. Transactional models also emphasize the interaction between the person and the environment. These models focus on belief-based cognitive appraisals of specific situations. Further, this interaction is conceptualized as primarily a cognitive process in which a person perceives and evaluates a specific situation. The necessity of considering the situational context is consistent with the studies that have indicated the importance of the situational context in determining behavior. Cognitive belief-based models also emphasize the importance in stress research of cognitive mediation (e.g., appraisal) and the resultant consequences, such as the choice of coping responses (e.g., problem or emotion focused).

Largely due to a general dissatisfaction with both the stimulus and response-based models, McGrath (1976) advanced a relational perspective that defined stress in terms of perceptions of demand, ability to cope, and importance of coping to the individual. Likewise, Cox and Mackay (1976) presented a cognitive belief-based model of occupational stress that proposed that stress responses were the result of an imbalance between an individual's perception of situational demands and the individual's perception of his/her capabilities to meet those demands.

The most common cognitive belief-based model is the transactional model that is associated with the work of Lazarus and his colleagues. The transactional model emphasizes the importance of the "transaction" that occurs between the person and any given situation. Originally, Lazarus (1966) proposed that a stress reaction occurs when

an individual evaluates a situation as some form of threat. Later, Lazarus and colleagues (1977, 1980) added that appraisals of harm/loss and challenge, in addition to threat appraisals, would also generate a stress reaction (Folkman & Lazarus, 1980; Monat & Lazarus, 1977).

Lazarus and Folkman's (1984) transactional model is based on the primary importance of the cognitive processes of appraisal of situational problems and the selection of coping mechanisms. Appraisal reflects the process of evaluating the meaning of a stimulus, while coping represents cognitive and behavioral efforts to manage psychological stress (Lazarus, 1993a; Lazarus & Folkman, 1984). Lazarus and Folkman's (1984) model has provided one of the most widely used definitions of stress as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (p. 19). In Lazarus and Folkman's transactional model, the appraisal stage is conceptually separated into primary and secondary appraisal processes. Primary appraisal involves an evaluation of the degree of threat posed by a stimulus. Secondary appraisal is an evaluation of capability or resources to cope with the threat.

Systemic Relationships

In addition to the two-factor person-context interaction relationships, systemic theories emphasize the importance of dynamic relationships among multiple factors. The systemic approaches focus on the interaction among many variables to manage limited resources (e.g., energy or attention) for pursuing some end goal. For example, a person struggling with a cognitive task may exert high levels of energy to compensate for limited

attentional resources. The focus is on a system of factors, which can be defined as a "group of interacting, interrelated, or interdependent elements forming a complex whole" (American Heritage Dictionary, 1982, p. 1234). Models that are systems oriented typically share several features. These features include the involvement of all units that are part of a functional system, the relationships among these variables both in terms of self-regulatory and goal pursuit processes, and the feedback mechanisms that play a central role in these processes.

A hallmark feature of systems theory is that a system can include many different variables. Moreover, in psychological and medical applications, systems models incorporate multiple variables from many levels of functioning (von Bertalanffy, 1968). As an example, Engel's (1977) formulation of the BPS model has been hailed as the first application of the systems theory to medicine (Schwartz, 1982; Schwartz, 1983). The BPS system includes multiple physiological variables (heart rate, respiration, perspiration, and muscle tension, psychological variables (knowledge, skills, beliefs and thought processes, and emotions) and social variables (relationships with family, friends, coworkers, and bosses).

Another central defining feature of a system is that the elements in a system are functionally related around common goals (Wiener, 1961). One example of a physiological system is the cardio-respiratory system whose components (e.g., lung, heart, veins) work together to supply the body's cellular structure with nutrients and to expel waste products. Therefore, instead of focusing on the relationship between a variable and an outcome in isolation, a systems-based model also focuses on variables in a system interacting in the pursuit of goals.

The pursuit of goals in a system is accomplished through ongoing self-regulatory processes (Wiener, 1961), much of which involves feedback between different components within the system and the overall system environment. Self-regulation refers to a control process by which the units within a system continuously interact and adjust to achieve a desired level of functioning. A central mechanism of self-regulation is the utilization of feedback about the system's current status in relation to the goal. A common example of this feedback process is a thermostat, which constantly compares ambient and desired temperature. If the ambient temperature is less or more than desired, then the thermostat directs the heater to turn on or off respectively. Key features of these self-regulatory processes are that feedback and comparator processes can influence behavior and the system seeks to preserve a particular state of balance or homeostasis.

Information processing models. Information processing models focus on the management of limited cognitive processes such as attention and memory in determining responses to environmental stimuli and how these processes are affected by stress.

Research on attentional processes frequently investigates attentional biases, which are irregularities in how a person attends to information in their environment. Studies have found considerable evidence that attentional biases exist in nearly every anxiety disorder and in people who generally have elevated levels of anxiety (see reviews by Mathews & MacLeod, 1987; Mathews & MacLeod, 1994). For example, trait anxiety is also associated with the tendency to be hypervigilant, which can result in increased distractibility to neutral cues (Eysenck & Byrne, 1992; Fox, 1993). In addition, Mogg and Bradley (1998) have proposed an information-processing model of anxiety in which

trait anxiety determines whether attention is directed towards or away from a stimulus that is perceived as threatening.

Energetic models. Systemic models also often include the role of energetic variables, which represent a system's capacity for action. Therefore energetic variables constitute resources necessary for functioning. However, energetic resources are in limited supply and the allocation of these resources has important short and long-term implications. In the short run, these resources can potentially be traded for increased performance. These resources also can be used as part of an adaptive compensatory process to supplement resource limitations in other parts of the system, which is consistent with the premise of systemic models that an entire system reacts in a coordinated fashion to achieve a goal (meet a demand). However, the extended use of these resources also involves a systemic cost that accumulates and may have detrimental effects in other aspects of system functioning. The idea that there are systemic costs that may be minimal in the short run, but adversely affect system functioning in the long run is consistent with the exhaustion stage of coping in Selye's general adaptation model.

Schonpflug (1983, 1986) has presented a resource model that is largely based on an integration of transactional and systemic models. In his model, stressors represent demands on the system that are conceptualized as non-optimal conditions or problems resulting from interactions between an individual and the environment. Likewise, stress responses reflect goal-directed activities to try to meet the demands. In addition, he posits that stress responses are primarily composed of two functional modes of responding to problems, represented by orientation and control processes. Orientation

refers to problem solving processes that are directed towards analyzing the problem and devising problem solving strategies. In contrast, control processes reflect the execution of problem solving activity.

Schonpflug (1983, 1986) proposed that both orientation and control processes are associated with psychological costs and benefits. A key issue in self-regulation is maintaining an optimal balance between these costs and benefits, which he described as a matter of economic efficiency. The benefits are the elimination of threats and challenges, which are the more obvious outcomes of coping efforts. In contrast, the costs are the psychological resources that are expended when employing coping efforts. For example, effort (activation) can be used to increase an individual's baseline capacity (capabilities) by energizing additional resources, but exerting this effort also is associated with various psychological costs (exhaustion of internal and external resources and deterioration of physical and mental health). Thus, Schonpflug's model is unique in that it focuses on the efficiency of coping efforts and the systemic costs associated with orientation and control processes.

Schonpflug's resource model has several important implications for the study of stress. First, the management and replenishment of energy is an important aspect of the stress process because energy is a critical and limited resource that is rapidly consumed (Schonpflug, 1986). In addition, people can successfully compensate for higher demands in the short term, but may work beyond their capacity over extended periods of time (Frankenhaeuser & Gardell, 1976). Lastly, people may also over-extend themselves if they do not take part in activities that are likely to restore their energy resources (e.g.,

proper rest, diet, exercise, or social activities). In this way, inefficient management of resources (over use or under replenishment) can lead to increased stress.

Summary of Stress Research Review

Stress research has advanced from its earliest emphasis on single stimulus or response factors by incorporating an increasing specificity in the identification of multiple stress-related factors and the relationships among these factors. The main advances in the identification of stress-related factors involves the recognition of contributions from the selection of measurement tools (objective and subjective reports), the relationship with mental and physical distress, the identification of more specific lower-order components of general factors found to represent both stress moderators and responses (e.g., specific factors representing fears of cognitive, physical, and social symptoms within the general construct of anxiety sensitivity, the fear of symptoms associated with anxiety), the level of functioning examined in relation to stress (physiological, psychological, and social), the temporal-proximity and duration of exposure to stressors or stress conditions (enduring, recent, acute), and the degree of situational specificity within which the stress response occurs. In contrast, the primary conceptual developments regarding the relationships of these stress-related factors include interactions of traits and beliefs with state variables as well as systemic relationships between all stress-related factors that focus on the management of limited resources like information processing and energy. All of these conceptual developments can be applied in the research of any stress-related phenomena.

Review of Cognitive Performance Research

Performance effects have been proposed to represent an important aspect of the stress process (Baum, Grunberg, & Singer, 1982). Similar to the general area of stress research, early research on cognitive performance effects from stress focused primarily on stress as a single representation of arousal. However, subsequent research on performance found that the relationship between stress and performance was more complex and affected by many different types of stressors (e.g., noise, social evaluation), stress responses (somatic and cognitive anxiety), and measures of performance (primary and secondary cognitive tasks). Because the nature of the performance task in this study has primary cognitive demands, this review will focus on cognitive performance aspects of stress unless otherwise indicated. The review of cognitive performance research includes studies in many contexts that involve cognitive tasks and skills, including academics, athletics, and experimental research. In addition, a review of the development of cognitive performance theories reveals a pattern of conceptual issues affecting the scientific study of performance that are similarly complex to those reflected in stress research. These conceptual issues include the importance of evaluating contributions from multidimensional factor constructions (e.g., anxiety and attention) and of examining both cognitive content (e.g., beliefs and attitudes) and cognitive processes (e.g., attention and memory) aspects of performance. Thus, as with theoretical models of stress, the cognitive performance theories have moved from more simplistic models to become increasingly multivariate and systemic.

Basic Findings in Performance Research

The study of the effects of stress on performance got an early start. Classic research by Yerkes and Dodson (1908) indicated that a moderate level of arousal (stress) is important for optimal performance and that too little or too much arousal can adversely impact performance, which is commonly referred to as the "inverted U" effect. In addition, the optimal level of stress seems to be lower for more complicated and novel tasks or problems. Therefore, more complicated tasks are predicted to be more sensitive to the performance-disrupting effects of stress. This theory of stress and performance has remained popular to this day.

The "inverted U" theory also provided a basis for the development of alternative theories, as critiques of the inverted U theory led to the development of new theories. A basic criticism is that the inverted U theory is ultimately untestable because the position on the inverted U curve can only be specified after an experiment (Koelega & Brinkman, 1986). The inverted U theory has also been criticized for failing to predict performance, account for the multidimensional nature of anxiety, or provide a theoretical mechanism for the relationship, as well as for a variety of methodological and statistical problems (Gould & Krane, 1992; Jones, 1990; Neiss, 1988; Weinberg, 1990). For example, in a review of data concerning the inverted U relationship between arousal and performance, Naatanen (1973) concluded that the descending curve of the inverted U was an artifact of distraction from other sources of stimulation and inappropriate experimental conditions. Naatanen (1973) also proposed that if a person can maintain attention on the task-relevant stimuli, then performance under increasing arousal will continue to increase, but at a decreasing rate.

In contrast, stress in the form of subjective anxiety has been found to consistently have an adverse effect on performance. For example, a meta-analytic review of 126 studies of academic performance found an overall effect size of $r = -.21$ with anxiety (Seipp, 1991). Similarly, a meta-analysis of 50 studies of athletic performance reported a weighted mean of all correlations between anxiety and sport performance of $r = -.19$ (Kleine, 1990). It is important to note that these effect sizes suggest that anxiety explains less than five percent of the variance in performance. However, certain factors have also been identified that moderate the strength of the relationship between anxiety and performance.

Both meta-analyses found similar theoretical and methodological factors that influence the relationship between stress and academic performance. One theoretical factor was the degree to which measures of anxiety contained items that were related to cognitive anxiety (e.g., worry) as opposed to emotionality. A second theoretical factor was the degree that anxiety measures were specific to a situation instead of generally applicable (e.g., test versus general anxiety). In addition, methodologically, post-performance measures of experienced anxiety were superior to pre-performance measures of anticipatory anxiety in finding a relationship between anxiety and performance.

Laboratory studies also support an inverse relationship between levels of anxiety and performance. In general, anxious individuals are more likely to demonstrate performance deficits involving more complex tasks and less detrimental effects on performance of simple motor tasks (see Eysenck, 1982 for a review). Anxiety-related performance deficits also have been found in specific areas of cognitive performance,

including reasoning ability (e.g., Leon & Revelle, 1985); verbal skills (e.g., Zarantonello, Slaymaker, Johnson, & Petzel, 1984), mathematical operations (e.g., Calvin, Koons, Bingham, & Fink, 1955), and memory functions (e.g., Darke, 1988; Knox & Grippaldi, 1970; Mueller & Overcast, 1976).

Finally, research has shown that attentional processes, which are a fundamental component of cognitive abilities, are affected by stress. An early example is from Easterbrook's (1959) review of research findings concerning the effects of arousal on the "range of cue utilization", which is the "total number of environmental cues that an organism observes, maintains an orientation towards, responds to, or associates with a response" (p. 183). Easterbrook concluded that anxiety is associated with a "cue restriction" or a narrowing of attention. Similarly, Hockey (1970) found that when stress is applied to tasks that require monitoring signals, attention narrows to the location of signals with the highest probabilities. Stress has also been found to be associated with an increased neglect of peripheral signals (Bursill, 1958; Davies & Tune, 1969). Therefore, we should expect stress to interfere with complex cognitive tasks requiring attention to a wide range of cues.

Conceptual Issues Impacting Performance Research

There have been a variety of conceptual issues that have been critically important in the continued progression of research on the effects of stress on cognitive performance. Many of these issues parallel the conceptual distinctions that have been made in stress research including multifactorial composition of anxiety and other performance-related constructs, dimensional continuum of performance-related constructs, temporal

proximity, and systemic interactions among variables. In addition, other issues are more unique to the study of cognitive performance such as information processing concepts, cognitive interference, cognitive efficiency, task demands, and performance outcomes.

Multifactorial Composition of Anxiety and Other Performance-Related Constructs

Multidimensional anxiety models of performance emphasize the difference between the cognitive and somatic dimensions of anxiety and their effects on performance. In addition, the physical aspects of anxiety are differentiated as either objective measures of physiological arousal or subjective reports of somatic anxiety. The multidimensional anxiety models propose that cognitive and somatic anxiety have different relationships with performance and that cognitive anxiety (worry) is the critical dimension of anxiety that impairs performance.

Liebert and Morris (1967) first proposed worry (cognitive anxiety) and emotionality (physiological anxiety) as the two main components of test anxiety. They described worry as a concern about the consequences of failure. In contrast, the emotionality component of anxiety might have been better labeled as somatic anxiety because it primarily referred to the subjectively reported physiological changes associated arousal of the autonomic arousal system, with little attention to emotional feelings. In subsequent research, Liebert and Morris (1969) found that cognitive anxiety was associated with impaired performance and somatic anxiety was associated with little or no performance decrements.

Some multidimensional models of anxiety also propose that both cognitive and somatic anxiety affect performance. Cognitive anxiety is predicted to have a negative

linear relationship with performance whereas somatic anxiety is expected to have an inverted U relationship with performance (Gould & Tuffy, 1996; Martens et al., 1990). Several studies, using polynomial regression analysis, have found some evidence supporting these differential relationships between the two dimensions of anxiety and performance (Burton, 1988; Gould, Petlichkoff, Simons, & Vevera, 1987; Gould, Petlichkoff, & Weinberg, 1984).

Dimensional Continuum of Performance-Related Constructs

Performance-related constructs can be expressed along a continuum. For example, attention is conceptualized along a developmental and functional continuum. As early as 1890, William James noted that attention was a critical aspect of normal development without which experience would be "utter chaos". Experiments involving visual and auditory stimuli that should be ignored have found that children are more vulnerable than adults to distraction (Comalli, Wapner, & Werner, 1962; Doyle, 1974). Likewise, the clinical expression of attention deficit hyperactivity disorder (ADHD) is a childhood attention-related disorder that often extends into adulthood and that is generally an extreme form of inattention and impulsivity observed in childhood.

Temporal Proximity

The distinctions between enduring, recent, and situational temporal proximities are typically framed as trait versus state differences. For example, studies have described attention as primarily a stable trait or a situational state phenomenon. Nideffer (1976) hypothesized that individuals demonstrate a particular attentional style that is consistent

across situations and time (enduring trait). The key dimensions of this attentional style are narrow-broad and internal-external focus. In addition, he proposed that an individual's specific attentional style might be more or less effective depending on performance tasks and situational context. Similarly, several researchers have suggested that distractibility may be an important trait-related individual difference variable affecting capacity (Alting & Markham, 1993; Dornic, 1977; Easterbrook, 1959; Pallak, Pittman, Heller, & Munson, 1975).

In contrast to the trait conceptualizations of attention, other theorists suggest that transient state conditions play the major role in determining situational attention. For example, Wine (1971) proposed that worry, which is an emotional state, impairs cognitive performance by distracting attentional resources from the target processing task. Likewise, the perceived availability of social support has been found to reduce the effects of cognitive interference on performance (Goldsmith & Albrecht, 1993; Sarason, 1981; Sarason, Sarason, & Shearin, 1986).

Systemic Interactions Among Variables

As with stress research, systemic resource models have also been developed to explain the relationship between stress and performance. The systemic models in performance research emphasize the same key types of interactions between variables with an increased focus on compensatory control mechanisms that involve systemic tradeoffs.

Kahneman's (1973) model is one of the earliest and most cited resource models. He proposed that the regulation of goals and actions depends on a compensatory control

mechanism that dynamically allocates resources. Effort is a critical energetic component in the model because it is used to increase the capacity of cognitive resources. The amount of effort devoted to a particular cognitive function is modulated by either increasing the total amount of effort in the system through an increase in total effort expended or redistributing where effort is being allocated within the system. However, increased effort is also postulated to be associated with systemic costs such as sympathetic activation.

Hockey (1997) proposed a cognitive-energetic model that is largely based on Kahneman's (1973) model. The model proposes that self-regulatory and motivational factors determine the allocation of energetic (effort) resources, and that the regulatory activity incurs systemic- and performance-cost tradeoffs. His main premise is that information-processing models must integrate the contributions of energetic processes in order to fully account for the variability of human performance under stressful conditions. Also, in contrast to more traditional activation theories that characterize energetic processes as solely responses to stimuli (Duffy, 1962; Malmo, 1959), Hockey's model suggests that energetic resources are systemically controlled and allocated by self-regulatory mechanisms. Thus, the model presumes the role of motivational control of action in which: (1) behavior is primarily goal-directed; (2) self-regulatory processes are used to control the pursuit of goal states; and (3) regulatory activity results in costs to other parts of the system.

Hockey's (1997) model is especially concerned with explaining the effects of stress on performance across a comprehensive systemic level. His model proposes that goal-directed performance under stress can be protected in two ways: (1) by recruiting

other energetic resources, which results in costs that can be expressed emotionally, behaviorally, or physiologically; or (2) by reducing the performance goals. Therefore, performance may not be impaired under stressful conditions because of the redirection of resources. However, the redirection of resources may involve certain costs that include: (1) indirect effects on performance that include the impairment of peripheral tasks and the use of less efficient strategies; and (2) an elevation of psychophysiological activation, distress, and fatigue that is associated with sympathetic dominance and adreno-medullary activation (Frankenhaeuser, 1986; Kahneman, 1973).

Sergeant's (2000) theoretical model of stress and performance in ADHD provides a comprehensive description of potential interactions among cognitive and energetic factors and their effect on performance. This model is based on a cognitive-energetic model of stress and performance proposed by Sanders (1983) and integrates the role of cognitive capacities, energy resources, and self-regulation. The model proposes that ADHD symptoms may reflect deficits at three levels of functioning: basic cognitive capacities (encoding, central processing, and response organization), energetic factors (arousal, activation, and effort), and executive self-regulatory functioning (inhibiting behaviors, planning, and organizing). Because ADHD represents an extreme along a continuum of normal attentional functioning, attentional difficulties in people without clinical attentional disorders also would be associated with disregulation among these three levels of functioning.

Information Processing Concepts

The cognitive variables in performance research are primarily information

processing concepts, which take a larger role in performance models than stress theory (e.g., Humpreys & Revelle, 1984; Kahneman, 1973; Kanfer & Ackerman, 1989; Revelle, 1987; Sanders, 1983; Sergeant; 2000). Important information processing concepts include resources and demands, capacity, and controlled and automatic processing.

Resources and Demands

Distinguishing between factors specific to the person and situation represents one conceptual issue, which is often simplified to the distinction between resources and demands (Kahneman, 1973). Resources are equivalent to the capacity or ability of the individual to process information. In contrast, demands are largely a reflection of the amount of information processing required by a task.

Limited Capacity

A central notion of many performance theories is that people have limited information processing capacities, which determines how much information they can handle at one time. A central assumption underlying capacity theories is that there are one or more pools of general purpose processing (cognitive) resources. These pools are used for performing basic cognitive operations and require energy (effort) to operate. A second main assumption is that when cognitive tasks are more demanding (a task is difficult or dual-task interference exists), then the limited capacity (scarcity of resources) of a system may impact performance of the task.

Attention and memory are two commonly referenced information processing domains with presumed finite cognitive capacities. These cognitive domains can each be

conceptualized as involving multiple functional dimensions. For example, Posner and Boise (1971) postulated that attention involves three interacting processes: selection (or focus), capacity, and alertness. Likewise, memory has been categorized as consisting of sensory, short-term, and long-term memory, each with its own distinct capacity (Cowan, 1988).

Capacity is partly seen as a product of different dimensions of cognitive ability and the ways that those dimensions are used. The different historical characterizations of attentional capacity illustrate various perspectives that have been put forth regarding the capacity of a cognitive ability construct. Fixed-capacity theories of attention (e.g., Broadbent, 1958; Norman, 1969) proposed that capacity is finite and does not change, remaining constant across different tasks. In contrast, undifferentiated-capacity theories (e.g., Kahneman, 1973) propose that capacity is a flexible but limited resource that can be channeled across tasks and changes according to task demands. Multiple resource theory (e.g., Navon & Gopher, 1979; Wickens, Kramer, & Donchin, 1984) represents a more sophisticated explanation of attentional capacity, suggesting that there are pools of resources that have independent capacities for information processing. The pools of attention resources are explained using a metaphor of multiple fuel reservoirs that power attentional processes. These fuel reserves can be described according to stimulus characteristics (auditory vs. visual), internal code (visual vs. verbal), and response mode (manual vs. verbal) (Wickens, 1984).

Controlled and Automatic Processing

Schneider, Dumais, & Schiffrin (1984) described a critical difference between

two basic processing types: controlled and automatic. Controlled processing is used to address tasks that are novel or that involve inconsistent information. This type of processing is generally conscious, active, effortful, and capacity limited. In contrast, automatic processing is associated with learned skills that are not under conscious control and are faster and more effortless than control processing. Therefore, when examining factors that affect cognitive performance, it is important to determine whether a performance task involves novel demands or well-learned skills.

Cognitive Interference

The cognitive interference model, one of the most popular and well-supported models of stress-related performance effects, focuses on the role of cognitive anxiety (Sarason, Pierce, & Sarason, 1996). The basic premise of the cognitive interference model is that some thoughts and thought patterns associated with worry intrude on and interfere with available resources that would otherwise be available for task performance (Sarason, 1972; Sarason, 1975; Wine, 1971).

Models of self-focused attention (e.g., Carver & Scheier, 1981) are a form of cognitive interference models. Self-focus is described as a "state of information processing in which one is especially attentive to some aspect of the self or to the self-relevance of information received from the environment" (Wood & Dodgson, 1996, p. 232). There are two categories of effects associated with self-focus. The first is an increased responsiveness to the aspect of the self that has become the center of attention (focus). Researchers have found that self-focus can accentuate moods (Scheier & Carver, 1977) and improve perceptiveness of bodily sensations (Gibbons, Carver, Scheier, &

Hormuth, 1979). The second effect associated with self-focus is an increased tendency to behave in accordance with personal standards. This effect is conceptualized as a function of self-regulation and self-evaluation processes. For instance, self-regulation is the process of comparing one's current state with goals or standards.

Carver and Scheier (1988) used self-focused attention as a core feature of a self-regulatory model of test anxiety. The model proposed that individuals have distinct cognitive structures (self-schemas) related to testing situations and these self-schemas affect how individuals process information in a testing situation. Test anxiety is conceptualized as a process where more attention is directed to the self-schemas regarding test-taking and to cues that are related to negative beliefs associated with the test-taking process. Therefore, less attention is allocated for effective task engagement.

It is important to note that self-focus has been examined as both a trait and state phenomenon. Researchers have likened self-focus to "self-consciousness", an individual difference variable that reflects a general level at which a person tends to be self-focused (Fenigstein, Scheier, & Buss, 1975). However, studies have also shown that self-focus varies according to changing situational factors. For example, the degree of self-focused attention can be manipulated by the use of stimuli (e.g., mirrors) that remind a person of the self (Carver & Scheier, 1981).

Cognitive Efficiency

Eysenck and Calvo (1992) proposed a processing efficiency theory, in which worry affects performance by: (1) reducing both the passive storage and active processing capacity components of working memory (Baddeley, 1986; Baddeley, 1992); and (2)

increasing on-task effort and activities designed to improve performance. This theory makes an important distinction between performance effectiveness and efficiency of performance, where efficiency is equal to performance effectiveness divided by effort. This distinction is important because worry is theoretically associated with an increase in on-task effort and activity. Therefore, examination of effectiveness alone may not reveal the impact of worry on performance, because decrements are more likely to be evident in performance efficiency.

Task Demands

Performance research assesses the demands associated with a task and the context in which the task occurs. Task demands are generally defined by the amount of information processing required to finish a given task or the amount of information processing resources (e.g., attention and memory) that are utilized when performing the task. Contextual elements associated with a task, such as noise, social evaluation, and subjective responses to a task, can also affect the performance of a task.

One example of how task demands are defined is Revelle's (1987) three categories of task demands, which are based on the type of cognitive resources required to complete a task. These three types of demands include sustained information transfer (SIT), short-term memory (STM), and long-term memory (LTM). SIT is the degree that tasks require subjects to actively process sensorial information with minimal memory resources required. Note that SIT tasks typically require a sustained readiness to respond, but are associated with minimal requirements for retention of information and amounts of distraction. In contrast, STM requires retention of information over short periods of time.

Similarly, LTM is the amount of previously learned material that must be recalled in order to complete a task.

Contextual Demands

In contrast to the demands associated with the task, there can also be contextual demands such as subjective responses to the task. Anxiety is an example of subjective response to a task that can affect performance before and during a task in academic (Hembree, 1988), athletic (Burton, 1988), and organizational (Motowildo, Packard, & Manning, 1986) contexts. Moreover, anxiety can be associated with different aspects of a task such as social evaluation (Turner, Beidel, & Townsley, 1992) or fears about injury or death, such as might be experienced during a hazardous activity like parachute jumping (Idzikowski & Baddeley, 1987).

Performance Outcomes

Performance research has gained a more fine-grained analysis of stress-related performance effects by evaluating the performance of secondary tasks in addition to the primary tasks (e.g., Finkleman & Glass, 1970). Consideration of both secondary and primary task performance outcomes has greatly enhanced development of more comprehensive and integrated performance models for explaining the effects of stress. In addition, understanding and identifying the impact of stress on performance is also enhanced when performance is evaluated not only by outcome, but also by the efficiency with which the task is completed. Efficiency considerations include the time it takes to accomplish a task, the number of errors made, and the time expended.

Summary of Cognitive Performance Research Review

This review indicates the important role of stress-related factors in cognitive performance research. The core themes from this research are that anxiety as a form of stress affects performance, the effects of stress on attentional processes have a central role in cognitive performance, and complex cognitive tasks are the most susceptible to the effects of stress. There are also multiple conceptual issues that have been critically important in the continued progression of research on the effects of stress on cognitive performance. Many of these issues parallel the conceptual distinctions that have been made in stress research including multiple dimensions of anxiety and systemic interactions among variables. In addition, other issues are more unique to the study of cognitive performance such as information processing concepts, cognitive interference, cognitive efficiency, task demands, and performance outcomes.

These issues highlight the importance of specificity when considering the types of anxiety (cognitive versus somatic), cognitive resources likely to be utilized (sustained information transfer, short-term memory, long-term memory), performance outcomes (primary versus secondary tasks), and how these factors are likely to interact. Another important point is that task performance is often directly related to cognitive resources (e.g., attention), which are both finite and sensitive to stress. Therefore, the interactions among the factors are especially important to consider because these interactions may involve a variety of systemic tradeoffs. On examples is when the limits imposed by finite resources and adverse effects of stress are temporarily compensated by other factors (e.g., increased energy expenditure) only at a long-term cost (e.g., increased likelihood of fatigue and other forms of affective distress).

Empirical Findings in Stress and Performance Research

A study of stress and performance not only requires examination of stress and performance theory, but also empirical evidence for specific factors that have been found to affect the relationship between stress and performance. Literature from many disciplines suggests that there are key physiological, psychological, and social factors that are related to performance and other responses during and following stressful circumstances. The factors that are relevant to the relationship between stress and performance are organized according to three major relational dimensions: temporal duration (enduring, recent, and situational), location (internal and external), and modifiability.

The temporal duration scheme distinguishes between enduring, recently developed, and situationally-specific variables (Leigh & Reiser, 1981). The main characteristic of these temporal distinctions is based on the duration of both the stressors and stress responses. Enduring variables are expected to represent relatively stable characteristics of a person, similar to that of a trait. Recent variables (e.g., general mood symptoms) refer to conditions and contributing factors that exist beyond the immediately acute situation (at least a day), but that have not yet become an enduring characteristic of a person. Finally, situational variables are associated with a specific situational context, which is parallel to the definition of a state (e.g., current mood state).

The second relational dimension distinguishes between internal and external variables, where internal variables represent factors that arise within the individual and external variables arise from the environment. External variables are especially

important because they include situationally-specific demands that frequently lead or contribute to the stress responses.

Variables that impact the stress-response relationship can also be classified as modifiable or non-modifiable. Modifiable variables are conceptually reactive to environmental influences and likely to be amenable to change. In contrast, non-modifiable variables are considered to be stable characteristics that are not likely to change. The pragmatic importance of the distinction between modifiable and non-modifiable variables is that modifiable risk factors are suitable targets for brief interventions whereas non-modifiable risk factors are more useful as screening criteria.

The following review of evidence for the role of specific biopsychosocial and environmental factors in the relationship between stress and performance will be organized primarily according to enduring, recent, and situational temporal categories. These temporal categories will contain factors that represent internal characteristics of person (e.g., cognitive ability) as well as external factors from the environment (e.g., major life events and daily life problems). Likewise, the temporal categories will also include non-modifiable factors (e.g., cognitive ability) and modifiable factors (e.g., problem solving skills).

Enduring Factors

Enduring factors include both external major life changes and a variety of internal abilities, beliefs, and attitudinal variables. Ability has been defined as a set of mental and motor skills that remain stable over time (Schonpflug, 1983). In addition, this study posits that some beliefs and attitudes are enduring characteristics of people and are the

central dimension underlying long-standing features represented by personality and trait anxiety.

The findings from studies suggest that following enduring factors affect the relationship between stress and performance: major life changes, general cognitive ability, anxiety (general anxiety, performance anxiety, and anxiety sensitivity), inattention, impulsivity, personality (conscientiousness and neuroticism), and problem solving (abilities, beliefs, and attitudes).

Major Life Changes

Holmes and Rahe (1967) defined social readjustment by the degree and duration of change required to respond to a life event, regardless of whether the event was desirable or not. Therefore, life events or changes included negative events like "death of a loved one" and "job loss" as well as more positive events like "getting married" and "going on a vacation". In addition, different events were expected to have different social readjustment demands, so the events were assigned different weightings called 'Life Change Units' (LCUs) and a total cumulative 'life change score' could be calculated for a given period. Based on this conceptualization of social readjustment, LCU scores from a 12-month period were inversely related to health (Holmes & Masuda, 1974).

A wide assortment of research indicates that there is a small but significant relationship between life events that require social readjustment and mental and physical health (for a review, see Rabkin & Struening, 1976). Negative life events have been associated with many forms of adverse psychological responses to stress (e.g., anxiety,

depression, and posttraumatic stress responses; Lin & Ensel, 1984; Slusarcick, Ursano, Fullerton, & Dinneen, 1999). A common presumption is that social relations attenuate the relationship between adverse life events and biopsychosocial distress (Holahan & Moos, 1981).

There is also evidence that life events are related to poor task performance. Levenson and colleagues (1983) reported that employees who had had industrial accidents often had been subject to life changes before the accident (Levenson, Hirschfeld, Hirschfeld, & Dzubay, 1983). Likewise, Alkov (1980), a naval psychologist who studied naval aviation, proposed that the life changes that presumably influence a person's health status, might also affect performance negatively (Alkov & Borowsky, 1980). Using flight surgeon's assessments of naval aviators, Alkov (1980) suggested that five life events were markers for aviators who were 'at fault' for an accident. These five life events included: (1) major decision about the future, (2) trouble with supervisors, (3) death of a family member or close friend, (4) interpersonal difficulties, and (5) recent marital engagement.

Life events have also been associated with the academic performance of students. Studies have found that life events have a small but significant relationship with the academic performance of university students (de Meuse, 1985; Lloyd, Alexander, Rice, & Greenfield, 1980; Wildman, 1978) and that this relationship is not mediated by an associated illness experience (Garrity & Ries, 1985). Similarly, Blumberg and Flaherty (1985) found that life events were associated with the academic performance of medical students. The authors also reported that life events in combination with depression, distance from hometown, and social support explained almost 15 percent of medical

school performance that was not explained by cognitive factors.

General Cognitive Ability

General cognitive abilities are also often referenced as intelligence. Weschler (1958) defined intelligence as a global concept that reflected an individual's ability to think systematically, act deliberately, and interact effectively with the environment. Cognitive abilities have been found to predict individual job performance across numerous studies (for reviews, see Barrett & Depinet, 1991; Hunter, 1986). In fact, several studies suggest that when using general cognitive ability as a predictor of job performance, very little incremental validity was gained by adding other variables such as specific abilities and knowledge (Ree, Earles, & Teachout, 1994) and noncognitive variables (McHenry et al., 1990).

Despite the strong support for role of general cognitive ability in predicting performance, there are two reasons not to rely solely on general cognitive abilities. First, Weschler (1958) cautioned that intelligence is actually broader than just intellectual ability because intelligence is a manifestation of the personality operating as a whole. Measures of cognitive ability may not measure some aspects of personality factors that, by their effect on motivation, affect performance. The second limitation is that measures of general cognitive ability focus on the outcome of performance and overlook important process elements of performance, such as problem-solving approaches (Embretson, Schneider, & Roth, 1986; Sigel, 1963). In support of the difference between general cognitive ability and problem solving processes, several studies have found that measures of general intelligence tend to have low correlations with real-life problem-solving

performance (Epstein & Meier, 1989; Heppner & et al., 1982; Spivak, Shure, & Platt, 1985; Sternberg, Wagner, Williams, & Horvath, 1995).

Anxiety

Trait anxiety

Spielberger (1983) defines anxiety as an emotional state that is the result of anticipating harm from a stimulus and a motivation to avoid the stimulus. He also differentiates between two types of anxiety: state and trait anxiety. State anxiety varies depending on the situation, whereas trait anxiety represents a more stable predisposition towards anxiety across different situations. There is evidence that trait anxiety moderates cognitive and motor performance (Katchmar, Ross, & Andrews, 1958). Moreover, trait anxiety may interact with an individual's level of experience in a given situation. For example, a study comparing the decisions of experienced and inexperienced instrument pilots found that high trait anxiety was associated with poorer decisions only in the group of inexperienced pilots (Stokes & Raby, 1989). Therefore, the effects of trait anxiety on performance may be greatest when the situation is relatively novel.

Social anxiety

Marks and Gelder (1969) originally described the condition of social phobia as a fear of looking ridiculous in front of other people. More recently, social anxiety has been conceptualized as fears associated with two different situations. The fourth edition of the Diagnostic and Statistical Manual of Mental Disorders suggests that social anxiety is a fear of either social or performance situations in which a person may become

embarrassed by the presence of others (APA, 1994). Another way to construe the differences in social anxiety is that it can be the result of two types of fears (Mattick & Clarke, 1998). One fear is of interacting with others (interaction-based anxiety) and the other fear concerns performing an activity while being observed by others (performance-based anxiety). Leary (1983) made a similar distinction between social anxieties about contingent and non-contingent social situations. In contingent interactions, a person's behavior is continuously contingent on the actions of the other people in an interaction. On the other hand, in non-contingent encounters, the person's behavior is influenced more by his/her plans than the responses from other people. However, despite the theoretical differences between these fears, studies indicate that these two fears also tend to be associated (e.g., Lovibond & Rapee, 1993).

Social anxiety also appears to be associated with various aspects of functioning and performance. In a study of individuals with clinical levels of social anxiety, greater than 90% of these individuals reported that their social anxiety disrupted their occupational functioning, and 85% reported interference with academic functioning (Turner, Beidel, Dancu, & Keys, 1986). However, Strahan and Conger (1998) noted that few studies have studied the relationship between social anxiety and performance measures of social competence. These researchers tested a specific performance deficit model and found that social anxiety did not predict performance on a social task or increase the number of negative self-assessments of performance (e.g., cognitive anxiety). They suggested that future studies should assess pre-existing differences in social competence and other measures of situational anxiety and performance, such as physiological arousal.

Strahan and Conger (1999) have also reviewed the issue of why studies often do not find a relationship between social anxiety and performance and made three suggestions for future research. First, they cite the finding that physiological and skills measures appear to be situational specific (Beidel, Turner, Stanley, & Dancu, 1989) and suggest that future studies should incorporate Fazey and Hardy's (1988) cusp model, which accounts for an interaction between cognitive and physiological anxiety. Second, they also propose that self-efficacy is an important factor that may moderate the relationship between anxiety and performance. Finally, they postulate that trait anxiety may interact with a person's competence level, "baseline" or trait social competence, for a specific task. Therefore, performance deficits are predicted to be related to social anxiety when a person experiences high levels of cognitive and physiological anxiety, low self-efficacy, and low initial social competence for a specific task.

Anxiety sensitivity

Anxiety sensitivity (AS) represents the extent to which a person believes that sensations associated with anxiety (e.g., autonomic arousal) can have harmful consequences (Reiss & McNally, 1985). AS has been conceptualized as a stable individual difference variable (Reiss, Peterson, Gursky, & McNally, 1986) that predisposes individuals to the development and maintenance of anxiety disorders (Reiss, 1987; Reiss, 1991).

There is evidence that AS is a risk factor for clinical responses to stress (e.g., panic attacks). Two studies have prospectively evaluated nonclinical samples of college students with no history of panic and found that AS is a risk factor for the subsequent

development of panic. Maller and Reiss (1992) found that individuals with high AS were five times more likely to develop an anxiety disorder during the 3-year follow-up period. However, the small sample size at follow-up (N = 48) limited confidence in these results. Schmidt, Lerew, and Jackson (1997) found that AS from a sample of over a thousand Air Force Academy first-year students, measured before a stressful initial training program, predicted the likelihood of panic attacks and other anxiety-related symptoms after the training program.

AS has also been found to predict anxious responding to sensations associated with stress that are provoked by biological challenges. For example, AS has predicted anxiogenic responses to hyperventilation and carbon dioxide challenges with anxiety patients and non-clinical subjects (Rapee, Brown, Antony, & Barlow, 1992).

AS may also be related to performance because AS constitutes a discomfort with the sensations that are associated with arousal, and arousal is a key characteristic of performing under stressful conditions. One useful definition of arousal is a physiological state of readiness to perform physically, intellectually, or perceptually (Cratty, 1989). It follows that arousal has been found to be a key aspect of responding to stress (e.g., Cannon, 1935, 1939; Selye, 1956) and performing under stress (e.g., Yerkes & Dodson, 1908; Zajonc, 1965).

Jones and Swain (1992, 1995), two sports psychology researchers, emphasize the importance of assessing an athlete's beliefs about symptoms of anxiety when studying the impact of stress on performance. They suggest that stress and performance research must not only consider the "intensity" of cognitive intrusions related to anxiety, but also the "direction" (how the person interprets anxiety). These researchers found that successful

and unsuccessful female gymnasts reported experiencing equivalent levels of anxiety intensity but that the successful gymnasts reported a greater belief in the performance-enhancing effects of cognitive anxiety (Jones & Swain, 1992). Likewise, other studies have found evidence that more successful athletes perceive anxiety symptoms as more facilitative than less successful athletes in swimming (Jones, Hanton, & Swain, 1994), and cricket (Jones & Swain, 1995).

Attention

Attention is a selective process in which certain stimuli are attended to while other stimuli are screened out or ignored (Broadbent, 1958). Attention is important to performance because performance requires an ability to identify, attend to, and process task relevant cues (Smith, 1996).

Stress is commonly associated with reports of adverse effects on attention, such as attention narrowing (Bacon, 1974; Hockey, 1970; Wachtel, 1967). In addition, theorists studying test anxiety have suggested that worry interferes with the attentional resources that would otherwise be used to attend to task-relevant information (Sarason, 1972; Wine, 1971). The results of several studies are consistent with the predicted negative relationship between worry and performance (Deffenbacher, 1978; Morris, Kellaway, & Smith, 1978; Sarason & Stoops, 1978). The attentional interference associated with worry hypothetically reduces the cognitive resources available for task-oriented activities.

Neuropsychological measures of attentional capacity have also been used to predict accident involvement, which is an index of poor performance. Several studies have shown that selective attention predicts motor vehicle accidents (Avolio, Kroeck, &

Panek, 1985; Barrett, Alexander, & Forbes, 1977) and petroleum-handling accidents (Arthur, Barrett, & Doverspike, 1990). Likewise, sustained attention has been identified as a contributing factor in several real-world disasters such as the Three Mile Island accident, the Bhopal chemical disaster, the Exxon Valdez oil spill, and several commercial aircraft crashes (National Traffic Safety Board, 1984; National Traffic Safety Board, 1986).

Impulsivity

A central aspect of behavioral control is impulsivity, which is a tendency to act without reflecting (Taylor, 1998). Impulsivity has also been characterized as over-quick responsiveness, sensation seeking, and difficulties delaying gratification and planning ahead (Taylor, 1998). Impulsivity has been found to be associated with performance on a wide range of cognitive tasks (Dickman, 1990; Loo, 1979; Revelle, 1987).

Impulsivity and attentional problems are similar to the symptoms reported by people who meet diagnostic criteria for attention deficit hyperactivity disorder (ADHD). Taylor (1994) conceptualizes hyperactivity, a cardinal feature of ADHD, as an enduring predisposition to behave in a restless, inattentive, impulsive, and disorganized manner (Taylor, 1994). He further suggests that hyperactivity is a trait that is continuously distributed in the general population. The suggestion that ADHD symptoms exist on a continuum has been supported by large-scale twin studies of genetic contributions to ADHD symptoms (Levy, Hay, McStephen, Wood, & Waldman, 1997). Since ADHD symptoms are likely to be normally distributed, research concerning ADHD symptoms also has implications about the functioning of people with non-clinical symptoms that are

similar to those exhibited by people who are diagnosed with ADHD.

There is reason to believe that a significant proportion of EOD students may share characteristics with people who have been diagnosed with ADHD. For example, the firefighter occupation shares many key characteristics with the EOD profession, especially exposure to a high level of danger. Survey research found that the percentage of firefighters reporting high levels of ADHD symptoms (18.5%) was three times greater than the rate found in the general adult population (5.6%; Cohen & Bailer, 1999, August). The study's author proposed that people with ADHD symptoms are attracted to the intensity and fast pace of the firefighter's job because it provides constant change and excitement. It is noteworthy that the author also suggests that although these characteristics are often related to impaired performance, they can also be the basis of superior performance because of additional characteristics like creativity, willingness to take risks, and ability to make quick decisions.

In general, ADHD symptoms have been theoretically and empirically associated with impaired performance. Despite a controversy over the underlying mechanisms responsible for ADHD symptoms, the two primary theoretical explanations of ADHD symptoms both predict a generally negative relationship with performance. These two primary theories propose that ADHD symptoms either reflect underlying behavioral or information-processing deficits. Barkley's (1997) behavioral theory proposes that ADHD is a developmental disorder of behavior disinhibition that disrupts self-regulation and temporal organization of behavior. In contrast, information-processing theories suggest that ADHD symptoms represent information-processing deficits, which interfere with the performance of various cognitive tasks.

The literature also provides evidence of performance deficits associated with ADHD symptoms. Performance deficiencies have been observed in the areas of social problem solving (Matthys, Cuperus, & Van Engeland, 1999) and academic achievement (Lambert, Hartsough, Sassone, & Sandoval, 1987) in children and adolescents. Moreover, ADHD also appears to affect the educational and occupational outcome of adults independent of current psychiatric diagnosis (Mannuzza, Klein, Bessler, Malloy, & Hynes, 1997; Weiss, Hechtman, Milroy, & Perlman, 1985). In addition, adults with ADHD have been found to be more likely to be involved in motor vehicular accidents (Barkley, Murphy, & Kwasnik, 1996).

Mental stress also appears to interact with ADHD symptoms on a biological level. Studies using several different technologies for brain imaging, including PET (Zametkin et al., 1990), QEEG with spectral analysis (Lubar, 1991), and SPECT (Amen & Carmichael, 1997) have found that mental stress in people with ADHD symptoms is associated with decreased activity in prefontal cortex. These findings are important for two reasons. First, the findings provide evidence that people with ADHD may differ biologically from people with other psychiatric disorders (Lou, Henriksen, & Bruhn, 1984) and no diagnoses (Amen & Carmichael, 1997; Zametkin et al., 1990). Second, the abnormalities in prefrontal cortical activity are important because this region of the brain is associated with complex cognitive functions, including attention and problem solving.

Personality

Personality variables are likely to influence performance and responses to stress, because these variables represent beliefs and attitudes underlying long-standing and

pervasive styles of thinking, feeling, and behaving. A comprehensive and empirical examination of personality variables is available using the five factor analytic dimensions of personality. Moreover, these personality dimensions have been associated with various aspects of work performance.

There are several ways to interpret and measure the five factor analytic dimensions of personality. These five dimensions of personality are commonly conceptualized using either the Big Five Model (BFM) or Five Factor Model (FFM). The BFM and FFM have the same labels for three of five dimensions: Extraversion, Agreeableness, and Conscientiousness. However, the BFM and FFM differ on their labels for two factors. The fourth BFM factor of "Emotional stability" is termed "Neuroticism" by the FFM. Moreover, the fifth BFM factor is labeled "Intellect or imagination" in contrast with the FFM dimension of "Openness to Experience". These basic dimensions of personality are assessed by measures corresponding to the BFM and FFM as well as other organizationally oriented measures such as the Assessment of Individual Motivation (AIM; White & Young, 1998) and Hogan Personality Inventory (HPI; Hogan & Hogan, 1989).

In a review of the BFM research, Digman (1990) concluded that the five factors of personality consistently explain the common variance among personality measures across instruments, samples, and cultures. Moreover, Costa (1996) suggests that the FFM offers organizational psychology benefits over previous models of personality, including an empirically validated and comprehensive structure of personality that can be used to organize occupationally relevant personality traits. Meta-analyses have found that the

five factor constructs are associated with performance, especially when an employee is in an autonomous role (Barrick & Mount, 1991, 1993).

Research indicates that the personality trait of conscientiousness has demonstrated the strongest pattern of relationships with performance and neuroticism is also an important correlate of performance. Various meta-analyses and studies have provided strong evidence that conscientiousness and neuroticism are correlated with job performance across many different occupations (Barrick & Mount, 1991; Salgado, 1998; Tett, Jackson, & Rothstein, 1991). Also, in a study with EOD students, Hogan and Hogan (1989) found that two dimensions of the Hogan Personality Instrument corresponding to conscientiousness (e.g., structure/planfulness and impulse control) were correlated ($r = .30$) with EOD course success but not EOD ranking.

Problem Solving Abilities, Beliefs, and Attitudes

Problem solving (PS) has been long recognized to have an important role in human functioning. PS has been associated with effective coping responses to intrapersonal and interpersonal stressors (D'Zurilla & Goldfried, 1971; Heppner & Petersen, 1982; Jahoda, 1953). In addition, from a more technical and organizational perspective, PS has also been conceptualized to be a key factor in the performance of many tasks (Davis, 1966; Duncan, 1959; Simon & Newell, 1971).

D'Zurilla and Nezu (D'Zurilla & Nezu, 1982; D'Zurilla & Nezu, 1986) proposed that PS ability is a function of problem solving orientation (beliefs and attitudes) and problem solving skills. PS orientation represents a set of cognitive responses to problems that is composed of beliefs and expectancies, reflecting how a person generally thinks

and feels about problems and his/her ability to solve them. Research suggests that these beliefs and expectancies moderate the relationship between stress, coping, and performance (Nezu & Nezu, 1987). These cognitive response variables include self-efficacy (Bandura, 1977), irrational beliefs (Ellis, 1962), causal attributions (Abramson, Seligman, & Teasdale, 1978), cognitive distortions (Beck, Rush, Shaw, & Emery, 1979), and appraisal processes (Lazarus & Folkman, 1984). In contrast, PS skills include (1) problem definition and formulation; (2) generation of alternative solutions; (3) decision making; and (4) solution implementation and verification. Each of these skills represents a critical stage of the PS process.

Studies have found that PS predicts stress responses and academic performance for college students. Problem solving has been found to predict general stress levels (D'Zurilla & Sheedy, 1991) and more severe clinical forms of distress, such as suicidal ideation and hopelessness, (Dixon, Heppner, & Anderson, 1991). Academic performance has been predicted by measures of PS (Elliott, Godshall, Shrout, & Witty, 1990) and problem solving approach (D'Zurilla & Sheedy, 1992). In addition, there is evidence that PS appraisal is related to study habits, a factor that is often directly related to academic performance (Elliot et al., 1990).

Practical evidence from organizational uses of PS training also suggests that PS training can help people improve their performance and reduce their distress. Xerox's use of PS and associated changes in measures of organizational performance supports the value of problem solving for improving operational performance. The Xerox Corporation first introduced PS training in 1983 as a systematic approach to empower employees to pursue daily problems. Since Xerox's implementation of problem solving

training, the problem solving process model has been improved and has become a fundamental component of Xerox's quality program, with which the corporation has demonstrated several notable organizational successes. These successes include winning two Malcom Baldrige National Quality Awards (1989, 1997). Also, according to the Xerox Business Service's application summary for the 1997 Baldrige Award, other quality-related accomplishments included increases in profit (30+% from 1992 to 1997) and decreases in expenses (from 28% of revenue in 1992 to 18% of revenue in 1997). Moreover, relating to positive changes in individual distress level, employees also reported increased job satisfaction (from 63% in 1993 to 80% in 1996), which Xerox partially attributed to empowerment strategies such as the problem solving training (Xerox, 1997).

Summary of Enduring Factors Research

The preceding section reviewed the evidence for the relationship of enduring factors with stress and performance. These enduring factors include major life changes, general cognitive ability, anxiety (general anxiety, performance anxiety, and anxiety sensitivity), inattention, impulsivity, personality dimensions (conscientiousness and neuroticism), and problem solving (abilities, beliefs, and attitudes). Of these factors, general cognitive ability, anxiety, and conscientiousness have the most robust empirical support across different performance domains. However, it is important to note that only general trait anxiety has been associated directly with performance.

The other enduring factors including anxiety sensitivity and social anxiety are included because of their empirical association with stress and conceptual relationship

with performance, especially aspects of performance related to EOD operations. These factors are expected to either directly or indirectly affect performance. Inattention, impulsivity, and problem solving are expected to directly affect performance. For example, inattention and impulsivity have been found to be associated with poor performance in the form of accidents. Factors associated with accidents are important because the EOD tasks typically involve high risks and emphasize safe procedures in addition to effectiveness. Likewise, problem solving is conceptually related to EOD performance because problem solving reflects the level of confidence and systematic analysis with which a person might approach a complex task. In contrast, anxiety sensitivity and social phobia are expected to indirectly affect performance by producing adverse stress responses during the testing process.

Recent Factors

Recent factors affecting the relationship between stress and performance include environmental events and internal conditions. Daily life problems and social relations are important environmental events. In contrast, mood states are internal conditions that have been found to be associated with stress and performance.

Daily Life Problems

Several studies have found that everyday problems are a significant source of stress and are more effective than life events in predicting psychological distress (Holahan, Holahan, & Belk, 1984; Kanner, Coyne, Schaeffer, & Lazarus, 1981) and physical illness (DeLongis & et al., 1982). Lazarus (1984) labeled these everyday

problems as hassles, which were situations of daily living that were appraised as harmful or threatening to an individual's well-being (Lazarus & Folkman, 1984).

Social Relationship Variables

The daily activity of adults requires frequent interactions with others in many capacities, especially in the context of the military operations. Moreover, the wide range of influences that people have on each other has been recognized by many classic social psychology studies. Out of the many features of social relations that can be investigated, the perception of the quality of the individual's relationship with leaders, peers, and significant others has been found to be related to performance and disruption of these relationships creates a stressor that can adversely impact performance.

Relations with Leaders and Peers

There are several ways to study the effects of social relations on performance and responses to stressors. Military researchers primarily focus on two aspects of social relations that appear important to operational effectiveness: leadership and group cohesiveness. Leadership is the relationship between the leader and his/her group of subordinates whereas cohesiveness refers to a quality of relations amongst the subordinates. Festinger (1950) characterized cohesiveness as "the resultant forces which are acting on the members to stay in a group" (p. 274). Moreover, the supportive nature of relations between people, what is termed as "social support" in the health and clinical psychology literature, is another useful way of studying the impact of relations on performance and functioning.

Many military studies have investigated the role of unit cohesiveness and leadership. Several studies suggest that relations between military personnel and with their leaders can moderate the effect of combat stress on performance and stress responding (Belenky, 1987). In a meta-analysis of the effects of group cohesion in military units, Oliver and colleagues (1999) found significant effect sizes between cohesion and several aspects of military effectiveness including group performance, individual performance, job/military satisfaction, retention, well-being, readiness, and discipline (Oliver, Harman, Hoover, Hayes, & Pandhi, 1999). The relationship between subordinates and their leaders also has been found to impact several aspects of performance and responses to stress. For example, Tziner and Vardi (1982) reported that leadership style affected group cohesiveness in military tank crews.

Sports psychology research also provides analogous evidence for the relationship between leadership and group performance and satisfaction. The role of athletic coach has several similarities with the duties of EOD instructors, including supervision, education, and motivation. Studies of the effect of coaching styles suggest that an athlete's satisfaction and performance is affected by interactions between actual and desired behaviors of a leader (see Chelladurai, 1993, for a review).

A relationship between group cohesion and performance has been supported by numerous studies (see meta-analytic reviews by Mullen & Copper, 1994; Oliver et al., 1999) and several important characteristics of that relationship have been noted (Mullen & Copper, 1994). First, the relationship between cohesiveness and performance was stronger for smaller than large groups and stronger for authentic than artificially generated groups. Second, the cohesion-performance relationship appeared to be more a

function of commitment to task than interpersonal attraction or group pride. Lastly, the longitudinal relationship between performance and cohesion may be stronger in the direction of performance to cohesion than vice versa.

There have been several research suggestions for improving the measurement and understanding of the effect of group cohesion on the relationship between stress and performance. Griffith and Vaitkus (1999) proposed that military research on cohesion could benefit by adopting some of the health psychology's conceptual and methodological approaches to studying social support. In addition, Bartone and Adler (1999) stress the importance of longitudinal designs for establishing causality and investigating how cohesion develops over time.

The support gained from social relations is frequently studied in clinical and health psychology studies. Social support can be defined as "information leading the subject to believe that he is cared for and loved, esteemed, and a member of a network of mutual obligations" (Cobb, 1976, p. 300). In line with military studies that suggest that cohesiveness can reduce stress casualties in combat, numerous other studies have demonstrated that the quality of social support is associated with the effects of stress on physical and mental health (Cohen & Wills, 1985; Kessler, Price, & Wortman, 1985). For example, House, Landis and Umberson (1988) reported that the mortality rates of individuals with poor social relationships are higher than the mortality rates of people who smoked cigarettes for many years (House, Landis, & Umberson, 1988).

Social support also appears to be protective factor that can be obtained from peers and supervisors in an organizational context. For example, social support from peers buffers the negative impact of workload on burnout (Koeske & Koeske, 1989). Likewise,

support from supervisors has been found to reduce the amount of anxiety associated with high perceived work loads (Kirmeyer & Dougherty, 1988) and strain-producing events (Greller, Parsons, & Mitchell, 1992). Greller, Parsons, and Mitchell (1992) suggest that supervisors are uniquely positioned to provide social support because they can provide the three factors (information, support, and esteem) that have been proposed by Cohen and Wills (1985) to contribute to a buffering relationship with stress.

Relations with Significant Others

The quality of marital relations is associated with physical and mental health and job performance. A stable and satisfying relationship is a protective factor against illness and premature death for adults and the best source of good physical health and emotional stability for children (Burman & Margolin, 1992; Dawson, Robinson, Butterfield, & Van Doorninck, 1991; Verbrugge, 1979). In contrast, poor marital relationships are associated with physical, mental, and occupational problems. Marital distress puts adults and children at increased risk for mental and physical problems (Cherlin & Furstenberg, 1994; Coie & Jacobs, 1993; Cowan & Cowan, 1992; Coyne, 1987; Fincham, Grych, & Osborne, 1994). Moreover, marital distress also appears to be associated with poor work performance and satisfaction (Forthofer, Markman, Cox, Stanley, & Kessler, 1996; Jones & Fletcher, 1996; Renshaw, 1976).

Military personnel may be especially vulnerable to the adverse effects of marital distress for two reasons. First, some degree of marital conflict should be anticipated for military personnel because the military and family are both "greedy" institutions that compete for the service member's time and energy (Segal, 1986). Second, the

performance demands of certain military occupations, such as aviation, are sensitive to even slight decrements in performance and these performance decrements may result in catastrophic consequences. Consequently, researchers have emphasized the importance of the spousal relationship in a pilot's ability to deal effectively with stress and performance demands and have suggested the operational importance of helping build stronger marital relationships (Karlins, Koh, & McCully, 1989; Raschmann, Patterson, & Schofield, 1990).

Mood States (Affective Distress and Fatigue)

Mood states can be defined as "pervasive and relatively mild" affective states that are less attributable to specific objects or events than acute emotions (e.g., fear and anger) (Mathews, 1992, p. 161). Thus, mood states represent subjective states that are more general and less intense than acute emotional reactions. Mood states also represent recent internal conditions, which temporally distinguishes them from situational emotions and enduring traits. In other words, moods represent conditions that are more persistent over time than situational emotions, yet less persistent than that of personality traits (Mathews, 1992).

There are three general mechanisms by which moods may influence cognitive performance: changing the availability of cognitive resources, biasing the nature of information that is processed, and interfering with cognitive processes. First, changes in mood and corresponding effects on physiological arousal can impact attentional resource availability (Mathews, May, Mogg, & Eysenck, 1990). Second, moods can result in selective processing of affect-related material (Bower, Gilligan, & Monteiro, 1981).

Finally, mood states can also impact performance by triggering the generation of task-irrelevant cognitions (e.g., worry about failure) that interfere with on-task performance (Wine, 1971). It is also important to note that moods may indirectly affect performance by reducing coping resources and thereby increasing a person's vulnerability to stress (Schonpflug, 1983).

Based on an examination of several mood models (Diener, Larsen, Levine, & Emmons, 1985; Russell, 1979; Sjoberg, 1977; Thayer, 1989; Watson & Tellegen, 1985), affective pleasantness and energy represent two central mood constructs. Affective distress and fatigue, both of which are polar extremes of these constructs, are common responses to stressors. For example, fatigue has been conceptualized "as a generalized response to stress over time" (Cameron, 1973, p. 640). In addition, there is evidence that affective distress and fatigue impact performance.

Affective distress can also be characterized as psychosocial distress and has been shown to be associated with impaired performance in operational settings. Hogan and Hogan (1989) reported that the absence of psychosocial distress ("not depressed") predicted completion of second-class diving and EOD schools (Hogan & Hogan, 1989). Likewise, elevations on a composite measure of psychosocial distress (e.g., illness concerns, anxiety, and depression) were associated with less favorable ratings on several aspects of police recruit and officer performance, including probationary job performance ratings, academy training ratings, and job turnover (Cortina, Doherty, Schmitt, Kaufman, & Smith, 1992).

Studies have also found that clinically depressed mood, an extreme form of affective distress, is associated with performance deficits in attention and memory

functions (Burt, Zembar, & Niederehe, 1995; Johnson & Magaro, 1987; Kindermann & Brown, 1997; Williams, Watts, MacLeod, & Mathews, 1990). Although the mechanisms for the relationship between depressed mood and impaired memory function are unclear, Johnson and Margaro (1987) proposed that the memory problems associated might be due to decreased effort and motivation that is associated with depressed mood. Other studies indicate that people with depressed mood tend to adopt more cautious and risk-averse responding styles that translate into greater inhibition in decision making (Leahy, 1999).

Fatigue also has been found to be associated with differential performance. Thayer (1978) was the first to identify the importance of considering the energetic component of mood in the relationship between physiological arousal and performance. Based on a review of studies, he proposed that the dimension of mood labeled energy, but not tension, predicted reaction time, verbal learning, and examination performance. In a review of subsequent research, Mathews (1992) concluded that energy facilitates performance efficiency on attentional tasks that involve limited attentional resources.

Sleep deprivation, which is a frequent cause of fatigue, has been associated with impaired performance. The most consistent findings are that sleep loss fatigue adversely affects the performance of vigilance tasks that require sustained concentration (Davies & Parasuraman, 1982). Studies have also found that fatigue can adversely impact short term tasks if the tasks have heavy requirements for working memory, focused attention, frequent responding, reasoning, or divergent (creative) thinking (for review, see Dinges & Kribbs, 1991). In addition, there is evidence that longer total sleeping time, earlier

bedtimes, and later weekday rising times are associated with better academic performance in adolescents (Wolfson & Carskadon, 1998).

Tilley and Brown (1992) reviewed other factors that have been found to increase the performance decrement associated with sleep deprivation, many of which were demonstrated in a series of classic sleep deprivation studies conducted at Walter Reed Army Institute by Williams and his colleagues (1959) (Tilley & Brown, 1992). The task-related factors that were associated with increased fatigue-related performance impairment included greater task duration (Williams, Lubin, & Goodnow, 1959), task difficulty (Williams & Lubin, 1967), task complexity (Wilkinson, Edwards, & Haines, 1966), and memory load (Heslegrave & Angus, 1985). In contrast, person-specific factors that countered fatigue-related performance decrements included greater control of pacing the task (Williams, Kearney, & Lubin, 1965), interest in the task (Wilkinson, 1964), and proficiency level (Johnson, 1982).

Research on pilot performance has also provided evidence of performance decrements associated with fatigue. A classic example are the "Cambridge Cockpit" studies that investigated the ability of pilots in a flight simulator (Drew, 1940), the results of which were summarized by Bartlett (1943) in his paper concerning "fatigue following highly skilled work". The general findings were that as time passed, the pilots demonstrated decreased standards of performance (increased tolerance for bearing and airspeed variations) and made increased unforced errors (Bartlett, 1943). In addition, Davies (1948), who used a different scoring criteria to analyze the data from the same studies, did not find evidence of a progressive deterioration of performance but did find that the errors in the later part of a simulated flight tended to be larger and last longer.

Sustained fatigue can be likened to the condition of burnout, which describes a combination of negative consequences associated with long-term occupational stress. Studies have found that burnout is associated with decreased coping ability, increased stress, and impaired work performance. For instance, burnout is associated with decreased ability to cope with emotional demands (Maslach & Pines, 1977) and with increased indicators of psychosocial distress (e.g., physical exhaustion, insomnia, increased use of drug and alcohol, and marital and family problems) (Maslach & Jackson, 1981). Burnout has also been associated with the measures of work dedication such as absenteeism and turnover (Maslach & Pines, 1977; Wright & Cropanzano, 1998).

Summary of Recent Factors Research

The recent temporal category represents factors that persist beyond specific situations but are not as chronic as enduring variables. These factors include both environmental events (daily life problems and social relations) and internal conditions (mood states of energy and affective distress). There is evidence that the majority of these factors are directly related to performance. In addition, all of these factors are directly related to stress, and thereby expected to have an indirect effect on the relationship between stress and performance. Moreover, the mood states may reflect depletion of energy resources over time possibly associated with extended over-exertion and lack of restorative activities. The depletion of resources, which may be very similar to burnout, is a likely consequence of conditions of extended high demands and limited control in the EOD training program.

Situational Factors

Studies have shown that a variety of situational factors affect the relationship between stress and performance. These situation factors can be described as internal processes, conditions, and responses pertaining to problem solving and anxiety. Specifically, the situational factors include problem solving self-efficacy and skills, inattention, and cognitive and somatic anxiety.

Problem Solving Self Efficacy and Skills

Personal beliefs about one's own ability to manage (control) events have long been associated with effective coping (Bandura, 1977; Cohen & Edwards, 1989; Thompson, 1981). Self-efficacy is a control-related belief that is situationally-specific, concerning an ability to enact the actions necessary to achieve a specific outcome in a specific context (Bandura & Adams, 1977). In addition, self-efficacy reflects not only a belief in ability, but also motivational factors such as "intentions for effort allocations" (Kanfer, 1987), p. 260). Therefore, self-efficacy not only includes the ability to do an activity, but also the motivation to do it. This is consistent with Bandura's (1977) prediction that self-efficacy is positively related to perseverance, the length of time that an individual will sustain a behavior, when faced with obstacles.

Problem-solving (PS) self-efficacy refers to a belief in one's ability to solve situationally-specific problems effectively (Maydeu-Olivares & D'Zurilla, 1997). PS self-efficacy is a situational expression of the individual's more enduring PS orientation when applied to a specific problem (D'Zurilla & Nezu, 1999). Although the impact of PS self-efficacy on performance has not been studied directly, there is substantial evidence

that general self-efficacy beliefs are related to several aspects of performance. In a meta-analysis of 114 studies, Stajkovic and Luthans (1998) found that self-efficacy beliefs had a significant weighted average correlation (r = .38) with performance across a variety of work-related tasks (Stajkovic & Luthans, 1998). In another meta-analysis, Multon, Brown, and Lent (1991) found that self-efficacy was significantly related to two academic outcomes, performance (effect size estimate = .38) and persistence (effect size estimate = .34). Moreover, this review also reported that the relationship between self-efficacy and academic performance was robust across a wide variety of subjects, experimental designs, and assessment methods (Multon et al., 1991). In addition, studies have also found evidence of relationships between self-efficacy and complex task performance. A series of studies by Wood and Bandura (Bandura & Wood, 1989; Wood, Bandura, & Bailey, 1990) found evidence of a relationship between self-efficacy and the quality of problem solving and analytic thinking processes.

Self-efficacy has also been associated with variables that are theoretically related to performance. For example, there is substantial evidence that self-efficacy is related to the amount of effort and persistence expended in the face of challenges and difficulties (Cervone, 1989; Cervone & Peake, 1986; Peake & Cervone, 1989; Stock & Cervone, 1990). In addition, studies have found relationships between self-efficacy and other performance-related variables such as lower levels of anxious arousal before and during stressful performance (Bandura, Cioffi, Taylor, & Brouillard, 1988) more effective study habits and attitudes (Elliott et al., 1990), increased confidence in decision making (Larsen & Diener, 1985), and higher levels of hope and goal-directed energy (Snyder, Irving, & Anderson, 1991).

Several factors appear to moderate the relationship between self-efficacy and performance. First, the meta-analysis by Stajkovic and Luthans (1998) found that a stronger relationship between self-efficacy and performance was associated with low task complexity and simulated performance contexts, and a lower relationship was associated with high task complexity and natural performance settings (Stajkovic & Luthans, 1998). In addition, the meta-analysis conducted by Multon and colleagues (1991) found that the stronger relationship between self-efficacy and academic performance was associated with post-treatment assessment of self-efficacy, student's with lower achievement status, older students (high school and college students as opposed to students in earlier grades), and measures of basic skills compared to more complex tasks (Multon et al., 1991). Finally, other studies indicate that self-efficacy is a better predictor of performance during early learning trials as opposed to later trials when performance tasks have been mastered (Mitchell et al., 1994) and when self-efficacy beliefs are in close temporal proximity to the time of performance (Bandura, 1986a), demonstrating the situationality effects of self-efficacy beliefs on performance. According to PS theory, self-efficacy is a cognitive-emotional component of PS orientation. Thus, PS self-efficacy is expected to be an important predictor of performance.

Cognitive and Somatic Anxiety Variables

There is evidence that two dimensions of situational anxiety, cognitive and somatic anxiety, can be differentiated and that these two dimensions have different effects on performance. A common characterization of cognitive anxiety is a cognitive process that reflects concerns about performing poorly and the associated social

judgments by others. In contrast, somatic anxiety represents perceptions of physiological arousal that represent common responses to psychological stress.

In general, the evidence suggests that cognitive anxiety has a robust negative relationship with stress, while somatic anxiety (perception of physiological arousal) has a less consistent and more complicated (i.e., inverted U) relationship with performance. In addition, later models have postulated that the interaction between cognitive and physiological arousal predicts performance better than models that only consider the independent effects of these dimensions of anxiety on performance (Hardy, 1996). See reviews under earlier section devoted to review of stress and performance conceptual issues and evidence supporting the relationship between anxiety and performance.

Summary of Situational Factors Research

The situational temporal category represents factors that are specific and limited to a situational context. These factors include problem solving self-efficacy and skills, state inattention, and cognitive and somatic anxiety. There is evidence that cognitive and somatic anxiety is directly related to performance. The study also assumes that problem solving self-efficacy will predict performance because self-efficacy is a robust predictor of performance in past research. In addition, as in the other temporal categories, all of these factors are directly related to stress and are thereby expected to have an indirect effect on the relationship between stress and performance.

Stress and Performance Factors in EOD Training

A study of the effects of stress on performance requires an understanding of the

person and the person's specific environmental context. The subjects who will be recruited for this study are military students enrolled in EOD training. The setting is the EOD training program, whose directorship has approved the development and initiation of stress and performance research in order to identify ways to decrease the high levels of student attrition (30%). To most effectively develop a stress and performance model that specifically can be applied to improve EOD training outcomes, it is necessary to evaluate and identify the specific stress and performance relationships that represent the important features of the EOD students and training program.

Information about the EOD students and the training program was gathered during several site visits to the EOD training school and frequent long-distance communication with EOD training staff. Information was collected using formal and informal methods of data collection. Formal methods of data collection included a focus group with a class of graduating students. Informal methods included discussions with students and instructors, observing classes and testing procedures, and reviewing EOD training documents.

EOD Students

The EOD student population reflects a heterogeneous group of military personnel from the four military services: Air Force, Army, Navy, and Marines. Students from each service undergo different service-specific pre-screening criteria (e.g., ASVAB composite scores and physical fitness criteria) and training programs (e.g., Navy Diver school and other previous military career requisites) prior to admission to EOD training. While the students generally represent all races, genders, levels of previous military

experience, and ranks, there are specific demographic features characterized by the majority of EOD trainees.

The demographic distribution of EOD students has been described in a study that involved all new EOD students over a 17-month period (Young, 2000). In the study's sample of students, 41% were from the Air Force, 36% were from the Army, 15% were from the Navy, and 8% were from the Marines. The majority of the students were male (96%) and Caucasian (77%). The students' ages ranged from 18 to 46 years with an average age of 24 years. Although the average amount of service per student was 3.3 years in the military, the students reported as little as less than a year of service up to 29 years of service. Most of the students are in the enlisted ranks, especially the rank of E-3 (30%) and E-4 (28%). Only 6% were officers.

The students start the EOD training program in classes of 25 individuals, which sometimes differ markedly with respect to service representation and previous shared experiences among class members. The Navy classes typically consist solely of Navy personnel who, as a unit, have already undergone another rigorous training program, dive school. In contrast, personnel from the other three services are typically placed in classes with members of the different services and many members of the class have not met prior to the beginning of EOD training.

EOD Training Environment

The EOD training program is approximately seven months long and consists of eight divisions of instruction, corresponding to different areas of EOD knowledge and skills (see Table 1). In general, the training starts with basic and general knowledge and

skills and progresses to training that is specific to a certain type of explosive ordnance (e.g., air ordinances such as aircraft missiles; ground ordnance including mines and artillery munitions). The program has traditionally been broken down into two phases, with each phase conducted at different training sites (first phase at Eglin AFB, FL and second phase at Indian Head, MD). The first phase consists of four instructional divisions: Core, Demolition, Tools and Methods, and Biological and Chemical. The second phase also has four divisions: Ground Ordnance, Air Ordnance, Improvised Explosive Devices, and Nuclear Weapons. Although the two phases of training have recently been consolidated at one training location, Eglin AFB, the two phases are still commonly referenced as distinct components of the training program.

Insert Table 1 here

The EOD training program involves numerous stressors. These stressors include the general demands associated with the overall training program and the cognitive workload imposed by the tasks and other aspects of the tasks. The general demands associated with the training program include those of a general military training environment as well as those of the overall EOD training environment. Thus, a basic source of stress for all trainees is the transition to a new environmental culture of EOD training and, in the case of new recruits, the additional stress of the transition into the military. Simply stated, the role of student in a demanding environment places the student in a stressful situation created by the combination of high job demands and low aspects of control (Karasek & Theorell, 1990).

The general demands of training include lengthy workdays, which can have both direct and indirect adverse effects. Progressively greater levels of fatigue are a direct result of the cumulative effects of long workdays. In addition, the long days can indirectly restrict the amount of time that is available for family, friends, recreation, or restorative activities or for completing personal business (e.g., errands) and managing routine problems.

Training also involves heavy cognitive demands in both learning and applying the course material. In a study of the second phase of EOD training, McCormick and Clutch (1991) reported that the major cognitive demands during training were associated with reading and comprehending extensive technical publications (McCormick & Clutch, 1991). Once the students are taught the technical material in each of the eight divisions of EOD training, the students are also evaluated by academic and practical testing procedures. To pass the academic and practical tests, students must meet a high level of performance (e.g., score at least an 86%). The academic tests evaluate technical knowledge whereas the practical tests focus more on the application of technical knowledge. In general, tests may be retaken one time if a review process determines that a student's previous performance has demonstrated adequate competence and motivation.

Failure of the practical tests is a major source of attrition. The practical tests are challenging because the students must perform the tasks in a limited time, the students' performance is evaluated under the stress of close observation, and the students' practical grades are the major determinant of success in EOD training. The practical tests involve a novel simulated ordnance disposal scenario in which the students must correctly perform three distinct tasks: identification and reconnaissance analyses (safely

approaching and identifying an ordnance), render safe procedures (making an ordnance safe to transport), and disposal procedures (destroying an ordnance). Within each of these tasks, various subtasks are assigned point values and are graded on an all-or-nothing basis. The largest point values are primarily associated with safety concerns due to the lethality of the EOD mission.

In general, the EOD practical testing procedures require cognitive processing that is accurate and efficient, primarily visually oriented, and effective in relatively novel situations. The tasks in a practical test scenario also impose several specific cognitive demands. These cognitive demands include attention to detail, situational awareness, problem solving, and controlled processing. First, attention to detail is important because the students are continually required to notice small details that have implications for safety concerns and operational procedures. Second, the students are also required to be simultaneously aware of several dimensions of an ordnance disposal scenario in order to arrive at a safe and effective solution. Third, the students must be able to meaningfully integrate the various levels of information about a given ordnance disposal scenario and logically choose, plan, and execute a solution. Finally, the applied tasks frequently require the use of newly learned skills, which makes greater demands on more controlled processing resources, is slow and effortful, and requires more attention than automatic processing in the performance of well-learned tasks (Schneider et al., 1984).

Other demanding aspects of the practical test conditions include close scrutiny and observation by an evaluator, restricted time for completing tasks, minimal feedback during the test, actions being graded according to strict safety standards in addition to task completion, and disagreeable consequences of poor performance.

Preliminary Data: Focus Group Results

In order to operationally identify activities and factors in the EOD training program that were related to stress, a focus group was conducted with students from a graduating class of Navy EOD students. Nine students participated in the focus group. The students were all males, primarily Caucasian, ranged in age from 20 to 30 years old, and reported having 2 to10 years of military service. Four of the students were married, three of whom had children. The students' overall performance averages on academic and practical tests ranged from 86% to 95% and the number of practical tests that had to be retaken varied from 0 to 5.

The focus group discussion revealed a wide range of perceived sources of stress and factors affecting their management of stress and performance. The students identified stressors that were associated with the continual evaluation process, the possibility of failing on the next test despite previous performance, lengthy work days, large amounts of required learning, poor administrative support, and insufficient time to address routine problems (e.g., financial problems and administrative issues such as failing a fitness test, not meeting weight standards, problems with security clearance). The students also reported that success in the training program was associated with various aspects of motivation (e.g., dedication and prioritization) and teamwork, whereas failure was associated with poor mental and physical performance, low class morale (e.g., dissatisfaction with being in the training program), poor teamwork, and interpersonal difficulties with significant others.

The students also described a "snowball effect" that occurs when an initial problem seems to rapidly accumulate other problems and the resultant combination of

problems becomes overwhelming. The students indicated that it was important to prevent problems from escalating, because unresolved problems could accumulate easily to the point where a student could not meet the demands of the EOD training program. Another analogy that seems to fit the situation of being an EOD student is a "house of cards". The EOD program is very challenging by itself and, because the student's resources are already being heavily taxed, any other demands may have a cascading adverse effect on the student's ability to meet the demands of EOD training.

PROPOSED MODEL OF STRESS AND PERFORMANCE VARIABLES

This study proposes a model that is designed to predict the relationship between stress and performance in EOD training. The proposed model improves upon previous models by integrating key theories and empirical findings from the preceding review of stress and performance literature. Specifically, the proposed model integrates: (1) levels of functioning and temporal domains; (2) a wide range of empirically supported variables; and (3) roles of variables and interactions posited by different models. Then, based on this integration of theories and findings, the study makes several assumptions about the relationship between stress and performance that can be tested by research.

Advantages of the Proposed Model Over Previous Models

Integration of Levels of Functioning and Temporal Domains

The first advantage of the proposed model over previous models is that the proposed model uses a broad framework that depicts the role of variables representing different levels of functioning (biological, psychological, social, environmental) and temporal domains (enduring, recent, and situational) instead of focusing on a limited number of variables linked to one specific theory. As first presented by Leigh (1981), this framework can be visualized as a two dimensional grid that creates categories for all combinations of functioning levels and temporal domains.

The temporal categories are the primary organizing framework of the proposed model. Therefore, the study developed specific duration criteria for distinguishing between the different temporal categories. Based on the precedent set by the DSM-IV diagnostic system, a period of six months is defined as the chronological transition

between a shorter-term reactive adjustment difficulty (recent variable) and a long-lasting and stable pattern (enduring variable). However, the duration of recent variables is typically several days to two weeks, which is the common timeframe for inventories dealing with affective distress and fatigue. In contrast, situational variables are by definition circumscribed to the duration of the situation.

Integration of Empirically Supported Variables

Using the broad framework of different levels of functioning and temporal domains, the proposed model incorporates a wide range of variables that have been empirically demonstrated to be related to stress and performance. As demonstrated by the previous review of empirically supported variables, these variables can be categorized according to temporal categories. First, empirical support was discussed for the role of enduring factors in the relationship between stress and performance. These enduring factors included general cognitive ability, anxiety, attention, impulsivity, personality, and problem solving. Second, evidence was reviewed that related to the role major life changes, daily problems, social relationships, and mood states in the relationship between stress and performance. Finally, evidence of the relationship between situational factors such as problem solving (self efficacy and skills) and anxiety (cognitive and somatic) variables and stress and performance were covered.

All of these variables can be categorized according to level of functioning. For example, somatic anxiety reflects the biological level of functioning, problem solving self-efficacy represents the psychological level, and relationships represent the social and environmental level of functioning. However, for sake of simplicity, the different levels

of functioning categories have been reduced to internal and external categories in the diagram of the proposed model. Thus, the model can be envisioned as a two by three matrix that consists of six subcategories of factors: external and internal enduring factors, external and internal recent factors, and external and internal situational factors. Each of the variables in the study can be placed in at least one of these subcategories.

Integration of Theory from Different Models

Because the proposed model is a framework for integrating variables that is not based on any single theory, the model permits the integration and testing of key theoretical positions from different models of stress and performance. The model integrates three main theoretical positions from the previous review of stress and performance theory. These three positions are the: (1) central role of cognitive beliefs and processes; (2) role of systemic interactions; and (3) role of moderating factors.

Central Role of Cognitive Variables

Theories in the fields of stress and performance research have increasingly suggested the central role of cognitive variables. These cognitive variables include both the basic categories: beliefs and perceptions versus processes. The theories about the role of beliefs and perception focus on the content of thoughts, specifically how a person appraises a situation and his/her ability to cope in the situation (e.g., Lazarus & Folkman, 1984). In contrast, the process-oriented theories investigate how cognitive resources (attention, working memory) are allocated (e.g., Kahneman, 1973). The proposed model suggests that both of these categories of cognitive variables represent central and

relatively independent aspects of the relationship between stress and performance that can be integrated in the same model.

Systemic Role of All Variables

Systemic theories offer a broad perspective of the possible interactions between variables in the relationship between stress and performance by introducing two fundamental notions about the roles of variables: the occurrence of systemic interactions between variables within a system and the compensatory processes that can occur within a system. The perspective of systemic interactions suggests that behavior of a system is not the product of a single variable, but can be best understood by considering the functional interactions of all the variables that comprise the system. The proposed model adopts a systemic perspective by investigating the interaction between a wide range of variables.

In turn, the idea of compensatory processes or tradeoffs suggests that absolute performance is the product of functional tradeoffs within the system. A tradeoff in a performance situation describes the allocation of systemic resources. For example, the energetic models suggest that a person can increase the availability of cognitive resources by exerting more energy. If this pattern is repeated chronically, then the person runs the risk of exhaustion, which can adversely affect performance. The model investigates the relationships between various systemic resources (attention, energy) in the context of the chronic demands of EOD training (long training days for many months, frequent tests.

Moderating Role of Additional Factors

Various models of stress and performance have suggested the role of a number of moderating factors. The proposed model suggests the moderating role of a number of factors that have been identified by different models of stress and performance and supported by empirical research. These moderating variables include major life events, daily problems, relationships, personality dimensions, self-efficacy, and mood states.

Summary of the Proposed Model

The proposed model represents an iterative and systemic process that includes both static and dynamic features (see Figure 1). Present and past experiences impact ongoing behavior, which in turn will impact future behavior. In addition, the expression of behavior represents the systemic balance between available resources and demands.

Stress is conceptualized as a transactional process that represents the interaction between the person and the environment factors in a given situation. Stress occurs when demands outbalance an individual's resource capacities (McGrath, 1976). The stress process is characterized as a combination of stressors and stress responses that can occur on multiple levels (e.g., physiological, psychological, and social) and that involve contributions from person- and environmentally-based factors (e.g., anxiety) that are themselves often composed of multiple dimensions (e.g., cognitive and somatic). The model emphasizes the role of three factors representing stress responses and cognitive processes, which are considered to be key determinants of performance. The importance of these factors is illustrated by the central role that each has been assigned in previous theories of stress and performance and the empirical evidence supporting the

relationship between each of the factors and stress and performance. These three factors are the stress responses, attentional control, and problem-solving appraisal.

The stress responses can be expressed as either recent or situation-specific phenomena. Both the recent and situational stress responses are important because they are consequences of the stress process and predictors of subsequent performance. The recent stress responses are operationalized as affective distress and fatigue and the situational stress responses are defined as cognitive and somatic anxiety. These forms of stress responses have been a primary component of several stress and performance models, especially models that focus on the role of multiple dimensions of anxiety (Martens et al., 1990; Rachman, 1978) and energy-related factors (Hockey, 1997; Schonpflug & Battmann, 1988; Sergeant, 2000).

The other two key factors, attentional control (the opposite of inattention) and problem-solving appraisal, represent the importance of cognitive factors in the relationship between stress and performance. These cognitive factors represent the effect of cognitive processes (attentional control) and cognitive beliefs (problem-solving appraisal). These cognitive factors are considered to be the primary determinants of stress responses and performance because it is assumed that they directly influence how problems are first perceived and what coping responses are selected in response.

Attentional control processes are operationalized as enduring, recent, and situational variables. Several theorists have proposed that attention is a critical aspect of cognitive functioning in the relationship between stress and performance (e.g., (Carver & Scheier, 1988; Eysenck & Calvo, 1992; Kanfer & Ackerman, 1989; Sarason, 1972; Sarason & et al., 1986). Likewise, studies have found that attentional processes are

affected by different aspects of stress (e.g., arousal, Easterbrook, 1959).

Similarly, variables representing problem-solving appraisals are operationalized as enduring (e.g., problem solving orientation) and situational (e.g., problem solving self efficacy) variables. Problem solving has been found to an important characteristic of effective coping.

The model also includes the role of moderating factors. The moderating factors include the role of external factors such as major life events, daily problems, and social support. In addition, internal factors such as impulsivity, problem solving skills, and personality variables are also part of the proposed model.

Assumptions about the Relationship Between Stress and Performance

The proposed model makes a number of assumptions about the relationship between stress and performance that provide the bases for predicting interrelationships among the variables. These assumptions are based on the previous review and integration of theoretical models and empirical evidence describing the relationship between stress and performance.

The first set of assumptions can be tested in a study context that is limited to two data collection time points. These assumptions directly underlie the study's hypotheses.

1) A broad range of factors and their interactions will predict more of the relationship between stress and performance in EOD training than single factors.
2) General cognitive resources and to specific cognitive processes associated with attentional control and problem solving will have the greatest ability to predict performance. However, these general and specific cognitive processes are also

believed to reciprocally interact with additional person-specific (internal and external) and environmental context factors to predict stress responding and performance.

3) Measures of clinical variables indicate a continuum of functioning the ranges from asymptomatic to characteristic but not diagnostic of mental disorders. Clinical and subclinical levels of these variables are expected to affect stress responses and performance.

4) The behavioral manifestations of enduring characteristics are inherently interactive with situational influences (Tellegen, 1981; Tellegen, Kamp, & Watson, 1982). Therefore, enduring characteristics are likely to have stronger effects on stress responses and performance when considered in interactions with theoretically relevant situational variables.

5) Recent factors (e.g., affective distress and fatigue) are expected to predict performance across different situations but in a time-limited manner.

6) Situational variables predict the greatest amount of variance in static performance measures because they are situation specific. The closer the temporal proximity of a contributing variable to a situation, the stronger will be the expected influence of that variable on the stress response (Mischel, 1968).

7) Although all of these stressors and stress responses are expected to interact dynamically (e.g., bi-directional and feedback relationships), cognitive mediational processes (e.g., appraisal, choice and regulation of coping processes, and attentional processes) are considered to be the central determinant of the resultant stress response and performance.

8) Stress responses will themselves mediate the relationship between stressors and performance. For example, environmental stressors (e.g., major life changes and daily problems) are expected to increase recent stress responses (e.g., affective distress and fatigue), which are expected to affect performance (e.g., practical test performance) in turn.

In addition to the assumptions that are relevant to the relatively static context of this study, there are four additional important assumptions representing the dynamic iterative and systemic features of the model. These assumptions cannot be tested in a static research study that samples an individual's behavior from a single situation.

1) The relationship between recent and situational factors is assumed to operate as a reciprocal process. Recent stress responses (e.g., mood and fatigue) are expected to impact situational stress responses (e.g., task performance, anxiety) and, in return, situational stress responses (e.g., task performance, anxiety) predict and contribute to the exacerbation of ongoing stress responses (elevated mood and fatigue).
2) Enduring characteristics are expected to provide the most consistent and stable predictors of performance across situations.
3) The situationally-specific variables that will have the most direct influence on the individual's stress response are also expected to be less generalizable across different situations.
4) The difference between personal and social resources that are available and those that are applied is conceptualized as being extra coping capacity that is protective against the adverse effects of additional demands (recent and situation-specific).

Insert Figure 1 here

Insert Table 2 here

HYPOTHESES

The proposed model integrates theoretical constructs that are expected to affect the relationship between stress and performance. The purpose of the study was to test specific aspects of the proposed model of stress and performance believed to provide a central role in predicting performance outcomes. The outcome variables include performance on a practical test during the training program (100-point scale) and overall program completion (complete/non-complete).

The study has two main hypotheses that are derived from the study's proposed model of stress and performance. The first main hypothesis describes variables that are expected to predict practical test performance. The second main hypothesis involves variables that are expected to predict program completion.

Hypothesis 1: Variables Predicting Practical Test Performance

The first main hypothesis is that temporally recent (R) variables (R relations with peers, R relations with instructors, R relations with significant others, R inattention, R impulsivity, R negative affect, R fatigue) in combination with (S) situational variables (S inattention, S cognitive anxiety, S somatic anxiety, S problem solving self-efficacy, S problem solving approach), and with interactions among these variables and enduring (E) variables (E inattention, E fears of cognitive catastrophe, E fears of somatic catastrophe, E conscientiousness) will predict performance on a practical test. Practical test performance is a continuous variable that is operationalized as a test score on a 100-point scale.

This hypothesis includes four subhypotheses:

1. Recent (R relations with peers, R relations with instructors, R relations with significant others, R inattention, R impulsivity, R negative affect, R fatigue) and situational variables (S inattention, S cognitive anxiety, S somatic anxiety, S problem solving self-efficacy, S problem solving approach) will *independently* predict practical test performance because studies have found evidence supporting the relationship between each of these variables and performance.
2. Recent variables (R relations with peers, R relations with instructors, R relations with significant others, R inattention, R impulsivity, R negative affect, R fatigue) will *jointly* predict program performance after controlling for demographics, social desirability, and daily problems. The recent variables are factors that are expected to exist prior to and possibly independent of the testing situation.
3. Situational variables (S inattention, S cognitive anxiety, S somatic anxiety, S problem solving self-efficacy, S problem solving approach) will *jointly* predict program performance after controlling for demographics, social desirability, daily problems, and recent variables. The situational variables are conceptualized as factors that are primarily associated with and limited to the specific testing situation.
4. Six interactions (E inattention X S cognitive anxiety, E fears of cognitive catastrophe X S inattention, E fears of somatic catastrophe X S somatic anxiety, E conscientiousness X S inattention, S problem solving skills X E inattention, S problem solving skills X S cognitive anxiety) will *jointly* predict practical test performance after controlling for demographics, social desirability, daily problems, and recent and situational variables. The first three of these

interactions represent vulnerability interactions where the enduring variable (i.e., E inattention, E high fears of cognitive catastrophe, E high fears of somatic catastrophe) increases the risk that performance will degrade when the individual experiences a given situational variable (i.e., S cognitive anxiety, S inattention, S somatic anxiety). The last three of these interactions represent protective interactions in which either an enduring variable (conscientiousness) or a situational variable (problem solving skills) is protective against performance degradation that is normally associated with the either situational inattention or situational cognitive anxiety.

a. The interaction between E inattention and S cognitive will predict practical test performance. More specifically, low E inattention increases a person's vulnerability to performance decrements associated with high S cognitive anxiety. The rationale for this hypothesis is that people with low E inattention are more vulnerable to being distracted by S cognitive anxiety.

b. The interaction between E fear of cognitive catastrophe and S inattention will predict performance on the practical test. This hypothesis expects that E fear of cognitive catastrophe will increase the likelihood of poor performance associated with low S inattention. The symptoms associated with low inattention are expected to activate fears of cognitive catastrophe, thereby increasing anxiety (including symptoms of low inattention) and decreasing focus on the performance task.

c. The interaction between E fear of somatic catastrophe and S somatic anxiety will predict performance on the practical test. The symptoms associated with somatic anxiety are expected to activate fears of somatic catastrophe, thereby increasing anxiety (including symptoms of somatic anxiety) and decreasing focus on the performance task.

d. The interaction between E conscientiousness and S inattention will predict performance on the practical test. In this interaction, when a person is experiencing high S inattention, the tendency to be systematic associated with E conscientiousness is expected to provide a structure (means of controlling) for keeping attention on the performance task.

e. The interaction between S problem solving skills and E inattention will predict performance on the practical test. In this interaction, when a person characteristically is inattentive (high E inattention), the practice of using problem solving skills (high S problem solving skills) is expected to provide a structure (means of controlling) for keeping attentional resources on the performance task.

f. The interaction between S problem solving skills and S cognitive anxiety will predict performance on the practical test. In this interaction, when a person is experiencing cognitive anxiety in a testing situation (high S cognitive anxiety), the practice of using problem solving skills (high S problem solving skills) is expected to provide an structure (means of controlling) for keeping attentional resources on the performance task.

Hypothesis 2: Variables Predicting Training Program Completion

The second main hypothesis proposes that the enduring variables (general cognitive ability, conscientiousness, neuroticism, trait anxiety, social performance anxiety, anxiety sensitivity, problem solving skills, inattention, impulsivity, problem solving orientation) will predict performance in the EOD training program as defined as the dichotomous outcome of completing or not completing the training program.

This main hypothesis involves four sub-hypotheses:

1. Each of the enduring variables will independently predict program performance because studies have found evidence supporting the relationship between each of these variables and performance.
2. Stable enduring variables (general cognitive ability, conscientiousness, neuroticism, trait anxiety, social performance anxiety, anxiety sensitivity) will jointly predict program performance after controlling for demographics, social desirability, and major life changes. These stable enduring variables are considered to be relatively non-modifiable, especially in the context of brief psychosocial interventions. The demographic variables include age, sex, race, marital status, military rank, military service, years of military service. The demographic variables and social desirability are expected to potentially bias responses on the self-report instruments.
3. Modifiable enduring variables (inattention, impulsivity, problem solving skills, problem solving orientation) will jointly predict program performance after controlling for demographics, social desirability, major life changes, and stable enduring variables. The modifiable enduring variables are expected to be

relatively more amenable to interventions than the stable enduring variables. Therefore, these variables could be a target of a brief psychosocial intervention if they are found to affect performance beyond the influence of more stable preexisting variables.

4. The interaction between two of the model's central variables, enduring inattention and problem solving skills, will jointly predict program performance after controlling for demographics, social desirability, major life changes, and stable and modifiable enduring variables are controlled. Problem solving skills are expected to have a greater effect on the performance of people with high inattention as opposed to low inattention. The rationale for this hypothesis is that, when inattention is high, problem solving skills may improve performance by providing an external structure for attention (e.g., the direction and regulation of cognitive resources).

RESEARCH DESIGN & METHODS

Study Participants

The subjects were U.S. military enlisted personnel who initiated training at the EOD School at Eglin AFB, FL. These subjects were in classes that entered training between 10 Aug 99 and 18 Oct 00. During that period, students from 28 classes were briefed on the study and asked to participate. The study brief was given each incoming class of students on their first day of training during their orientation briefings. Of the 517 students who were briefed on study participation, 498 (96%) students completed the informed consent documentation agreeing to participate in the study.

Data was collected at three subsequent time points: immediately following the study brief on the first day of training and before and after the students took their first practical test during the 5th day of training.

Invalid Questionnaires

The determination of invalid questionnaire packages was based on two criteria: indistinguishable student identification and response patterns indicating biased responding. The factors associated with indistinguishable student identification included student codes being missing, partially completed, or not matching the master list. These factors were identified in two questionnaire packages from time point one (beginning of the training program), five questionnaire packages from time point two (immediately before the practical test on day five), and no questionnaire packages from time point three (immediately following the practical test on day five).

Response patterns indicating biased responding was associated with completing less than half of the questionnaires in a questionnaire package, providing the same response on two consecutive inventories, and writing comments indicating that they were not responding directly to the questions. These factors were identified in two questionnaire packages from time point one (at the beginning of the training program), five questionnaire packages from time point two (immediately before the practical test on day five), and four questionnaire packages from time point three (immediately following the practical test on day five). The determination of response patterns indicating biased responding was made blinded to the outcome measures.

Outcome Variables

In order to predict the relationship between stress and performance, performance must be operationalized in a clear and meaningful manner. Performance in an organizational context can be defined as all measurable work behaviors that are related to organizational goals and within the individual's control (Campbell, Gasser, & Oswald, 1996). Organizational performance typically involves many different outcomes so it is important to select performance criteria that are also related to the goal of an analysis. The primary goal of the EOD study is to identify variables that predict attrition, which can be thought of as program performance. Academic and practical test scores determine program performance. Non-academic reasons for leaving the program include a voluntary resignation, inability to maintain physical fitness or weight standards, inability to qualify for a security clearance, disciplinary problems, and personal emergency situations.

Practical Test Performance

The student's performance was measured on the first practical test in the first division of training (Core Division). There were two reasons for selecting the first practical test in Core Division. First, because the test involves fundamental skills that are required for the rest of the training program, performance on this test is directly related to performance in later training. Second, the test is part of the first division of training, so that the study can sample a maximum number of students who do not continue in training are included in this situational measure of performance. Practical test performance is evaluated on a 100-point scale and the grade is the number of points out of 100.

EOD Training Program Completion

The successful completion of the EOD training program is the ultimate performance measure because the study has been requested for the purposes of reducing student attrition. In order to pass the EOD training program, students must pass all academic and practical tests, with an allowance for a second attempt for failed tests. Program performance is measured by the dichotomous outcome of completion or non-completion. Non-completion can be due to a variety of reasons. Data from the EOD School from Fiscal Years 1999 and 2000 indicated that approximately 60% of attrition was due to academic failures, 20% to Drop On Requests (DORs), and 20% to other non-academic reasons. However, the EOD staff indicated that DORs are often associated with academic performance problems. The non-academic other reasons include discipline/misconduct, medical, inability to gain security clearance, and inability to meet physical fitness and weight standards.

Control Variables

Demographic Variables

The study collected seven sociodemographic variables from the subjects and their military records. The variables include age, gender, race, marital status, military rank, military service, and years of service.

Response Bias

Social Desirability

The Marlowe Crowne Social Desirability Scale (SDS; Crowne & Marlowe, 1964) was used to measure social desirability. The SDS is a 33-item scale that measures a person's need for social approval.

External Stressors

Major Life Changes

The Life Experiences Survey (LES; Sarason, Johnson, & Siegel, 1978) was used to measure the impact of life changes. The LES is a list of 57 events that are associated with life changes. The respondents are asked to indicate which events they have experienced and whether they perceived the event as having a positive or negative impact on their life. Examples of some events are marriage, death, change in sleeping or eating habits, and various interpersonal difficulties. Sarason and colleagues (1978) found that the LES demonstrated adequate psychometric properties.

Daily Life Problems

The Survey of Recent Life Experiences (SRLE; Kohn & Macdonald, 1992) was used to measure routine problem events, which are also known as daily hassles. The SRLE is a 51-item self-report list of common problematic experiences such as not having enough leisure time, car problems, and a variety of minor financial and interpersonal difficulties. The directions instruct the respondent to rate the intensity of each possible experience on a scale from 1 (not at all part of my life) to 4 (very much part of my life).

The SRLE was developed to address methodological problems with other measures of daily hassles (Kanner et al., 1981). Measures of daily hassles have been critiqued for contaminating the measure of hassles experienced with stress-related physical and mental distress associated with these hassles (Dohrenwend & Shrout, 1985; Reich, Parrella, & Filstead, 1988). Therefore, the items of the Hassles scale included the same physical and mental distress that the scale was designed to predict. In contrast, the SRLE items were designed to be free of this sort of contamination. Instead of having respondents rate the severity of their experience, the respondents are directed to indicate the extent of each experience over a given time frame.

Kohn & Macdonald (1992) reported that the SRLE demonstrated adequate psychometrics. The alpha correlation of the SRLE was .91 and .92 in two item-selection subsamples (Kohn & Macdonald, 1992). Likewise, the correlation between the SRLE and the perceived stress scale was .57 and .60 in the same two subsamples. Further exploration of the SRLE's psychometrics indicated that the scale is composed of six factors: (1) Social and cultural difficulties, (2) Work, (3) Time pressure, (4) Finances, (5) Social acceptability, and (6) Social victimization.

Predictor Variables

Selection Criteria for Measures

Measures were selected based on theoretical, empirical, and pragmatic considerations. The most important theoretical concern was how well a measure assessed the target variable from the model. In addition, the measure was expected to be sensitive to differences between non-clinical subjects as well as be able to measure subclinical levels of a variable.

The scales were also evaluated according to the strength of psychometric properties and the availability of suitable norms. Psychometric properties included reliability and validity statistics. In addition, scales were selected that had norms for non-clinical populations.

Lastly, the scales were selected based on their brevity. The brevity of measures is of pragmatic importance because the EOD students have very little free time during their training schedule for assessment procedures and many measures are needed to assess the comprehensive range of predictors and outcomes. Moreover, a secondary goal of this study is to identify short measures that may be useful screening tools in other military contexts. Therefore the measures are relatively short, so as not to adversely impact student training as well as to be viable for future use with EOD students and other military populations.

Enduring Factors

The study's model includes enduring abilities, beliefs, and attitudinal variables. The enduring abilities include general cognitive ability, inattention, impulsivity, and

problem-solving skills. The enduring beliefs and attitudes are represented by problem-solving orientation, three dimensions of trait anxiety (general, social performance, and anxiety sensitivity), and personality traits.

General Cognitive Ability

Spearman (1927) proposed that general cognitive ability is a single factor that can explain most of an individual's performance on many different types of intellectual activity (e.g., verbal, mathematical, and spatial). It follows then that general cognitive ability is typically measured with a battery of tests of different cognitive abilities. The Armed Services Vocational Aptitude Battery (ASVAB) provides a well-researched measure of several cognitive abilities from which to derive a general cognitive ability score (Ree & Carretta, 1994; Ree & Earles, 1991).

The ASVAB is a measure that was developed jointly for use in all the armed services (Bayroff & Fuchs, 1970). The ASVAB is designed to be a screening and classification instrument. The ASVAB consists of 10 subtests: Arithmetic Reasoning (AR), Numerical Operations (NO), Paragraph Comprehension (PC), Word Knowledge (WK), Coding Speed (CS), General Science, Mathematics Knowledge, Electronics Information, Mechanical Comprehension, and Automotive and Shop Information.

The ASVAB contains power and speeded tests. The power tests allow enough time that every subject should be able to attempt all test items whereas speeded tests are time limited and score differences are partly determined by the speed of an individual's performance (Anastasi, 1988). Only two of the ASVAB subtests, NO and CS, are speeded tests. The rest are power tests.

Various composites of ASVAB subtests are used for screening military personnel for different career fields. According the ASVAB technical manual, the Armed Forces Qualifications Test (AFQT) is a basic composite that has served as a qualifying measure of "trainability" across the services since the 1950's (US Department of Defense, 1994). The AFQT consists of the AR, NO, PC, and WK subtests. The AFQT score will be used as the measure of general cognitive ability for the present study.

The ASVAB composites and test scores have demonstrated moderate to strong reliability. The Kuder Richardson Formula 20 (KR 20) internal consistency coefficients range between .92 and .96 for ASVAB composite tests and between .71 and .91 for individual power tests. In addition, the alternate-form reliability for the ASVAB speeded tests range between .77 and .85.

The ASVAB composites have also been shown to predict performance in over 50 military technical training programs, with a median coefficient over .60 (U.S. Department of Defense, 1984a; Maier & Truss, 1984). In addition, a series of studies by a joint-service research program has found that ASVAB scores predicts performance of many military jobs, as evidenced by correlations ranging from .23 to .73 (U.S Department of Defense, 1981, 1982a, 1983, 1984a, 1985, 1986a, 1987).

Anxiety

Three dimensions of anxiety will be measured using different clinical scales that have been normed with non-clinical populations. These dimensions include general anxiety, social performance anxiety, and anxiety sensitivity.

General/Test Anxiety

Trait anxiety was measured by the Trait Anxiety (A-trait) subscale of Spielberger et al.'s (1970) State-Trait Anxiety Inventory (STAI). Moreover, because the STAI measure of trait anxiety has been found to be equally or more predictive of test performance than three measures of test anxiety (Bedell & Marlowe, 1995), the STAI will be used to represent both general and test anxiety. The STAI is a 20-item self-report measure that has demonstrated high internal consistency (.86-.95; (Kendall & Watson, 1989) and strong test-retest reliabilities (r = .76-.84 over a 20-day interval and r = .73-.77 over a 104-day interval) with college students (Spielberger, Gorsuch, & Lushene, 1970).

Social anxiety

The Social Phobia Scale (SPS), which was developed by Mattick and Clark (1989), was used to measure social anxiety in performance situations. The scale, which consists of 20 items, measures anxiety in non-contingent situations where the individual receives very little feedback from others while carrying out tasks such as testing situations. The SPS is typically administered with a measure of another form of social anxiety by the same authors, the Social Interaction Anxiety Scale (SIAS), which is designed to measure anxiety in contingent situations where the individual must interact with others. With normal samples made up of undergraduate students and community volunteers, the SPS and SIAS have demonstrated good internal consistency (α = .85-.93), adequate (r = .66 for the SPS) to good (r = .86 for the SIAS) test-retest reliability, and average to good correlations with other established self-report measures of social anxiety (r = .53-.82; (Heimberg et al., 1992).

Anxiety Sensitivity

The Anxiety Sensitivity Index (ASI; Reiss et al., 1986) was used to measure anxiety sensitivity, which is the extent to which a person believes autonomic arousal can have harmful consequences (Reiss & McNally, 1985). The ASI is a well-researched self-report measure of the dispositional model of anxiety sensitivity. The ASI has 16 items that assess the fear of anxiety-related symptoms and a concern about negative meaning of symptoms or that symptoms will result in negative consequences. The reliability reports vary from acceptable to strong correlations for a two-week interval ($r = 0.75$; Reiss et al., 1986), three-year period ($r = .71$; Maller & Reiss, 1992) and split-half reliability ($r = 0.85$; (Peterson & Heilbronner, 1987).

Using exploratory and confirmatory factor analyses, Zinbarg, Barlow, and Brown (1997) found a three-factor solution for the ASI. This factor solution is consistent with the multiple factor solutions reviewed by Taylor (1995). In addition, these factors have been found to be generally consistent across clinical and non-clinical populations and across genders (Stewart, Taylor, & Baker, 1997; Zinbarg, Barlow, & Brown, 1997). The factors were organized as fears of catastrophes pertaining to physical harm (e.g., heart attack), cognitive harm (e.g., going crazy), and social judgment. The physical harm factor is defined by eight items (3, 4, 6, 8, 9, 10, 11, 14), the cognitive harm factor consists of four items (2, 12, 15, 16) and the social judgment factor is also made up of four items (1, 5, 7, 13).

Inattention and Impulsivity

Inattention and impulsivity symptoms are the primary diagnostic criteria for attention deficit hyperactivity disorder (ADHD). Measures of ADHD symptoms are appropriate for normal subjects because ADHD symptoms are conceptualized as a trait that is continuously distributed in the general population (Taylor, 1994) and studies support the view that ADHD symptoms occur on a continuum (Levy, et al., 1997).

The title of the Current Behaviors Scales for adults is a modified title of scale that was developed as a measure of the presence or absence of the 18 clinical symptoms of ADHD. These symptoms were established for partial determination of ADHD diagnosis on the basis of expert consensus, as described in the Diagnostic and Statistical Manual: Fourth Edition (DSM-IV) classification system. Standardization of these measures was based on a convenience sample of 720 adults presenting for renewal of driver's licenses in Massachusetts, and normative data is provided for three age groupings (17-29, 30-49, 50+) (Murphy & Barkley, 1996b). The scales yield two scores corresponding to inattention (distractibility) and hyperactivity/impulsivity criteria.

Conscientiousness and Neuroticism

The study used the NEO Five Factor Index (FFI; Costa & McCrae, 1992) to assess two dimensions of personality that are relevant to stress responses and performance. These dimensions are conscientiousness and neuroticism.

The FFI is a shortened version of the NEO PI-R Form S, which is an extensively researched measure of the five-factor model of personality. The NEO FFI is comprised of 60 items and the test requires 10-15 minutes for an adult with 6th-grade reading skills.

The FFI scale scores correlate .77-.92 with NEO PI-R domain scales. In addition, the FFI scale scores have been found to have adequate to strong Internal consistency, ranging from .68-.86.

Problem Solving Orientation and Skills

Enduring problem solving was assessed by the Social Problem-Solving Inventory-Revised (SPSI-R; D'Zurilla, Nezu, & Maydeu-Olivares, 2000). The SPSI-R is a 52-item self-report inventory that measures five dimensions of social problem solving. These five dimensions include two types of orientation to a problem, positive and negative, and three types of response styles including rational problem solving, impulsivity-carelessness style, and avoidance style. All five scales have demonstrated adequate to high internal consistency (α = .69-.95) and test-retest correlations (r = .68-.91) with non-clinical subjects (Kant, D'Zurilla, & Maydeu-Olivares, 1997). Structural, concurrent, predictive, and convergent and discriminant validity of the SPSI-R has been established (for review, see D'Zurilla, Nezu, & Maydeu-Olivares, 1996).

The study used two scales from the SPSI-R. These scales are associated with two main components of the problem solving process. The scales are problem solving orientation and problem solving skills.

Recent Factors

The proposed model includes recent environmental events (social relations), internal processes (inattention and impulsivity), and internal conditions (affective distress and fatigue).

Social Relations

The perceived quality of relationships on several levels of social interaction was measured because each of these relationships is expected to have significant and unique influences on student's responses to stress and performance.

Relations with instructors and peers

The Work Environment Scale – Form R (WES; Moos, 1986) was used to measure two variables representing perceptions of social support from instructors and peers. The WES Form R is a 90-item self-report inventory that assesses 10 subscales including involvement, peer cohesion, supervisor support, autonomy, task orientation, work pressure, clarity, control, innovation, and physical comfort. The internal consistencies are moderate for supervisor support ($\alpha = .77$) and peer cohesion ($\alpha = .69$). Likewise, the supervisor support and peer cohesion subscales have shown adequate test-retest reliabilities for one month ($r = .71$-$.82$) and 12-month ($r = .51$-$.58$) periods.

Relations with significant others

Social support from significant others was measured by the total score from the Dyadic Adjustment Scale (DAS; Spanier, 1976) measures. The DAS is a 32-item self-report of the quality of the relationship between married or cohabitating couples, which also yields four factors of a relationship: dyadic satisfaction (DS), dyadic cohesion (DCoh), dyadic consensus (Dcon), and affection Al expression (AE). The DAS has a high internal consistency ($\alpha = .96$) and the subscales have fair to excellent internal consistency ranging from .73 to .94. Evidence of the validity of DAS is supported by the

DAS's ability to distinguish between married and divorced couples on each item and significant correlations with the Locke-Wallace Marital Adjustment scale.

Inattention and Impulsivity

The Work Performance Rating Scale from Barkley and Murphy's (1998) clinical workbook was used to measure recent inattention and impulsivity. As with the measures of enduring inattention and impulsivity, this measure was developed to assess the presence or absence of the 18 clinical symptoms of ADHD (Barkley, 1998). Standardization of these measures was based on a convenience sample of 720 adults presenting for renewal of driver's licenses in Massachusetts, and normative data is provided for three age groupings (17-29, 30-49, 50+) (Murphy & Barkley, 1996a). The scales yield two scores corresponding to inattention (distractibility) and hyperactivity/impulsivity criteria.

Affective Distress and Fatigue

This study used two variables, affective distress and fatigue, to represent recent responses to stressors. Affective distress was measured by the Outcomes Questionnaire (Seelert, 1997) and fatigue was measured with the Short Form 36 (Ware & Sherbourne, 1992). Both the Outcomes Questionnaire and Short Form 36 are measures of general health. A single scale is used from each of these instruments to represent affective distress and fatigue.

The Outcomes Questionnaire (OQ -10.2) is a brief measure for identifying medical patients who are experiencing significant amounts of distress and may need

further mental health screening. The OQ-10.2 consists of 10 items that were derived from the 45 items on the OQ-45.2, a measure that has excellent psychometric properties including stability as a repeated measure with nontreated clinical subjects and sensitivity to change in clinical subjects who received treatment (Burlingame, Lambert, Reisinger, Neff, & Mosier, 1995).

The OQ-10.2 has demonstrated adequate reliability. Test-retest reliability was found to be $r = .62$ in a sample of community volunteers (N=180) tested over a three-week period. The internal consistency of the OQ-10.2 is high, suggesting that the scale items are measuring a similar construct.

Research also indicates that the OQ-10-2 is a valid screening tool for general distress. Seelert (1997) found that the OQ-10.2 was correlated with several functioning and mental health subscales, including Mental Health ($r = -.77$; Anxiety & Depression ($r = .72$); General Health ($r = -.70$); Self-esteem ($r = -.70$); Social Health ($r = -.60$); Physical Health ($r = -.33$); Perceived Health ($r = -.32$); and Pain ($r = .23$). All correlations were significant at the .001 level of confidence (Seelert, 1997). Moreover, an OQ-10.2 cutoff score of >12 resulting in a specificity/sensitivity of > .70 for identifying distressed patients in need of further screening.

The Short Form-36 (SF-36; Ware & Sherbourne, 1992) is a 36-item instrument that measures eight dimensions of health: physical functioning (PF), role physical (RF), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH). The SF-36 takes approximately 10 minutes to complete and has demonstrated moderately high internal consistency across the six scales

(α = .81-.87). Criterion validity and relative precision have been established for the SF-36 scales (McHorney, Ware, Rogers, Raczek, & Lu, 1992).

Situational Factors

The proposed model includes situational cognitive processes and beliefs (e.g., inattention and problem-solving self-efficacy) and situational responses (e.g., problem solving approach, cognitive anxiety, and somatic anxiety). The difference between these groups of factors is theoretically important because the cognitive processes and beliefs are expected initially to precede the situational responses and have more effect on the situational responses than vice versa. However, the factors in these two groups are also expected to interact bi-directionally as proposed by the model.

Inattention and Cognitive and Somatic Anxiety

Situational inattention and two forms of situational anxiety, cognitive and somatic, was measured with the Cognitive and Somatic Anxeity Questionnaire (CSAQ; Calvo, Alamo, & Ramos, 1990). The CSAQ items were developed based on items from 14 previously validated scales (e.g., Cox & McKay, 1985; King, Burrows, & Stanley, 1983; Schwartz et al., 1978). The questionnaire contains two scales, one measuring cognitive aspects of anxiety and the other measuring somatic symptoms of anxiety. Each scale contains 10 items each and has been found to be highly internally consistent with coefficient of alpha values between 0.86 and 0.88.

The CSAQ has been rationally divided into two subscales that theoretically represent inattention and cognitive anxiety. Inattention was defined as items that

reflected difficulties in the process of controlling attention and that were not directly associated with worry. Three CSAQ items were selected to represent the process of inattention (10, 12, 20). These items included "I find it difficult to focus my attention on the tasks", "Thoughts irrelevant to task performance run through my mind", and "I cannot concentrate on the tasks".

In contrast, cognitive anxiety was defined as directly reflecting worrisome thought content and other beliefs about the ability to perform. Seven items (2, 4, 6, 8, 14, 16, 18) theoretically reflect cognitive anxiety. These items are "I feel skilled at these tasks", "I think I am failing at these tasks", "I feel self confident about my performance", "I feel uneasy concerning the tasks", "I think other students are more skilled than I am", "I am worrying about my performance", and "I think I will have a low outcome".

Problem Solving Self-Efficacy and Skills

Two situational problem solving variables, self-efficacy and skills, were assessed by a version of the Problem Solving Inventory (PSI; Heppner & Petersen, 1982) that was modified by Maydeu-Olivares and D'Zurilla (Modified PSI, Maydeu-Olivares & D'Zurilla, 1997). The original PSI is a 35 item self-report scale that was designed to measure how an individual thinks he/she reacts to daily problems. These items were created based on D'Zurilla and Goldfried's (1971) problem solving model. Responses are made on a six point likert scale ranging from "strongly agree" to "strongly disagree" (D'Zurilla & Goldfried, 1971).

Based on the observation that the original PSI did not adequately reflect social problem-solving theory, Maydeu-Olivares and D'Zurilla (1997) conducted a theoretical

and empirical analysis of the PSI scales and items. The PSI items were analyzed for theoretical correspondence to social problem-solving theory and 16 items were selected as being directly relevant. A maximum likelihood factor analysis was conducted on responses of 415 undergraduate students on these 16 items, which found a two-factor solution. These factors were labeled problem solving self-efficacy and problem solving skills. Both scales demonstrated strong measures of internal consistency, with coefficient alphas equal to .79. In addition, both scales were highly correlated with the corresponding scales from the SPSI-R. For example, the Modified PSI measure of PS self-efficacy was strongly related to the two problem-solving orientation scales of the SPSI-R, positive and negative problem orientation, r = .61 and -.69 respectively. This correlation is especially strong considering that the Modified PSI's construct of PS self-efficacy does not include several aspects of problem orientation such as challenge and threat appraisals, problem solving outcome expectancies, and frustration tolerance (Chang & D'Zurilla, 1996; Maydeu-Olivares & D'Zurilla, 1996).

Modifications to Assessment Instruments

Modifications were made to several instruments to improve their readability and applicability to this study. The changes were minor and expected to have little impact on the psychometric properties of the tests, especially for comparison purposes within EOD students. For example, in WES items, references to "supervisors" were changed to "supervisors/instructors" and references to "employees" were changed to "employees/trainees" to make several items more applicable. Similar changes have been made to some of the items in the PSI and the CSAQ.

Procedures

Focus Group

Prior to running the study, a focus group was conducted with student volunteers from a class who had just completed EOD training. The focus group was conducted after receiving IRB approval and consenting the students. The information gathered from the focus groups was used to refine study hypotheses. Description of focus group procedures was submitted to the IRB as a separate document. To assure confidentiality of focus group participants, students were asked to use first names only and the audiotape of the focus group was erased after general information had been noted.

Recruitment

Classes of students were briefed about study participation during their first week at EOD training. The briefing included: (1) a description of the study, (2) steps to ensure confidentiality, (3) limits to confidentiality. After the study was explained, consent forms were distributed and signed. Students who refused to participate were asked to release information from their EOD and military records for the purpose of ensuring that the study is not recruiting a biased sample.

Assessment Periods

There were three assessment periods during which a variety of self-report questionnaires were administered. These assessment periods include a baseline, pre-test, and post-test assessment. The baseline assessment, which was conducted before the training program began, was designed to measure enduring variables. The pre-test and

post-test assessments were administered before and after the first practical test in the first division of training (Core Division). These pre-test and post-test assessment periods was designed to assess recent and situational factors respectively.

The baseline assessment period was conducted on the second day of the training program in the morning (0630-0730). Because the first day of the EOD program was used for indoctrination briefings and inprocessing procedures, this assessment time point was before the start of formal training courses. This time point consisted of a questionnaire package that assessed all of the enduring variables except for general cognitive ability (see Table 3).

Insert Table 3 here

The pre-test and post-test assessment periods were used to assess recent and situational variables associated with a specific practical test. A practical test during Core division was selected for several reasons. First, Core Division was associated with one of the highest levels of attrition. Therefore, Core Division was presumably associated with high levels of stress. In addition, it was also important to assess students during Core division because a main objective of the study is to predict the students who have difficulties with the training program. Lastly, the assessment sessions was scheduled the day of the first major practical test in order to measure the stress associated with an approaching test.

The pre-test assessment period was the morning (0630-0730) of the day that the students took their first practical test. The questionnaire packages were filled out before

the practical testing started, providing a prospective measure of the variables that were used to predict practical test performance outcome. This questionnaire package was designed to assess recent variables (e.g, affective distress and fatigue; see Table 4).

Insert Table 4 here

After the students completed the pre-test questionnaire package, they were given the post-test questionnaire package and were instructed to fill out this package immediately following their practical test. This questionnaire package was designed to measure situational performance factors (e.g., cognitive and somatic anxiety during testing; see Table 5). The post-test questionnaire package was designed to be filled out in a short amount of time (10 minutes or less) immediately after finishing the practical test, before the evaluator gave the student feedback on the student's performance.

Insert Table 5 here

In contrast to the variables that were measured prospectively in the pre-test assessment period, the post-test questionnaire package retrospectively assessed situational variables. There are two reasons for assessing these variables retrospectively. The retrospective assessment allows the measurement of variables from before and during the testing process. In addition, the situational measures asked questions about how the student expected to perform and prospective measures of these questions might have influenced a student's performance. By assessing these situation specific variables

after the practical test, the assessment process minimized the likelihood of interfering with the students' practical test performance.

In summary, there were three assessment periods (see Figure 2). The baseline assessment was conducted before the training classes have begun. The baseline was designed to assess enduring factors. The pre-test and post-test assessments were scheduled on the day of the first practical test in Core division. These time points assessed variables that were used to predict practical test performance. The pre-test assessment period prospectively assessed recent variables before the practical test. The post-test assessment period retrospectively assessed situational variables specific to the practical test.

Insert Figure 2 here

STATISTICAL ANALYSES

Comparisons of Variables across Services

Each of the four services admits students to EOD training using different screening criteria and processes, which may lead to differences among students from each service. To investigate potential inter-service differences, mean values of all variables were generated for each service and between-service comparisons were analyzed using one-way ANOVAs. In addition, the relationships between specific services were clarified with post-hoc analyses comparing mean differences. Scheffe criteria were used as the most conservative form of post hoc test available in SPSS.

Main Hypotheses

The main study hypotheses were tested with multivariate regression models. Multivariate regressions were used to test the strength of association between predictors and outcome measures (Cohen & Cohen, 1983). One of the models was a linear regression based on a continuous outcome of practical test graded on a 100-point scale, and the other model was a logistic regression based on the dichotomous outcome of EOD training program success (completion/non-completion).

The development of each multivariate regression model incorporated the model building strategies that are recommended by Hosmer and Lemeshow (1989). Each multivariate analysis was preceded by univariate analyses to determine the association between each individual predictor and the outcome. The univariate analyses were used primarily to screen out predictor variables that have weak relationships with the outcome variable (alpha level > .05). According to Hosmer and Lemeshow (1989), the reason for

screening out predictor variables is to minimize the number of variables that are entered in the multivariate model and thereby increase the likelihood of the model being numerically stable and more easily generalizable.

Interactions between predictor variables that had significant univariate relationships with the outcome variables were plotted using three steps outlined by Preacher (2001). The computations used the unstandardized regression coefficients. The first step involved creating formulas for two lines representing high and low conditions of one of the predictors (high and low Variable 1 lines). Assigning the predictor variable with high and low values and then solving the line formula in terms of the other predictor and the outcome variable created each of the formulas for these lines. The low value was the mean minus one standard deviation and the high value was the mean plus one standard deviation. The second step assigned high and low values to the other predictor to high and low values and solved the line equations for these values (high and low Variable 2 x-axis intercepts). The high and low values of the other predictor were also defined as the mean plus and minus one standard deviation respectively. The third step involved plotting the outcome of the formulas for the two lines representing high and low Variable 1 with the values of high and low Variable 2.

After the predictor variables for each model were selected, the variables were hierarchically entered in their respective model. The hierarchical design requires a sequential entry of blocks of variables. The composition and order of blocks of variables are based on the study's overall stress and performance model and the specific hypotheses being tested.

Hypothesis 1

The first hypothesis proposed that recent variables (R relations with peers, R relations with instructors, R relations with significant others, R inattention, R impulsivity, R negative affect, R fatigue), situational variables (S inattention, S cognitive anxiety, S somatic anxiety, S problem solving self-efficacy, S problem solving approach), and interactions among enduring and situational factors would predict practical test performance as operationalized by a grade on a 100 point scale.

The univariate analyses involved correlations between all predictor variables. The correlations between predictor variables were used to determine if any two variables share an extensive amount of variance, as defined as at least $r = .75$. If two predictor variables were highly correlated, then only one of the two variables was retained. The judgment about which variable was to be retained was determined by the factor that had the strongest relationship with the outcome variable.

The univariate analyses also included correlations between each predictor variable and the practical test score. These correlations were used to determine if each predictor variable has a statistically and pragmatically meaningful relationship with the outcome variable. Statistical significance was determined by an alpha level $\leq .05$. Practical significance was defined as a predictor variable that explains at least 3 % of the variance ($r = .09$) in practical test performance. Predictor variables that met criteria for the criteria for statistical and practical significance were retained for use with the multivariate model.

Once the predictor variables were selected for the final model, then the predictor variables were entered in a hierarchical linear regression model. The blocks of predictor variables were determined by the study's theoretical model. The groupings of variables

in each block are based on their potential for being modified and importance in the study's model.

The first block of variables statistically controlled for the effects of demographic variables (age, sex, race, marital status, military rank, military service, years of military service), response bias (social desirability), and external stressors (daily life problems). In contrast, the recent and situational predictor variables in blocks two and three respectively are theoretically more modifiable and are key components of the study's model. The recent and situational variables are conceptually different based on previously-defined temporal distinctions. The recent variables are conceptualized as contextual variables that exist prior to and independent of the testing situation. Situational variables are considered to be factors that are primarily associated with and limited to the specific testing situation.

The fourth block of variables consists of interactions among situational and enduring variables.

In summary, the overall hierarchical regression model predicting practical test performance includes the following blocks of variables:

Block 1: Control variables: demographic variables (7 variables: age, sex, race, marital status, military rank, military service, years of military service), social desirability, environmental stressors (daily life problems)

Block 2: Recent (R) predictor variables (7 variables: R relations with peers, R relations with instructors, R relations with significant others, R inattention, R impulsivity, R negative affect, R fatigue)

Block 3: Situational (S) predictor variables: (5 variables: S inattention, S cognitive anxiety, S somatic anxiety, S problem solving self-efficacy, S problem solving approach)

Block 4: Interactions among enduring (E) and situational (S) variables: (6 interactions: E inattention X S cognitive anxiety, E fears of cognitive catastrophe X S inattention, E fears of somatic catastrophe X S somatic anxiety, E conscientiousness X S inattention, S problem solving skills X E inattention, S problem solving skills X S cognitive anxiety)

Hypothesis 2

The second hypothesis proposed that enduring variables (general cognitive ability, conscientiousness, neuroticism, trait anxiety, social performance anxiety, social interaction anxiety, anxiety sensitivity, inattention, impulsivity, problem solving skills, problem solving orientation) would predict performance in the EOD training program as defined as the dichotomous outcome of passing or failing the training program.

The univariate analyses involved correlations between all predictor variables. The correlations between all predictor variables were used to determine if any two variables share an extensive relationship, which is defined as $r > .75$. If two predictor variables were highly correlated, then one of the two variables was retained. The judgment about which variable was to be retained was determined by the factor that had the strongest relationship with the outcome variable.

The univariate analyses also involved univariate logistic regression analyses between each predictor variable and the practical test score. The criterion for retaining predictor variables was a Wald chi-square probability of 0.05.

Four blocks of predictor variables were entered in the hierarchical multivariate logistic model. The first block of variables statistically controlled for the effects of demographic variables (age, sex, race, marital status, military rank, military service, years of military service), response bias (social desirability), and external stressors (major life changes).

The second and third blocks represent hypotheses that two types of enduring predictor variables, stable and modifiable, will predict program performance. The third block consists of the non-modifiable variables because they are considered to be relatively stable (e.g., general cognitive ability and personality dimensions). In contrast, the fourth block represents the influence of the predictor variables that are expected to be relatively more amenable to interventions. The order of entry is designed to evaluate the effects of enduring non-modifiable variables first and then the residual contribution of modifiable variables after controlling for non-modifiable contributions.

Lastly, the fourth block represented an interaction between two of the model's central variables, enduring inattention and problem solving skills. Problem solving skills were expected to have a greater effect on the performance of people with high inattention as opposed to low inattention. The rationale for this hypothesis is that, when inattention is high, problem solving skills may improve performance by providing an external structure for attention (e.g., the direction and regulation of cognitive resources).

In summary, the overall hierarchical regression model predicting program completion includes the following blocks of variables:

Block 1: Control variables: demographic variables (7 variables: age, sex, race, marital status, military rank, military service, years of military service), social desirability, and external stressors (major life changes)

Block 2: Enduring (E) stable abilities and traits (6 variables: E general cognitive ability, E conscientiousness, E neuroticism, E trait anxiety, E social performance anxiety, E anxiety sensitivity)

Block 3: Enduring modifiable abilities and traits (4 variables: E inattention, E impulsivity, E problem solving skills, E problem solving orientation)

Block 4: Interactions (1 variable: E inattention X E problem solving skills)

POWER ANALYSES

All power analyses assumed that the predictors are continuous and have a joint multivariate distribution. The power analyses were calculated for the hierarchical regressions that will be used to test each main hypothesis. The control variables (demographic variables, social desirability, and environmental stressors) were entered as the first block in both hierarchical regressions. Therefore, the control variables are considered as one variable in power calculations.

Hypothesis 1

Half of the original sample size ($\underline{n}$ = 386) was expected to provide data for the situational variables. Therefore, the estimated sample size for the second hypothesis was 193 students.

The first main hypothesis was tested with a hierarchical linear regression. The supporting research indicated that the level of association between variables would be generally small to medium. Based on Cohen's (1988) recommended conventions for small and medium effect sizes (δ = .02 and .15 respectively) for multivariate linear regression analyses, an average effect size δ = .12 was selected to represent an expected slightly smaller than medium effect size. When the demographic variables and control variables were counted as one predictor variable, there were a total of 18 predictor variables. A sample size of 183 students was required to examine the hypotheses based on an a priori power analysis with 18 predictors, a power > 80% (β < .20), and a Type I error (α) of < .05 (Erlfelder, Faul, & Buchner, 1996). Based on the estimated $\underline{n}$ = 231, the study is expected to meet the desired alpha and power criteria.

Hypothesis 2

The second main hypothesis was tested with a hierarchical logistic regression. The hierarchical regression consisted of five blocks of variables (demographics, social desirability, stable abilities and traits, modifiable abilities and traits, and interactions). Training program completion was the predicted outcome and an estimate of 30% of EOD students will fail the training program. When the sample size is 359, a logistic regression test would be able to detect an odds ratio of 1.70 to predict training outcome, with a power of 80% ($\beta < .20$), and a Type I error (α) of $< .05$ (two-sided) (Elashoff, 1999). This assumed that the blocks of predictor variables added to the model were normally distributed and that their correlation with the predictor variables already in the model is 0.30. Based on the estimated effective sample size of 386 students and the expectation that at least one predictor variable will be removed after the univariate analyses, the study was expected to meet the desired alpha and power criteria.

RESULTS

Participation Rates

Of the 517 students who were briefed on study participation, 498 (96%) students completed the informed consent documentation agreeing to participate in the study. Participation rates across the three subsequent data collection time points of the study were variable and were affected by declining participation and late introduction of some study measures (i.e., all measures of inattention and impulsivity measures and the situational measures of anxiety and problem solving) after the study was underway. In addition, final sample sizes used in each set of analyses also reflect the elimination of invalid data.

In the first data collection time point immediately following the study brief on the first day of training, valid data was collected from 476 (96%) students. This sample was used to predict overall program performance outcome. Subsequently, valid data was collected from 419 (84%) students in the second data collection time point (before the first practical test) and from 152 (30%) of these students in the third time point (after the first practical test). These are the maximum sample sizes at all data collection time points, however actual sample size for each measure varied due to other factors such as whether a measure was introduced at the beginning of the study or later and whether the responses were valid.

Demographics

A total of 498 students initially agreed to participate in the study. This group was comprised of 192 Air Force students (38.6%), 183 Army students (36.7%), 46 Marine

students (9.2%), and 77 Navy students (15.5%). The most commonly reported demographic characteristics of this group included male (97.6%), Caucasian (90.0%) and single marital status (75.7%). The sample ranged in age from 17 to 42 with a mean age of 23.0 (SD = 4.6). Similarly, time in military service ranged from 2 - 228 months with a mean time in service of 30.4 months (SD = 35.8). Pay grade of the majority of students was E-1 (30.7%), however there was also a significant percentage of students with E-4 (20.1%) and E-5 (23.7%) pay grades.

Outcome Variables

The mean score on the practical test for all subjects was 91.6% with a standard deviation of 7.7%. The mean scores for students from each service were 92.4% (SD = 6.7) for AF students, 89.8% (SD = 9.2) for Army students, 92.1% (SD = 7.7) for Marine Corps students, 92.7% (SD = 6.1) for Navy students. A one-way ANOVA detected differences among the services' practical test scores ($F_{3,444} = 4.09$, $p < .01$; see Table 6). Scheffe post-hoc analyses indicated that the Army mean score was significantly lower than the Air Force score (see Table 7).

Descriptive data for students who passed versus failed the practical test (pass > 85 practical test score) for all continuous control and predictor variables is shown in Table 8. Subsequent analyses related to the first main hypothesis explore the relationship between model variables and the practical test score. An example of the distribution of practical test scores around a continuous variable from the model (situational cognitive anxiety) is shown in Figure 3.

Insert Tables 6-8 here

Insert Figure 3 here

The average program completion rate for all students was 69%. The average completion rates for students from each service were 65% (SD = .48) for AF students, 64% (SD = .48) for Army students, 76% (SD = .43) for Marine Corps students, and 90% (SD = .31) for Navy students. A one-way ANOVA revealed inter-service differences across program completion rates ($F_{3,494} = 6.91$, $p < .001$; see Table 9). Scheffe post-hoc analyses revealed that the Navy failure rate was significantly lower than both the Army and Air Force rates (see Table 10).

Descriptive data for completers and non-completers for all continuous control and predictor variables is shown in Table 11. Subsequent analyses related to the second main hypothesis explore the differences between completers and non-completers.

Insert Tables 9-11 here

Comparisons of Control and Predictor Variables across Services

Control Variables

Demographic Variables

Demographic variables were used as control variables for predicting both the practical test and overall program performance outcomes. These demographic variables included age, gender, ethnicity, marital status, enlisted pay grade, time in service, and branch of service. Significant inter-service differences were found overall for all demographic variables except gender (see Table 12).

Post hoc analyses revealed that differences existed between at least three of the services for all demographic variables except gender (see Tables 13-17). The Air Force and Army students were younger (2.5-5.4 years difference), lower ranking (1.5-2.9 pay grades difference), and less experienced (25.0-57.5 months of military difference) than the Marine and Navy students. In addition, the Air Force students were younger (1.9 years difference), lower ranking (1.0 pay grade difference), and had fewer months in service (27.4 months difference) than the Army students. Another difference was across marital rates. The Air Force and Navy students were much less likely to be married (8%) than the Army (35%) and Marine (78%) students. In addition, the Marine students had a greater proportion of non-Caucasian students than both the Air Force (18 % difference) and Army (15% difference).

Insert Tables 12-17 here

Response Bias and External Stressors

The study also controlled for the influence of response bias (social desirability) and external stressors (daily life problems and major life changes). No service-specific differences were observed across these variables (see Table 18).

Insert Table 18 here

Enduring Variables

Mean service differences were compared across all stable enduring variables (cognitive ability, conscientiousness, neuroticism, trait anxiety, social performance anxiety, and anxiety sensitivity; see Table 19) and modifiable enduring variables (inattention, impulsivity, problem solving orientation, and problem solving skills; see Table 20). A significant difference across services was found for only one of the enduring variables, cognitive ability ($F_{3,480} = 28.28$, $p < .001$). Post hoc analyses revealed that the Air Force and Navy students had significantly higher scores on the measure of cognitive ability than the Marine and Army students (see Table 21). The students from these two pairs of services differed by 9 to 16 percentage points.

Insert Tables 19-21 here

Recent Variables

Inter-service differences were compared across all recent variables including relationship with peers, relationship with supervisors, relationship with significant others, inattention, impulsivity, negative affect, and energy. The analyses found differences among the services on two of the recent variables, relationship with peers ($F_{3,417} = 4.75$, $p < .01$) and energy ($F_{3,418} = 2.84$, $p < .05$; see Table 22). Post hoc analyses revealed that the Marine students reported lower cohesiveness with fellow students than the Army and Navy students (0.94 and 1.16 differences respectively on a 10 point scale; see Table 23). The other inter-service difference across recent variables was that Navy students reported higher energy levels (7.76 on a 100 point scale) than Air Force students (see Table 24).

Insert Tables 22-24 here

Situational Variables

Inter-service differences were compared across all situational variables including inattention, cognitive anxiety, somatic anxiety, problem solving self efficacy, and problem solving skills. The students from each service had different scores only across the measure of somatic anxiety during the practical test ($F_{3,148} = 3.50$, $p < .05$; see table 25). Post hoc tests revealed that the Navy students reported higher somatic anxiety symptoms than the Air Force students with a mean difference of 5.17 on a 40-point scale (see Table 26).

Insert Tables 25-26 here

Summary of Inter-Service Differences

Given the extent of inter-service differences across control and predictor variables, service itself is an important variable to evaluate.

Study Hypotheses

The study was designed to test two primary hypotheses and each of these hypotheses consisted of several related subhypotheses. The first main hypothesis proposed that a model combining recent external (environmental) and internal (subject) factors, situationally-specific subject factors, and interactions among enduring and situational factors would predict scores on practical test performance (i.e., 0-100%). Four sub-hypotheses were generated to systematically evaluate the independent and joint influences of these model factors after controlling for demographic variables, social desirability, and recent external stressors (daily life problems over past month). Hierarchical linear regression analyses were used to test these hypotheses.

The second main hypothesis was that enduring subject factors would predict overall program outcome (i.e., pass/fail). Four sub-hypotheses were generated to systematically evaluate the independent and joint influences of the enduring variables after controlling for demographic variables, social desirability, and enduring external stressors (major life changes in last six months). Hierarchical logistic regression analyses were used to test these hypotheses.

Hypothesis 1: Predicting Performance on a Practical Test

The first main hypothesis (H1) proposed that the recent (R) and situational (S) variables as well as interactions among these variables and enduring variables would predict practical test performance after controlling for demographic variables and social desirability. This main hypothesis was comprised of four progressive sub-hypotheses (H1.1-H1.4) to evaluate the independent and joint contributions of stable and modifiable enduring variables along with demographic variables.

Sub-hypothesis H1.1

The first sub-hypotheses (H1.1) investigated univariate relationships among demographic variables, social desirability, recent and situational variables, and practical test performance in three steps. The first step looked at univariate relationships between the variables in each conceptual category specified by the hypothesis (demographic variables, social desirability, recent and situational variables, and interactions among enduring and situational variables) and practical test performance. The second step plotted the interactions to explore the nature of the relationship between the variables. The third step examined the relationships among the predictor variables and social desirability.

Univariate Predictors of Practical Test Performance

In the first step of this sub-hypothesis, correlation analyses were conducted to measure the independent predictive ability of each of the hypothesis variables on practical test performance. In addition, univariate relationships between enduring

variables and practical test performance were calculated because of the interactions involving enduring variables. The findings are displayed in Tables 27-29.

The results indicate that one third (10/30) of the recent, situational, and interaction variables were significantly related to the outcome on the univariate level. The variables that predicted better performance on the practical test included male gender ($r = .15$, $p < 0.01$), Caucasian ethnicity ($r = .10$, $p < 0.05$), and situational problem solving self efficacy ($r = .23$, $p < 0.05$). The predictors of poorer performance included Army Service ($r = .16$, $p < 0.01$), recent inattention ($r = .16$, $p < 0.05$), recent negative affect ($r = .11$, $p < 0.05$), and situational cognitive anxiety ($r = .36$, $p < 0.001$). In addition, three interactions were significant predictors. These interactions included enduring inattention and situational cognitive anxiety ($r = .23$, $p < 0.05$), enduring fears cognitive and situational inattention ($r = .19$, $p < 0.05$), and situational problem solving skills and situational cognitive anxiety ($r = .30$, $p < 0.01$).

Insert Tables 27-29 here

Interactions Predicting Practical Test Performance

Three of the six hypothesized interactions for predicting practical test score were significant when examined at a univariate level. These interactions included enduring inattention and situational cognitive anxiety, enduring fears of cognitive catastrophe and situational inattention, and situational cognitive anxiety and situational problem solve

skills. The plots of these three interactions reveal that there is mixed support for the hypothesized manner of relationships between the variables in each interaction.

The proposed interaction between enduring inattention and situational cognitive anxiety was based on a vulnerability hypothesis in which enduring inattention was a vulnerability factor for performance decrements associated with cognitive anxiety. The plot of this interaction (see Figure 4) does not support the expected relationship. High cognitive anxiety appears to have an equivalent impact on performance independent of high or low inattention. However, the interaction does support the negative effects of cognitive anxiety on performance and the benefits of low cognitive anxiety. In addition, the interaction suggests that people with high inattention may benefit more than people with low inattention by experiencing low cognitive anxiety.

Insert Figure 4 here

The proposed interaction between enduring fears of cognitive harm and situational inattention is also a vulnerability hypothesis. This hypothesis predicted that enduring fears of cognitive harm were a vulnerability factor for performance decrements associated with situational inattention. The plot of this interaction only partly supports the expected relationship (see Figure 5). As expected, people who reported high enduring fears of cognitive harm had decreased performance associated with high situational inattention in comparison with people with low enduring fears of cognitive harm. However, the plot of the interaction suggests two additional findings. First, high enduring fear may actually facilitate performance for people with low situational

inattention (e.g., increased ability to focus attention). Second, in conditions of low situational inattention, people with high fears of cognitive harm actually may do better than people with low fears of cognitive harm.

Insert Figure 5 here

In contrast to the two vulnerability hypotheses, the proposed interaction between situational cognitive anxiety and situational problem solving skills was a protective hypothesis. This hypothesis predicted that situational problem solving skills would be a protective factor against the negative performance effects associated with situational cognitive anxiety. The plot of this interaction provides weak support the expected relationship (see Figure 6). The dominant effect is that high situational cognitive anxiety is associated with performance decrements with both high and low situational problem solving skills. High problem solving skills appear to provide a slight buffering effect of the adverse effects on performance associated with high cognitive anxiety.

Insert Figure 6 here

Relationships among Predictors of Practical Test Performance

Relationships among the recent and situational variables were evaluated using correlation analyses. Correlations were limited to among variables that were in the same temporal group (either recent or situational) because variables within the same temporal

group were expected to share the strongest relationships. In addition, social desirability was included in correlation analyses of relationships among the variables because of the variable's potential to influence all temporal categories of variables.

The results of the Pearson correlation analyses of the relationships among recent variables indicated that all but one pair of these variables were related to each other (see Table 30). The three strongest relationships were between recent inattention and recent impulsivity ($r = .72$, $p < 0.001$), recent negative affect and recent energy ($r = .57$, $p < 0.001$), and recent inattention and recent negative affect ($r = .55$, $p < 0.001$). All other correlations ranged from $r = .16$-$.46$. The different measures of relationships (peers, supervisor, and significant others) were directly related to energy and social desirability and inversely related to the other recent variables (inattention, impulsivity, negative affect). All recent variables were related to social desirability ($r = .18$-$.40$, $p < 0.001$).

Insert Table 30 here

The correlation analyses of the relationships among situational variables demonstrated that nearly all of these variables were also related to each other with the exception of situational inattention and social desirability (see Table 31). The three conceptually-related situational variables that were expected to be negatively related to performance, inattention, cognitive anxiety, and somatic anxiety, were strongly related to each other ($r = .49$ - $.60$, $p < 0.001$). Likewise, the two conceptually related situational variables that were expected to be positively related to performance, problem solving self-efficacy and skills, were also strongly related ($r = .78$, $p < 0.001$). Social desirability

was inversely related to cognitive and somatic anxiety ($r = .18$, $p < 0.05$) and directly related to the problem solving self efficacy ($r = .21$, $p < 0.05$) and skills ($r = .26$, $p < 0.01$).

Insert Table 31 here

Sub-hypothesis H1.2

The second sub-hypothesis (H1.2) was that recent variables would predict program performance after controlling for demographic variables, social desirability, and daily problems. No recent variables met the study's exclusionary criteria for extensive overlap ($r > .75$). The following variables were excluded due to having insignificant relationships with the outcome variable: age, marital status, enlisted pay grade, time in service, all services except for army, social desirability, all three types of relationships (peers, supervisors, and significant other), impulsivity, and energy. In addition, gender was also excluded based on a highly skewed distribution (98% male).

This analysis was conducted using a two block hierarchical regression (see Table 32). The regression entered control variables in the first block and recent variables in the second block. Social desirability and daily life problems were not entered because they did not have a significant univariate relationship with practical test performance.

The overall model of practical test performance tested by a two-block hierarchical regression was significant ($F_{2,227} = 4.3$, $p < .05$) and the variance explained by the addition of second block (adjusted $R^2 = .03$) was also significant ($F_{2,227} = 3.5$, $p < .05$).

The p-value of the Hosmer and Lemeshow goodness of fit test is .40, suggesting that the model fits reasonably well. Army service was the only significant predictor ($\beta = -.18$, $p < .01$) within this model as an independent predictor. Neither recent inattention nor negative affect was significant. The total variance explained by this model was small (adjusted $R^2 = .06$).

Insert Table 32 here

Sub-hypothesis H1.3

The third sub-hypothesis (H1.3) was that situational abilities and traits would predict program performance after controlling for demographic variables, social desirability, daily problems, and recent ability and trait variables. One pair of situational variables, problem solving self-efficacy and problem solving skills, met the exclusion criteria for sharing extensive overlap with one another. Two situational variables, cognitive anxiety and problem solving self efficacy, met the inclusion criteria of having a significant univariate relationship with the outcome variable. The analysis was conducted with a three-block hierarchical regression (see Table 33). These blocks were control variables, recent ability and trait variables, and the situational ability and trait variables.

The results of the three-block hierarchical regression indicate that the model remained significant $F_{6, 113} = 4.9$, $p < .001$ and the change in variation explained associated with addition of the third block was also significant ($F_{2, 113} = 8.5$, $p < .001$).

The p-value of the Hosmer and Lemeshow goodness of fit test is .98, suggesting that the model fits reasonably well. The total variation explained was small (adjusted $R^2 = .17$). Significant independent predictors within the model included Army service ($\beta = -.18$, $p < .05$) and situational cognitive anxiety ($\beta = -.37$, $p < .01$).

Insert Table 33 here

Sub-hypothesis H1.4

The fourth sub-hypothesis (H1.4) stated that interactions among situational and enduring variables would predict performance after controlling for all other variables in the model. Four interactions met the criteria of having an independent relationship with the outcome variable. The interactions were enduring inattention and situational cognitive anxiety, enduring fears about cognitive symptoms and situational inattention, situational problem solving skills and enduring inattention, situational problem solving skills and situational cognitive anxiety. These interactions were entered as the fourth block in a hierarchical regression model after entering blocks containing demographic, social desirability, and recent variables.

The results indicate that the entire model was significant $F_{10, 113} = 3.3$, $p < .01$ but that the addition of the fourth block did not significantly increase the amount of variance explained (see Table 34). The p-value of the Hosmer and Lemeshow goodness of fit test is .70, suggesting that the model fits reasonably well. Negative affect was the only significant predictor ($\beta = .24$, $p < .05$) within the model.

Insert Table 34 here

Summary of H1 results

The cumulative results of the four H1 sub-hypotheses indicate that the addition of recent and situational variables resulted in a statistically significant increase in the explanation of variation in practical test performance. In contrast, the addition of factors representing interactions among enduring and situational factors did not add significant explanatory capability to the model. It is also important to note that the addition of recent and situational variables added little practical explanatory model beyond the performance predicted by control variables, notably the demographic variables. The final three-block model predicted a practically small amount of variance and a small ratio of variables (two out of five) within the model were significant independent predictors.

Hypothesis 2: Predicting EOD Training Program Completion

The second main hypothesis (H2) proposed that a range of enduring variables would predict program outcome (pass/fail) after controlling for demographic variables and social desirability. The enduring variables were classified as either stable or modifiable. Stable enduring variables were cognitive ability, conscientiousness, emotional stability, trait anxiety, social performance anxiety, and anxiety sensitivity. In contrast, modifiable enduring variables included inattention, impulsivity, problem solving orientation, and problem solving skills. This main hypothesis was divided into four

progressive sub-hypotheses (H2.1-H2.4) to evaluate the independent and joint contributions of stable and modifiable enduring variables along with demographic variables.

Sub-hypothesis H2.1

The first sub-hypotheses (H2.1) investigated univariate relationships among demographic variables, social desirability, enduring variables, interactions, and program outcome performance in three steps. The first step looked at univariate relationships between the variables in each conceptual category (demographic variables, social desirability, enduring variables) and program outcome performance. The second step plotted the regression lines for the significant interactions to explore the nature of the interaction between the variables. The third step examined the relationships among the predictor variables and social desirability.

Univariate Predictors of Program Completion

In the first step of this sub-hypothesis (H2.1.1), logistic regression analyses were conducted to measure the independent predictive ability of each variable on program performance. The results show that more than half (14/23) of the variables were significantly related to the outcome (see Table 35). The variables that predicted success in program performance include age (OR = 1.05; 95% CI: 1.00-1.10), enlisted pay grade (OR = 1.33; 99.9% CI: 1.18-1.49), time in service (OR = 1.01; 99% CI: 1.01-1.02), Navy service (OR = 4.48; 99.9% CI: 2.10-9.58), social desirability (OR = 1.04; 95% CI: 1.01-1.08), conscientiousness (OR = 1.06; 95% CI: 1.02-1.10), and problem solving skills (OR

= 1.20; 95% CI: 1.04-1.38). In contrast, the variables that predicted poor performance were Army service (OR = 0.67; 95% CI: 0.45-0.98), neuroticism (OR = 0.96; 99% CI: 0.94-0.99), trait anxiety (OR = 0.95; 99.9% CI: 0.93-0.98), social performance anxiety (OR = 0.98; 95% CI: 0.96-1.00), inattention (OR = 0.90; 99% CI: 0.83-0.97), and impulsivity (OR = 0.93; 95% CI: 0.87-0.97). In addition, the interaction between inattention and problem solving skill also predicted performance (OR = 0.99; 99% CI: 0.98-1.00). Across all of the variables that predicted performance, the effect sizes were low to moderate in nature. Successful completion of EOD training thus appears to be related to a number of different variables, but with small contributions from each of these variables.

Insert Table 35 here

Interaction Predicting Program Completion

The interaction between enduring factors of inattention and problem solving skills was a significant predictor of program completion. When the interaction is plotted (see figure 7), the results show that program performance drops with high inattention when problem-solving skills are low but not when problem-solving skills are high. Thus, the interaction appears to support the hypothesis that problem-solving skills are protective for people with inattention.

Relationships among Predictors of Program Completion

Relationships among the enduring variables were evaluated using correlation analyses. Correlations were limited to among variables that were in the same conceptual group (demographics, stable, modifiable) because these variables were expected to share the strongest relationships. In addition, social desirability was included in correlation analyses of relationships among stable and modifiable variables because of the variable's potential to influence both categories of variables.

The correlation analyses among demographic variables indicated that the majority of demographic variables were related (see Table 36). The demographic variables of age, time in service, and enlisted pay grade were highly correlated (r = .63 -.75, p < .001). In addition, each of these three variables also had significant but less strong correlations with marital status (r = .21-.39, p < .001).

Insert Table 36 here

The correlation analyses among theoretically stable ability and trait variables also demonstrated that many of these variables were related to each other (see Table 37). The strongest relationship was between neuroticism and trait anxiety (r = .76, p < .001). Likewise, these variables and all of the other variables representing forms of anxiety were related (r = .37 - .61, p < .001). Also, as would be expected, conscientiousness was negatively related to variables representing different forms of anxiety (r = .18 - .55, p < .001). Social desirability was related to all variables except cognitive ability. Social desirability had a positive relationship with conscientiousness (r = .47, p < .001) and

negative relationships with variables representing different forms of anxiety (r = .25 - .53, p < .001).

Insert Table 37 here

The correlation analyses among theoretically modifiable ability and trait variables also demonstrated that all of these variables were related to each other (see Table 38). The two variables of ADHD symptoms, inattention and impulsivity, were strongly related (r = .62, p < .001). Likewise, the two variables representing problem solving orientation and skills were moderately correlated (r = .46, p < .001). In addition, impulsivity and inattention were both inversely related to problem solving orientation and skills (r = .24 - .62, p < .001). Social desirability was directly related to the problem solving variables (r = .46 -.47, p < .001) and inversely related to the inattention and impulsivity variables (r = .41 -.47, p < .001).

Insert Table 38 here

Sub-hypothesis H2.2

The second sub-hypothesis (H2.2) was that stable abilities and traits would predict program performance after controlling for demographic variables and social desirability. This hypothesis was analyzed using a hierarchical regression. Variables were selected based on one exclusion and inclusion criterion. The analysis excluded variables that were

extensively related ($r > .75$) with each other. Two pairs of variables met the study's definition for extensive overlap. These pairs were enlisted pay grade and time in service, and trait anxiety and neuroticism. The variables in each pair that had a weaker relationship with the outcome variable were excluded from entry in the hierarchical analyses. The excluded variables included time in service and neuroticism. In addition, the hierarchical regression model only included the variables that demonstrated significant univariate relationships with the program performance outcome. These variables included age, enlisted pay grade, army service, navy service, social desirability, conscientiousness, trait anxiety, social performance anxiety, inattention, impulsivity, and problem solving skills. The analysis consisted of a two block hierarchical regression. The regression entered demographic and social desirability control variables in the first block, and stable abilities and traits variables in the second block (see Table 39).

The results of the two-block hierarchical regression were that the overall model was significant ($\chi^2_{8, 467} = 46.7$, $p < .001$), but that the addition of third block was not significant. Enlisted pay grade, age, and Navy service were significant predictors within this model. None of the stable ability and trait predictor variables were significant.

Insert Table 39 here

Sub-hypothesis H2.3

The third sub-hypothesis (H2.3) was that modifiable abilities and traits predict program performance after controlling for demographic variables, social desirability, and

stable ability and trait variables. None of the modifiable ability and trait variables met exclusion criteria of having an extensive overlap ($r > .75$) with other variables. Only one modifiable variable, problem solving orientation, did not meet the inclusion criteria of demonstrating a univariate relationship with program performance. The analysis was conducted with a three-block hierarchical regression. These blocks were control variables (demographics and social desirability), stable ability and trait variables, and modifiable ability and trait variables.

The results of the three-block hierarchical regression indicate that model remained significant ($\chi^2_{11, 346} = 36.9$, $p < .001$), but the addition of the third block was not significant (see table 40). Significant predictors within the model included age (OR = 0.93; 95% CI: 0.86-1.00) and enlisted pay grade (OR = 1.43; 99.9% CI: 1.16-1.75). None of the modifiable ability and trait variables were significant within the model.

Insert Table 40 here

Sub-hypothesis H2.4

The fourth sub-hypothesis (H2.4) was that an interaction between two modifiable enduring variables, problem solving skill and inattention, would predict performance after controlling for all other variables in the model. The interaction met the inclusion criteria of having a significant univariate relationship with the outcome variable. This interaction was added to the hierarchical regression as a fourth block, thereby controlling

for the previously entered demographic, social desirability, stable and modifiable abilities and trait variables.

The results indicate that the entire model was significant ($\chi^2_{12, 346} = 41.7$, $p < .001$) as well as the addition of the fourth block ($\chi^2_{1, 346} = 4.8$, $p < .05$; see Table 41). However, the model accounted for only a small amount of the variation in program performance ($R^2 = .11$). Four variables within the final model were significant predictors. These variables included enlisted pay grade (OR = 1.41; 99% CI: 1.14-1.73), Navy service (OR = 3.09; 95% CI: 1.05-9.12), inattention (OR = 0.55; 95% CI: 0.55-0.94), and the interaction between problem solving skills and inattention (OR = 1.05; 95% CI: 1.00-1.11).

Insert Table 41 here

Summary of H2 results

The cumulative results of the four H2 sub-hypotheses indicate that the addition of recent variables, situational variables, and the interaction between enduring inattention and enduring problem solving all resulted in a statistically significant increases in the prediction of practical test performance beyond the performance predicted by control variables. However, it is also practically important to note that the overall amount of predicted variance in program performance is a small amount ($R^2 = .11$) and a small ratio of variables, four out of nine, in this model were significant independent predictors.

DISCUSSION

The present study was designed to evaluate the role of a comprehensive range of risk factors in predicting two types of training performance outcomes. The risk factors, all of which are supported by previous theoretical models and studies as being related to stress and performance, were integrated in an atheoretical model of stress and performance. This risk factor model allowed the integration of risk factors from three different time references (enduring, recent, and situational) as well as an investigation of interactions between these variables.

The study context was a military training program, which had several advantages. First, the training program involved natural sources of stress. In addition, nearly all the trainees initially agreed to participate and a significant number of these participants participated in all but the last time point, making the data collected at these time points likely to be representative of the actual student population. Lastly, the study was conducted not only to advance scientific knowledge in the field of stress and performance research, but also to address the applied problem of reducing training attrition for the military.

Risk Factors

Inter-Service Differences

Students from different services were found to differ across a large number of demographic control variables and a limited number of predictor variables. The multiple demographic differences between students from each service indicated that branch of service itself should be included as a potential risk factor. In addition, the significant

inter-service differences across nearly all demographic variables supported statistically controlling for these variables before considering the influence of other risk factors.

The majority of demographic variables varied across services. One of the most striking differences is that the Air Force and Army students are younger, lower ranking, and less experienced than their Marine and Navy counterparts. Moreover, the Air Force students are younger, lower ranking, and less experienced than the Army students. These demographic differences appear to be the result of different EOD program recruiting strategies employed by the different services.

There are also feasible service-specific explanations for a number of other differences between services. One example is that each service has different ASVAB criteria for EOD student applicants. The Army and Marine services have lower cutoff scores than the Air Force and Navy resulting in a substantial difference in mean ASVAB scores. However, it is interesting to note that cognitive ability as measured by the ASVAB was not a significant predictor suggesting that general cognitive ability may not be a prime determinant of success in EOD training.

The observed differences across two recent variables, peer relationships and energy level, may also be explained by service differences. The lower peer relations reported by Marine students may be associated with the low number of Marine students. Since the Marine students are few in number, they enter EOD training in classes composed of students from other services. The Marine students are required to integrate themselves with these students from other services, many of whom have already formed relationships during service-specific screening and training preceding EOD training. Likewise, the students from other services are likely to be in a class with many students

from their own service and they may also have had the opportunity to develop relationships with the students.

The observed difference between the Air Force and Navy on the measure of recent energy may be associated with the different requirements imposed on students from each service. Since the majority of Air Force students have recently joined the military, they are required to comply with a phase training program at the first assignment in addition to their regular duties. The phase program is meant to be a continuation of basic military training so it involves practice of military drills and restrictions on liberties. As such, the phase program may constitute a significant stressor in the context of EOD training.

Control Variables

The study controlled for the influence of various demographic variables, the response bias of social desirability, and the influence of environmental stressors. Several of these demographic variables and social desirability were identified as risk factors, but neither measure of external stressors (major life changes or daily life problems) was found to impact performance.

Three general demographic predictors predicted program performance. These demographic variables were age, time in service, and enlisted pay grade. Pay grade emerged as the strongest predictor of the three, which makes logical sense because pay grade likely reflects the combined influence of age and time in service and factors in a person's ability to excel in the military.

Service was a military-specific demographic variable that also predicted both performance outcomes. The Army service was found to be a risk factor for poor performance on the practical test. In contrast, the Navy service was a protective factor in overall program completion outcome.

Social desirability emerged as a predictor of overall training program performance but not practical test performance. Moreover, correlation analyses revealed that social desirability was related to nearly all other predictors suggesting that many of the students were concerned with responding in a socially favorable direction.

Univariate Relationships

Univariate Relationships with Performance Outcome

Univariate analyses revealed that a large number of the variables in the risk factor model were significantly associated with performance outcomes. However, the relationships were small to modest in magnitude. The numerous predictors with small contributions suggest that performance is multifactorial phenomenon.

More than half of the enduring variables predicted performance in program performance. These predictors included conscientiousness, neuroticism, trait anxiety, social performance anxiety, inattention, impulsivity, and problem solving skills. A curious null finding was the cognitive ability did not predict performance despite being a nearly universal predictor of performance in other research contexts. This is very likely due to the range restriction associated with the high ASVAB scores used by each service for accepting applicants for the EOD training program.

Similarly, one-third of the recent and situational variables individually predicted performance on the first practical test during training. These predictors included gender, ethnicity, Army service, recent inattention, recent negative affect, situational cognitive anxiety, and situational problem solving self-efficacy.

Univariate Relationships among Control and Predictor Variables

Correlation analyses revealed that the majority of control and predictor variables were inter-related in expected directions. The demographic variables of age, time in service, and pay grade were highly related, which reflects that rank is partly a function of time in the military and may indicate that the amount of experiences in life (age) and in the military (time in service) may also contribute to pay grade. The amount of experience may be associated with a variety of potential predictors typically characterized as maturity (impulse control, delay of gratification, emotional stability).

Social desirability was significantly related to all predictor variables except for enduring cognitive ability and situational inattention. The observed independence among cognitive ability and social desirability was expected because measures of cognitive ability do not offer many choices in which a person can respond in a socially favorable manner and the measure of cognitive ability was administered prior to the training context and independent of the measure of social desirability.

The situational measures were conceptually least likely to be associated with a trait measure of social desirability (style of responding across situations) for two reasons. First, the situational measures were designed to measure a student's experience in a specific situation (practical test) thereby emphasizing reactions unique to that situation as

opposed to a general style of responding. Second, the measures were administered immediately after the situation to reduce biases associated with recalling behavior that occurred in the past. As expected, the correlations between social desirability and situational variables were generally smaller in magnitude (average $r = .19$) than with the recent predictors (mean $r = .31$) and enduring predictors (mean $r = .42$). There was also one non-significant relationship between social desirability and the situational inattention, which suggests that the measure of situational inattention was not significantly influenced by social desirability.

Multivariate Relationships

The multivariate analyses that simultaneously compared all risk factors' ability to predict outcome produced two major findings. First, only one primary predictor of both program performance and practical test performance had unique relationships with the performance outcomes. Enduring inattention was found to predict program performance after controlling for all other enduring risk factors, social desirability, and demographic variables. Likewise, situational cognitive anxiety about performance during the test was found to predict practical test score after controlling for recent, situational, and demographic variables. Thus, even though the model was based on the premise that many factors would have cumulative influence on performance, these results indicate that the majority of the explainable variance in performance in each model is associated with only a few variables.

It is also important to note that, in the models predicting overall program performance and practical test performance, several demographic control factors emerged

as unique predictors. Both enlisted pay grade and Navy service predicted better overall program performance. In contrast, Army service predicted poorer performance on the practical test. These finding indicate that the demographic control variables are important predictors. In addition, these findings suggest that there are important service specific findings that are not explainable by the other factors entered in each regression. These findings may be reflective of the preparatory value of each services pre-screening program. For example, the Navy EOD students have to pass dive school before attending EOD School. The Navy dive school is a stressful program that may eliminate students who have difficulties managing stress. In addition, Navy dive school also likely provides students who pass dive school with an opportunity to practice performing under stressful conditions and increasing their confidence in this type of performance situation.

The second major finding was the majority of factors that were expected to be pre-eminent predictors of performance based on previous research were not unique predictors. These factors included general cognitive ability, enduring forms of anxiety, and conscientiousness. Some potential explanations for these null findings include that these factors truly are not uniquely important in the prediction of performance. In addition, there may be a range restriction due to the extensive pre-screening of this population (e.g., ASVAB score cut-offs, pre-training programs with significant attrition). Also, as posited in the interactional hypotheses of personality theorists, these enduring factors (traits) may only be operative in interaction with certain situational factors and, therefore, the impact of enduring factors needs to be assessed in an interactional context.

Interaction Relationships

Analyses of interactions among the predictors demonstrated that several interactions predicted performance. The interaction between enduring factors of inattention and problem solving skills was a significant predictor of program completion. This interaction remained significant even after controlling for the univariate contributions of these same variables. When the interaction is plotted (see figure 3), the results show that program performance drops with high inattention when problem-solving skills are low but not when problem-solving skills are high. Thus, the interaction appears to support the hypothesis that problem-solving skills are protective for people with inattention.

Three of the six hypothesized interactions for predicting practical test score were significant when examined at a univariate level, but were not significant when examined in the multivariate model when controlling for the univariate contributions of other variables. These interactions included enduring inattention and situational cognitive anxiety, enduring fears of cognitive catastrophe and situational inattention, and situational cognitive anxiety and situational problem solve skills. The plots of these three interactions reveal that there is mixed support for the hypothesized manner of relationships between the variables in each interaction. Because these interactions have not been proposed by previous research, their significance as univariate predictors has exploratory value, as the nature of these interactions may have important implications for future research.

Although the proposed nature of the interaction between enduring inattention and situational cognitive anxiety was only partially supported by the observed relationship,

the findings suggest that inattention may actually enhance performance under certain conditions. Specifically, people with high inattention may benefit more than people with low inattention by experiencing low cognitive anxiety. One possible explanation for this relationship might be that if people with high inattention can stay focused on the task instead of cognitive anxiety (worry), they may perform better because they are more cognitively flexible and more capable of brainstorming solutions than people with low inattention.

In addition, the interaction between enduring fears of cognitive harm and situational inattention was only partially supported but offered two additional interesting findings. First, high enduring fear may actually facilitate performance for people with low situational inattention (e.g., increased ability to focus attention). Second, in conditions of low situational inattention, people with high fears of cognitive harm actually may do better than people with low fears of cognitive harm.

Finally, the observed interaction between situational cognitive anxiety and situational inattention offered weak support the expected relationship. The dominant effect is that high situational cognitive anxiety is associated with performance decrements with both high and low situational problem solving skills. Therefore, problem solving skills seem to provide only a slight buffering effect of the adverse effects on performance associated with high cognitive anxiety.

Study Limitations

There are a number of limitations that apply to this study. These limitations have to do with reliance on self-report measures for data collection, use of retrospective

measures of situational predictor variables, dependence on subjects to complete questionnaires on their own in a context with many competing pressures, limited control of variables, and investigation of a large number of variables.

The study used self-report questionnaires to collect the data. Although the titles of these questionnaires were abbreviated to conceal the focus of the questions, the questions themselves were face valid and, therefore, responses may have been influenced by demand characteristics (e.g., faking good, faking bad). Because of the training context and assumed desire of each student to present in a favorable light, social desirability was considered to be the most likely bias and was assessed by self report. Moreover, the subjects were tested during a busy and stressful training program, so it is possible that the subjects may have completed the questionnaires in a hurried fashion.

A second limitation is that the study does not directly measure biological and physiological indices of anxiety. Biological and physiological measures would have provided additional important information. The importance of this information would have been a more objective measure of stress than self-report measures. Even though this data would not be expected to directly correspond to the self-report measures and measures of other aspects of stress (cognitive anxiety), they would be important data to integrate in interpreting findings regarding the relationship between stress and performance.

The use of retrospective measures of situational variables is another limitation. All five situational variables were measured retrospectively, after the performance task was completed. This strategy was deemed necessary for two reasons. First, the measure was intended to assess the student's experience during testing so that it had to be

administered after the testing process. Second, even though consideration was given to assessing anticipation anxiety and performance expectations prior to testing, the retrospective measure was chosen as a means of avoiding potentially negatively affecting the mindset of the students before and during they took their test. However, a risk of this approach was that the students responses may be influenced by whether they performed well or not on the test.

Another limitation was the reduced participation rate in the last portion of the study. This portion of the study assessed situational variables immediately followed the practical test. A probable reason for the low participation rate is due to the unique context of that part of training program and the approach for collecting data in that context. The data collection context was unique because the students were asked to complete questionnaires after finishing a stressful testing process and before they received feedback on their testing performance. The students were probably fatigued and focused on getting feedback on their performance. Moreover, the data collection strategy involved distributing the feedback questionnaire (two short inventories) before the students took their practical test with the instructions to put in a slotted lock box after test completion and before receiving feedback on their test performance. The study did not assess the number of students who had a copy of the feedback questionnaire at the end of their practical test.

The study also had limitations associated with both experimental and statistical control of third variables. As a field study, the study did not have randomized subject groups and experimental control of variables, which makes any statements about causality impossible. In addition, the subjects represented a heterogeneous group. Some

of these pre-existing differences among students were statistically controlled such as age, education, military service, rank, and experience with other members in their EOD class. Even though the subject heterogeneity increases the external validity, the influence of the preexisting differences between subjects on the stress and performance relationship is unknown.

A final limitation is that the study's model integrates a large number of variables. From a theoretical standpoint, the large number of variables may not represent a parsimonious description of the relationship between stress and performance. Likewise, from a pragmatic perspective, there is inherent difficulty in collecting the range of variables because they were from three distinct temporal categories.

Implications for Future Research

The study and findings have implications for the methodology and objectives of future research. Methodological implications include the need to control for demographic variables and social desirability, integration of variables from different temporal domains, and use of contextual elements that increase participation, and the integration of other types of measures of the variables in the model. Implications for future research include replication of key findings, identification of other service-specific differences that predict performance, and exploration of other general variables that predict performance.

Research Methodology

The findings indicate that demographic variables can predict performance, even after controlling for the influence of other performance variables. Similar studies of performance should assess and control for the influence of demographic variables. Likewise, social desirability was found to be a predictor of training program performance as well as related to the majority of predictors of training program performance. Therefore, future studies should control for social desirability in similar training contexts. Multivariate statistical analyses appear to be a useful method for controlling the contributions of demographic and other variables, analyzing over-lapping prediction of variance and identifying the risk factors that uniquely predict the outcome.

Future studies should also assess and integrate the role of variables representing different temporal domains (e.g., enduring and situational) as well as interactions of variables from these different temporal domains can predict performance. For example, the present study's conceptualization of variables from two different temporal domains (enduring and situational) revealed two predictors of performance (enduring inattention and situational cognitive anxiety) associated with two forms of performance (program performance and practical test performance).

Incorporating other assessment methods of the same or similar variables could strengthen the measurement of variables. The study's use of retrospective self-report measures may be vulnerable to biases associated with subject's experiences during and after testing (e.g., actual test performance, self evaluation, explicit and implicit feedback from the instructor). There are several options for other ways to assess relevant variables including behavioral observations, biological and physiological measures, and

neuropsychological instruments. For example, anxiety during testing could also be assessed by observers' ratings of behavioral indices (e.g., trembling hands reflecting somatic anxiety, worksheet responses indicating level of problem solving). In addition, situational somatic anxiety could be assessed with physiological indices (e.g., breathing rate, heart rate, blood pressure) or biological indices (e.g., cortisol, catecholamines). Likewise, neuropsychological tests of different types of attention problems could be used to assess, verify, and better understand self-reported inattention.

Research Objectives

Subsequent research could attempt to replicate the key findings of this study. One focus could be on the role of inattention in performance for two reasons. First, inattention is not commonly studied in performance research but was found to have a strong main effect on performance. Second, inattention may have either negative or positive effects on performance depending on interaction with other variables. Two interactions that warrant future research are the possibility that trait problem solving skills can act as a protective factor against the negative effects on performance associated with trait inattention and that trait inattention may actually be associated with enhanced performance if cognitive anxiety is kept low.

Future research could explore the role of other predictor variables in predicting of performance, especially variables that could explain service-specific differences in performance and be integrated into the theoretical model of stress and performance. The fact that military services were found to predict performance after controlling for observed differences on demographic variables and ASVAB scores suggest the role of

other service-specific variables. For example, the Navy service was found to be a protective factor for passing the training program and the Army service was found to be a risk factor for performance on the practical test after controlling for demographic differences. Another inter-service difference is the Air Force phase program, which is extra military training that the majority of AF students are required to participate in concurrently with EOD training as a continuation of their basic military training. The Air Force phase program is a potentially important difference during training because it adds stressors to during program by increasing demands (e.g., requires early rising, additional formations) and decreases stress coping by lowering control and coping resources (e.g., imposes limits on time, modes of transportation, and interactions with others). The key for future research is to identify performance variables that can explain inter-service differences in performance.

Future studies could also explore additional predictor variables that are related to observed predictors from this study such as inattention. One example is the possible role of sensation seeking, which is theoretically related to inattention. Sensation seeking is also relevant to the EOD population because of the attraction of the challenge and risk associated with the EOD mission. Another potential predictor variable that could be integrated into the stress and performance model is the quantity and quality of sleep, which is also theoretically related to inattention.

Implications for Prevention

The findings have several implications for two types of prevention interventions that are dependent on whether the risk factor is relatively stable or modifiable. Stable

variables are those that are long standing, global, and assumed to be relatively fixed over time. Such stable variables would be useful in screening out students who have a high likelihood of program incompletion. In contrast, modifiable variables are viewed as more transient, situational-specific, and amenable to change. Brief performance-enhancing interventions could potentially be used to help students modify these factors and thereby increase their level of performance.

Prevention by Screening

Stable variables may provide useful screening criteria. For example, enlisted pay grade was found to have one of the largest effect sizes (O.R. = 1.33) predicting program performance. In practical terms, a single increase in pay grade is associated with a 33% decrease in the risk of failure. The Air Force and Army currently recruit lower-ranking students and may be able to decrease attrition by increasing the pay grade of incoming students.

The study also identified one enduring variable, inattention, that could be used to screen non-completers without eliminating any successful completers because the objectives of the military planners is to reduce attrition without affecting completion rates. The effect size associated with enduring inattention is small to moderate (O.R. = 0.90). An investigation of classification table from the univariate logistic regression statistics of inattention predicting program completion (see Table 42) indicated that this regression correctly predicted 100% of completers (sensitivity) and 6% of non-completers (specificity). Subsequent examination of frequency and outcome statistics revealed that a cut-off score of ≥ 12 would have resulted in decreasing 6 student failures

out of 300 total students, 99 who did not pass the program. It is also important to note that this screening criterion would not have eliminated any students who would have passed. The projected benefits over 1 year is to reduce costs by $.33M-$.60M based on each recruit beginning training at a cost between $55-$100K per recruit (Young, 2000). The services should consider replicating these findings.

Insert Table 42 here

One important negative finding was the inability of ASVAB AFQT scores to predict attrition in this sample. The ASVAB has historically been a primary screening tool for military training programs. The null findings are especially noteworthy given the substantial differences of mean AFQT scores among students from the different services. These findings may suggest that the ASVAB cutoff criteria for some services are too high and are excluding students who might be successful in EOD training.

Prevention by Performance Enhancement Interventions

These findings suggest that performance enhancement interventions could be used to improve student performance by targeting modifiable risk factors. Inattention and cognitive anxiety were identified as risk factors predicting attrition. In addition, problem solving skills was identified as a potential protective factor, both as enduring variable representing a general approach to problems and as a situational variable reflecting the student's actual approach to a practical test. These findings suggest that performance enhancement interventions could help students improve performance by

teaching them general skills for managing inattention and cognitive anxiety as well as specific problem solving skills to structure their attention and effort. These intervention goals can be taught in a brief class (e.g., 60 minutes). Such an intervention is likely to be most effective if taught early and practiced often. Therefore, such an intervention should be implemented before the students arrive at EOD training or at the beginning of training. In addition, the intervention should be followed up with regular booster sessions to improve these skills and reinforce their practice.

Conclusion

The present study systematically investigated the role of a wide range of theoretically-based variables in predicting two types of performance outcomes in the US military EOD training. The statistical procedures included multivariate analyses to identify unique predictors of performance and interactional analyses to clarify how pairs of variables might be interacting to affect performance. A substantial number of variables were found to predict performance on a univariate level. Demographic variables, trait inattention, and situationally experienced cognitive anxiety emerged as key predictors of performance in comparison with the other predictors in the model. The findings also suggested that problem-solving skills might act as a protective factor against the negative performance effects associated with both trait inattention and situational cognitive anxiety. Finally, even though trait inattention was found to be a risk factor for poorer performance, the findings also suggested that inattention could be associated with enhanced performance if paired with either situational variables of high utilization of problem solving skill or low cognitive anxiety experienced during a test. The data for the

situational variables in this study may have been unrepresentative of the EOD student population because these variables were measured retrospectively and data was available for a reduced number of subjects. It is recommended that future research attempt to replicate these findings involving situational variables. If the findings are confirmed, they have potential applications in performance-enhancing interactions.

TABLES

TABLE 1

Table 1.
Instructional Divisions in the EOD Training Program

Instructional Division	Course content
Core	Basic operational principles, procedures and safety precautions (math, electricity, physics, fuze and ordnance identification)
Demolition	Basic demolition materials, explosive safety, and disposal techniques
Tools and Methods	Special tools and procedures
Biological and Chemical	Biological/chemical materials, clothing, and related procedures
Ground Ordnance	Explosive devices associated with ground operations (grenades, mines, projectiles)
Air Ordnance	Explosive devices associated with air operations (missiles, air-delivered mines)
Improvised Explosive Devices	Unconventional explosive devices (terrorist bombs)
Nuclear Weapons	Nuclear explosive devices

TABLE 2

Variables Representing Each Factor in the Model of Stress and Performance

	Factor	Variables	Measures
Outcome Variables	Long term performance	Program performance	Pass, Fail
	Situational performance	Test performance	Score (0-100)
Control Variables	Demographics	Age	Recorded from military records
		Gender	
		Race	
		Marital status	
		Military rank	
		Military service	
		Time in service	
	Response Bias	Social Desirability	Social Desirability Scale (SDS)
	External Stressors	Daily Life Problems	Schedule of Recent Life Events (SRLE)
		Major Life Changes	Life Events Scale (LES)
Enduring Abilities	General cognitive ability	Cognitive ability	Armed Forces Qualification Test (AFQT)
	Inattention	Inattention	Modified Current Behaviors Scale (Mod CBS)
	Impulsivity	Impulsivity	Mod CBS
	PS skills	PS skills	Social Problem Solving Inventory-Revised (SPSI-R)
Enduring Beliefs and Attitudes	PS orientation	PS orientation	SPSI-R
	Personality	Conscientiousness	NEO Five Factor Inventory (NEO FFI)
		Neuroticism	
	Anxiety	General and test	State-Trait Anxiety Inventory (STAI)
		Social performance	Social Phobia Inventory (SPS)
		Anxiety sensitivity	Anxiety Sensitivity Inventory (ASI)
	Social desirability	Social desirability	Social Desirability Scale (SDS)
Recent Environmental Events	Events	Major life changes	Life Experiences Survey (LES)
		Routine problems	Schedule of Recent Life Events (SRLE)
	Social relations	Supervisors	Work Environment Scale (WES)
		Peers	Dyadic Adjustment Scale (DAS)
		Significant others	DAS
Recent Internal Processes & Conditions	Inattention	Inattention	Work Behaviors Scale (WBS)
	Impulsivity	Impulsivity	
	Stress Responses	Affective distress	Outcomes Questionnaire (OQ-10)
		Fatigue	Short Form-36 (SF-36)
Situational Internal Processes and Beliefs	Inattention	Inattention	Modified Cognitive Somatic Anxiety Questionnaire (Mod CSAQ)
	PS appraisal	PS self-efficacy	Modified Problem Solving Inventory (Mod PSI)
Situational Responses	PS skills	PS skills	Mod PSI
	Anxiety	Cognitive anxiety	Mod CSAQ
		Somatic anxiety	Mod CSAQ

TABLES 3-5

Table 3.
Time Point One: Baseline Assessment

Measure	Variable	Time required
Modified Current Behaviors Scale (Mod CBS)	Inattention Impulsivity	5 mins
Social Problem Solving Inventory (SPSI-R)	PS orientation PS approach	12 mins
NEO Personality Inventory (NEO PI)	Conscientiousness Neuroticism	12 mins
Social Desirability Scale (SDS)	Social desirability	5 mins
Life Events Scale (LES)	Life changes	12 mins
Outcomes questionnaire-10 (OQ-10)	Affective distress	5 mins
Dyadic Adjustment Scale (DAS)	Relations with significant others	5 mins
7 measures	10 variables	56 mins

Table 4.
Time Point Two: Pre-test Assessment

Measure	Variable	Time required
Schedule of Recent Life Experiences (SRLE)	Daily problems	12 mins
Work Environment Scale (WES)	Relations with instructors Relations with peers	12 mins
Dyadic Adjustment Scale (DAS)	Relations with significant others	5 mins
Work Behavior Scale (WBS)	Inattention Impulsivity	5 mins
Outcomes questionnaire-10 (OQ-10)	Affective distress	5 mins
Short form 36 health survey (SF-36)	Fatigue	10 mins
6 measures	8 variables	49 mins

Table 5.
Time Point Three: Post-test Assessment

Measure	Variable	Time required
Cognitive and somatic anxiety questionnaire (CSAQ)	Inattention Cognitive anxiety Somatic anxiety	5 mins
Modified problem solving inventory (Mod PSI)	PS self-efficacy PS approach	5 mins
2 measures	5 variables	10 mins

TABLES 6-8

Table 6
Comparisons of Practical Test Grade Across Services

	Air Force M (SD)	Army M (SD)	Marines M (SD)	Navy M (SD)	F
Practical test performance (0-100)	92 (6.71) (n = 176)	90 (9.23) (n = 152)	92(7.65) (n =44)	93 (6.09) (n = 76)	4.09**

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 7
Practical Test Grade Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army	2.64*	---	
Marines			---
Navy			

Note. Uses Scheffe criteria$p < .05$. ** $p < .01$. *** $p < .001$.

Table 8

Descriptive Statistics for Continuous Predictor Variables of Students Who Passed Versus Failed the Practical Test

	Pass			Fail		
	n	M	SD	n	M	SD
Demographic Control Variables						
Age (years)	360	23.13	4.43	87	22.94	4.55
Enlisted Pay Grade (1-6)	360	3.21	1.68	88	2.90	1.74
Time in Service (months)	330	31.02	34.79	75	31.15	39.66
Response Bias Control Variable						
Social Desirability (0-33)	343	20.68	5.54	83	20.88	6.11
Environmental Stressor Control Variable						
Daily Life Problems	311	76.71	18.53	77	81.29	21.69
Recent Predictors						
Relationship with Peers (0-10)	310	7.20	1.67	77	7.11	1.89
Relationship with Supervisors (0-10)	309	6.04	1.55	77	6.18	1.59
Relationship with Sig Other (0-151)	142	96.59	11.85	35	97.88	18.60
R Inattention (0-27)	189	2.21	2.43	41	3.48	4.70
R Impulsivity (0-27)	189	3.71	2.77	41	4.54	4.19
Negative Affect (0-20)	311	5.32	3.29	77	5.78	3.05
Energy (0-100)	311	64.29	3.29	77	62.92	19.82
Situational Predictors						
Inattention (0-12)	100	3.72	1.84	23	4.00	1.71
Cognitive Anxiety (0-28)	100	12.96	5.54	23	15.83	6.11
Somatic Anxiety (0-40)	100	15.91	7.39	23	14.92	5.95
Problem Solving Self-Effic (0-56)	96	35.03	6.64	23	31.01	8.01
Problem Solving Skills (0-63)	96	77.52	14.10	23	72.15	17.84

Tables 9-11

Table 9
Comparisons of Program Completion Rates Across Services

	Air Force M (SD)	Army M (SD)	Marines M (SD)	Navy M (SD)	F
Program Completion	.65 (.48) (n = 192)	.64 (.48) (n = 183)	.76 (.43) (n =46)	.90 (.31)(n = 77)	6.91***

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.
p < .05. ** p < .01. *** p < .001.

Table 10
Program Completion Rate Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army		---	
Marines			---
Navy	.25**	.26**	

Note. Uses Scheffe criteria
p < .05. ** p < .01. *** p < .001.

Table 11
Descriptive Statistics for Continuous Predictor Variables of Students who Completed Versus Did Not Complete the EOD Training Program

	Complete			Non-complete		
	n	M	SD	n	M	SD
Demographic Control Variables						
Age (years)	345	23.31	.44	152	22.4	4.7
Gender (1=male, 2=female)	345	1.03	.18	152	1.01	.01
Ethnicity (Caucasian)	344	.91	.29	152	.89	.32
Marital Status (married)	345	1.26	.44	152	1.2	.40
Enlisted Pay Grade (1-6)	346	3.34	1.67	152	2.6	1.60
Time in Service (months)	316	34.21	36.46	152	21.2	32.42
Svc – Air Force	346	.36	.48	152	.44	.50
Svc – Army	346	.34	.47	152	.43	.50
Svc – Marines	346	.10	.30	152	.07	.26
Svc – Navy	346	.20	.40	152	.05	.22
Response Bias Control Variable						
Social Desirability (0-33)	332	21.08	5.47	143	19.72	5.83
Environmental Stressor Control Variable						
Major Life Changes	334	18.95	14.00	137	19.26	13.95
Stable Abilities & Trait Predictors						
Cognitive Ability (0-100)	336	73.73	16.61	148	70.92	18.04
Conscientiousness (0-48)	330	47.98	5.15	143	46.17	6.18
Neuroticism (0-48)	330	26.31	6.89	143	28.27	7.66
Trait Anxiety (20-80)	332	35.98	6.54	143	38.52	8.16
Social Performance Anxiety (0-80)	328	7.22	8.38	143	9.18	11.33
Anxiety Sensitivity (0-64)	328	10.97	6.58	143	11.59	8.29
Modifiable Abilities & Trait Predictors						
Inattention (0-27)	252	2.46	2.43	99	3.41	3.77
Impulsivity (0-27)	252	4.72	3.22	99	5.58	3.58
Problem Solving Orientation (0-8)	332	6.25	.88	143	6.11	1.10
Problem Solving Skills (0-12)	332	8.92	1.20	143	8.58	1.68

TABLES 12-17

Table 12
Comparisons of Demographic Variables Across Services

	Air Force (n = 181-192)	Army (n = 146-183)	Marines (n =44-46)	Navy (n = 75-77)	F
Age (years)	21.3 (4.2)	23.1 (4.0)	23.8 (2.8)	26.7 (4.5)	32.80***
Gender (males)	95%	98%	100%	100%	2.60
Ethnicity (Caucasian)	94%	91%	76%	87%	5.18***
Marital Status (married)	8%	35%	78%	8%	53.00***
Pay Grade (E1-E6)	2.1 (1.4)	3.1 (1.5)	5.1 (.25)	4.7 (1.0)	108.02***
Time in Svc (months)	6.6 (18.9)	34.0 (33.3)	59.0 (15.8)	64.1 (38.3)	96.61***

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 13
Age Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army	1.85***	---	
Marines	2.51**		---
Navy	5.38***	3.53***	

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 14
Ethnicity Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army		---	
Marines	.18**	.15*	---
Navy			

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 15
Marital Status Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army	.26***	---	
Marines	.70***	.44***	---
Navy		.27***	.70***

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 16
Enlisted Pay Grade Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army	1.04***	---	
Marines	2.89***	1.85***	---
Navy	2.63***	1.59***	

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 17
Time in Service Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army	27.44***	---	
Marines	52.43***	24.98***	---
Navy	57.50***	30.05***	

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 18

Table 18
Comparison of Response Bias & External Stressor Control Variables

	Air Force	Army	Marines	Navy	F
Social Desirability (0-33)	21.4 (5.5) (n = 191)	20.3 (5.7) (n = 176)	19.6 (5.5) (n =46)	20.2 (5.8) (n = 62)	2.14
Daily Life Problems (51-204)	76.6 (15.6) (n = 168)	76.0 (19.3) (n = 155)	80.0 (24.5) (n =46)	81.7 (22.5) (n = 61)	0.71
Major Life Changes (0-216)	18.0 (12.4) (n = 189)	19.7 (15.8) (n = 165)	19.0 (12.6) (n =46)	20.6 (14.3) (n = 62)	1.64

TABLE 19-21

Table 19
Comparisons of Enduring Stable Abilities, Beliefs, and Attitudinal Variables Across Services

	Air Force (n = 189-191)	Army (n = 174-177)	Marines (n = 45-46)	Navy (n = 60-62)	F
Cognitive Ability (0-100)	80 (13.3)	66 (18.6)	64	75	28.28***
Conscientiousness (0 – 48)	47.1 (5.5)	47.3 (5.7)	48.3 (5.9)	48.4 (4.8)	1.28
Neuroticism (0 – 48)	27.2 (6.9)	26.7 (6.8)	26.7 (8.4)	26.6 (8.2)	0.21
Trait Anxiety (20 – 80)	36.8 (6.7)	36.9 (7.7)	37.4 (6.8)	35.6 (7.2)	0.71
Social Performance Anxiety (0 – 80)	7.6 (8.9)	8.8 (10.7)	7.1 (8.7)	6.0 (6.7)	1.53
Anxiety Sensitivity (0 – 64)	11.8 (7.2)	10.9 (7.6)	11.7 (6.5)	9.3 (5.1)	1.99

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 20
Comparisons of Modifiable Stable Abilities, Beliefs, and Attitudinal Variables Across Services

	Air Force (n = 126-191)	Army (n = 135-176)	Marines (n = 39-46)	Navy (n = 51-62)	F
Inattention (0 – 27)	2.6 (2.7)	2.8 (3.0)	3.3 (3.1)	2.6 (3.0)	0.63
Impulsivity (0 – 27)	4.9 (3.2)	4.9 (3.3)	5.9 (4.0)	4.4 (3.1)	1.56
Problem Solving Orientation (0-8)	6.2 (0.9)	6.2 (1.0)	6.1 (1.1)	6.3 (1.0)	0.69
Problem Solving Skills (0-12)	8.8 (1.3)	8.8 (1.5)	8.8 (1.2)	9.0 (1.3)	0.55

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.

Table 21
Enduring Cognitive Ability (ASVAB AFQT Score) Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army	13.72***	---	
Marines	15.93***		---
Navy		9.03**	11.24**

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLES 22-24

Table 22
Comparisons of Recent Predictors Across Services

	Air Force (n = 54-168)	Army (n = 68-155)	Marines (n = 32-39)	Navy (n = 37-59)	F
Relationship with Peers (0-10)	7.1 (1.7)	7.4 (1.6)	6.4 (2.0)	7.6 (1.6)	4.75**
Relationship with Supervisors (0-10)	6.2 (1.4)	6.0 (1.6)	5.8 (1.8)	6.0 (1.7)	0.85
Relationship with Sig Other (0-151)	99.2 (12.2)	95.3 (14.1)	95.2 (16.5)	95.3 (9.4)	1.10
R Inattention (0-27)	2.0 (2.2)	2.6 (3.5)	3.1 (3.3)	2.4 (2.6)	1.20
R Impulsivity (0-27)	3.3 (2.5)	4.1 (3.3)	4.5 (3.2)	3.6 (3.0)	1.76
Negative Affect (0-20)	5.2 (3.0)	5.3 (3.4)	5.4 (3.1)	5.9 (3.8)	0.68
Energy (0-100)	62.0 (16.7)	63.6 (18.0)	64.4 (19.5)	70.0 (18.8)	2.84*

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 23
Recent Relationship with Peers Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army		---	
Marines		.94**	---
Navy			1.16*

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 24
Recent Energy Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army		---	
Marines			---
Navy	7.76*		

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLES 25-23

Table 25
Comparisons of Situational Predictors Across Services

	Air Force (n = 53)	Army (n = 52-54)	Marines (n = 17-19)	Navy (n = 26)	F
Inattention (0-12)	4.6 (1.6)	4.6 (1.3)	4.8 (1.8)	5.2 (2.4)	0.71
Cognitive Anxiety (0-28)	14.1 (5.9)	15.8 (5.9)	12.9 (4.8)	15.5 (5.7)	1.59
Somatic Anxiety (0-40)	14.8 (4.4)	16.7 (6.3)	17.1 (6.4)	20.0 (10.5)	3.50*
Problem Solving Self-Efficacy (0-56)	35.0 (6.9)	33.5 (6.5)	34.0 (7.9)	35.3 (6.3)	0.68
Problem Solving Skills (0-63)	42.3 (8.0)	41.2 (7.7)	40.7 (10.5)	44.2 (8.8)	0.92

Note. One-way ANOVAs were used to detect differences among services. For variables with significant differences among services, Scheffe post hoc comparisons of mean scores were used to identify number of significant different service pairs.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 26
Situational Somatic Anxiety Mean Differences Using Multiple Comparison Post Hoc Tests

	Air Force	Army	Marines
Air Force	---		
Army		---	
Marines			---
Navy	5.17*		

Note. Uses Scheffe criteria
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLES 27-29

Table 27
Univariate Analyses of Associations Between Control Variables and Practical Test Performance

Variable	n	r
Demographic Control Variables		
Age	447	.03
Gender – Male	447	.15**
Ethnicity – Caucasian	446	.10*
Marital Status	447	-.02
Pay Grade – Enlisted	448	.06
Time in Service	405	.03
Svc – Air Force	448	.09
Svc – Army	448	-.16**
Svc – Marines	448	.02
Svc – Navy	448	.07
Response Bias Control Variable		
Social Desirability	426	-.04
Environmental Stressor Control Variable		
Daily Life Problems	388	-.09

Note.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 28
Univariate Analyses of Associations Between Enduring, Recent, and Situational Predictor Variables and Practical Test Performance

Variable	n	r
Enduring Predictor Variables		
Cognitive Ability	434	.18***
Conscientiousness	424	.11*
Neuroticism	424	-.05
Trait Anxiety	426	-.05
Social Performance Anxiety	423	-.07
Anxiety Sensitivity	421	-.05
Inattention	309	-.01
Impulsivity	309	-.03
Problem Solving Orientation	426	-.06
Problem Solving Skills	426	-.05
Recent Predictor Variables		
Relationship with Peers	387	.05
Relationships with Supervisors	386	-.03
Relationship with Significant Others	177	.03
Inattention	230	-.16*
Impulsivity	230	-.09
Negative Affect	388	-.11*
Energy	388	.02
Situational Predictor Variables		
Inattention	123	-.14
Cognitive Anxiety	123	-.36***
Somatic Anxiety	123	.03
Problem Solving Self-Efficacy	119	.23*
Problem Solving Skills	119	.09

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 29

Univariate Analyses of Associations Between Interactions among Predictor Variables and Practical Test Performance

Variable	n	r
Interaction Variables		
E Inattention X S Cognitive Anxiety	122	-.23*
E Fears Cognitive X S Inattention	123	-.19*
E Fears Somatic X S Somatic Anxiety	123	-.09
E Conscientiousness X S Inattention	123	-.11
S Problem Solving Skills X E Inattention	122	-.03
S Problem Solving Skills X S Cognitive Anxiety	119	.30**

Note. Abbreviations: E = Enduring, S = Situational

* $p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 30-31

Table 30
Zero-Order Correlations Among Temporally Recent Variables (Block 2) and Social Desirability

Variable	1	2	3	4	5	6	7
1. R Relations Peers	---						
2. R Relations Supervisors	.36***	---					
3. R Relations Significant Others	.16*	.16*	---				
4. R Inattention	-.30***	-.23***	-.19*	---			
5. R Impulsivity	-.25***	-.13*	-.14	.72***	---		
6. R Negative Affect	-.22***	-.25***	-.32***	.55***	.46***	---	
7. R Energy	.26***	.28***	.24**	-.40***	-.39***	-.57***	---
8. Social Desirability	.18***	.18***	.28**	-.40***	-.40***	-.39***	-.36***

Note. N's range from 129-475 (low N's associated with limited number of subjects reporting relationship with significant other and limited number of subjects given measures of inattention and impulsivity).
Abbreviation: R = Recent.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 31
Zero-Order Correlations Among Social Desirability and Temporally Situational Variables (Block 3) and Social Desirability

Variable	1	2	3	4	5
1. S Attentional Control	---				
2. S Cognitive Anxiety	.50***	---			
3. S Somatic Anxiety	.60***	.49***	---		
4. S Problem Solving Self-Efficacy	-.24**	-.44***	-.17*	---	
5. S Problem Solving Skills	-.24**	-.23**	-.13	.78***	
6. Social Desirability	-.12	-.18*	-.18*	.21*	.26**

Note. N's range from 147-152.
Abbreviation: S = Situational.
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLES 32-34

Table 32
Two Block Hierarchical Linear Regression Model of Performance on a Test during the EOD Training Program

Model and Variables	Adjusted R^2	R^2 Change	sr	B	SE B	β
Model: Adding Second Block	.06**	.03**				
(Block 1 Control Variables)						
Ethnicity – Caucasian			.12	3.07	1.68	.12
Service – Army			-.19	-3.01	1.06	-.18**
(Block 2 Recent Predictors)						
R Inattention			-.10	-.31	.20	.12
R Negative Affect			-.06	-.18	.19	.07

Note. Minimum pairwise N = 227
[a] sr^2 = semi-partial correlation, which describes the percent variance accounted for by each predictor
Abbreviation: R = Recent.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 33
Three Block Hierarchical Linear Regression Model of Performance on a Test during the EOD Training Program

Model and Variables	Adjusted R^2	R^2 Change	sr	B	SE B	β
Model: Adding Third Block	.17***	.12***				
(Block 1 Control Variables)						
Ethnicity – Caucasian			.07	1.55	0.07	.07
Service – Army			-.20	-2.86	-0.18	-.18*
(Block 2 Recent Predictors)						
R Inattention			-.03	-0.01	-0.03	-.03
R Negative Affect			.17	0.44	0.20	.20
(Block 3 Situational Predictors)						
S Cognitive Anxiety			-.32	-0.46	-0.37	-.37**
S Prob Solve Self Efficacy			.13	0.14	0.14	.14

Note. Minimum pairwise N = 114
[a] sr^2 = semi-partial correlation, which describes the percent variance accounted for by each predictor
Abbreviations: R = Recent, S = Situational
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 34
Four Block Hierarchical Linear Regression Model of Performance on a Test during the EOD Training Program

Model & Variables	Adjusted R^2	R^2 Change	sr	B	SE B	β
Model: Adding Fourth Block	.18***	.03				
(Block 1 Control Variables)						
Ethnicity – Caucasian			.09	1.92	2.06	.08
Service – Army			-.19	-2.76	1.40	-.18
(Block 2 Recent Predictors)						
R Inattention			.08	.26	.31	.11
R Negative Affect			.20	.52	.25	.24*
(Block 3 Situational Predictors)						
S Cog Anxiety			-.08	-.32	.38	-.26
S Prob Solve Self Efficacy			.11	.18	.16	.18
(Block 4 Interactions)						
E Fears Cog X S Inattn Anx			-.11	-.07	.07	-.14
E Inattn X S Cog Anx			-.10	-.01	.01	-.14
S Cog Anx X S PS Skill			-.02	.00	.00	-.06

Note: Minimum pairwise N = 113
[a] sr^2 = semi-partial correlation, which describes the percent variance accounted for by each predictor
Abbreviations: E = Enduring, R = Recent, S = Situational.
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 35

Table 35
Univariate Analyses of Associations Between Predictor Variables and EOD Training Program Successful Completion

Variable	n	B	Wald χ^2	OR (95% C.I.)
Demographic Control Variables				
Age (years)	497	0.05	4.23	1.05 (1.00-1.10)*
Gender (female)	497	1.59	2.32	4.91 (0.63-37.99)
Ethnicity (Caucasian)	496	0.24	0.57	1.27 (0.68-2.38)
Marital Status (married)	497	0.32	1.85	1.38 (0.87-2.19)
Enlisted Pay Grade (1 – 6)	498	0.28	21.9	1.33 (1.18-1.49)***
Time in Service (months)	446	0.01	11.67	1.01 (1.01-1.02)**
Svc – Air Force	498	-0.33	2.81	0.72 (0.49-1.06)
Svc – Army	498	-0.41	4.17	0.67 (0.45-0.98)*
Svc – Marines	498	0.37	1.03	1.44 (0.71-2.92)
Svc – Navy	498	1.50	15.00	4.48 (2.10-9.58)***
Response Bias Control Variable				
Social Desirability (0-33)	475	0.43	5.80	1.04 (1.01-1.08)**
Environmental Stressor Control Variable				
Major Life Changes	461	0.00	0.01	1.00 (0.98-1.01)
Stable Abilities & Trait Predictors				
Cognitive Ability (0 – 100)	484	0.01	2.77	1.01 (1.00-1.02)
Conscientiousness (0 – 48)	473	0.06	10.50	1.06 (1.02-1.10)**
Neuroticism (0 – 48)	473	-0.04	7.34	0.96 (0.94-0.99)**
Trait Anxiety (20 – 80)	475	-0.05	12.21	0.95 (0.93-0.98)***
Social Performance Anxiety (0 – 80)	471	-0.02	4.18	0.98 (0.96-1.00)*
Anxiety Sensitivity (0 – 64)	470	-0.01	0.75	0.99 (0.96-1.02)
Modifiable Abilities & Trait Predictors				
Inattention (0 – 27)	351	-0.11	7.32	0.90 (0.83-0.97)**
Impulsivity (0 – 27)	351	-0.07	4.54	0.93 (0.87-0.99)*
Problem Solving Orientation (0 – 8)	475	0.16	2.45	1.18 (0.96-1.44)
Problem Solving Skills (0 – 12)	475	0.18	6.22	1.20 (1.04-1.38)*
Interaction				
Inattention X Problem Solving Skill	350	-0.01	3.85	0.99 (0.98-1.00)*

Note. Univariate logistic regression analysis conducted by SPSS. All analyses based on 1 degree of freedom.
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLES 36-38

Table 36
Zero-Order Correlations Among Binary, Ordinal, and Scale Demographic Control Variables (Block 1) and Their Means and Standard Deviations

Variable	1	2	3	4	5
1. Age	---				
2. Sex	-.04	---			
3. Marital status	.21***	-.03	---		
4. Caucasian Ethnicity	-.05	.01	-.07	---	
5. Enlisted Pay Grade	.66***	-.08	.38***	-.11	---
6. Time in Service	.63***	-.10*	.39***	-.08	.75***

Note. N's range from 472-483
Abbreviation: E = Enduring.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 37
Zero-Order Correlations Among Theoretically Stable Enduring Ability and Trait Predictor Variables (Block 2) and Social Desirability

Variable	1	2	3	4	5	6
1. E Cognitive Ability	---					
2. E Conscientiousness	-.06	---				
3. E Neuroticism	-.07	-.55***	---			
4. E Trait Anxiety	-.05	-.54***	.76***	---		
5. E Social Performance Anxiety	-.14**	-.30***	.53***	.61***	---	
6. E Anxiety Sensitivity	-.05	-.18***	.37***	.45***	.58***	---
7. Social Desirability	-.07	.47***	-.50***	-.53***	-.36***	-.25***

Note. N's range from 472-483
Abbreviation: E = Enduring.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 38
Zero-Order Correlations Among Theoretically Modifiable Enduring Ability and Trait Predictor Variables (Block 3) and Social Desirability

Variable	1	2	3	4
1. E Inattention	---			
2. E Impulsivity	.62***	---		
3. E Problem Solving Skills	-.55***	-.38***	---	
4. E Problem Solving Orientation	-.55***	-.34***	.70***	---
5. Social Desirability	-.47***	-.41***	.47***	.35***

Note. N's range from 350-483
Abbreviation: E = Enduring.
$p < .05$. ** $p < .01$. *** $p < .001$.

TABLES 39-41

Table 39
Two Block Hierarchical Logistic Regression Model of Stable and Modifiable Abilities and Traits Predicting EOD Training Program Successful Completion

Model and Variables	R^2	Model χ^2	Block added χ^2	B	SE B	O.R. (95% CI)
Model: Adding Second Block	.10	46.7***	5.76			
(Block 1 Control Variables)						
Age				-.07	.03	.93 (.88-1.00)*
Enlisted Pay Grade				.34	.09	1.41 (1.18-1.69)***
Svc – Army				-.18	.23	.84 (.54-.1.31)
Svc – Navy				1.16	.49	3.19 (1.23-8.31)*
Social Desirability				.03	.02	1.03 (.98-1.08)
(Block 2 Stable Abilities & Traits)						
E Conscientiousness				.02	.02	1.02 (.97-1.07)
E Trait Anxiety				-.04	.02	.96 (.92-1.00)
E Social Performance Anxiety				.01	.01	1.01 (.99-1.04)

Note. Minimum pairwise N = 467
R^2 estimated using Cox & Snell R^2
Abbreviation: E = Enduring.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 40
Three Block Hierarchical Logistic Regression Model of Stable and Modifiable Abilities and Traits Predicting EOD Training Program Successful Completion

Model and Variables	R^2	Model χ^2	Block added χ^2	B	SE B	O.R. (95% CI)
Model: Adding Fourth Block	.10	36.9***	3.0			
(Block 1 Control Variables)						
Age				-.08	.04	0.93 (.86-1.00)*
Enlisted Pay Grade				.36	.11	1.43 (1.16-1.75)**
Svc – Army				-.27	.27	0.76 (.45-1.29)
Svc – Navy				1.06	.55	2.90 (.99-8.48)
Social Desirability				-.01	.03	0.99 (.93-1.05)
(Block 2 Stable Abilities & Traits)						
E Conscientiousness				.03	.03	1.03 (.96-1.10)
E Trait Anxiety				-.03	.03	0.97 (.92-1.03)
E Social Performance Anxiety				.02	.02	1.02 (.98-1.06)
(Block 3 Modifiable Abilities & Traits)						
E Inattention				-08	.07	0.92 (.80-1.06)
E Impulsivity				-03	.05	0.97 (.88-1.07)
E Problem Solving Skills				.02	.13	1.02 (.79-1.32)

Note. Minimum pairwise N = 346
R^2 estimated using Cox & Snell R^2
Abbreviation: E = Enduring.
$p < .05$. ** $p < .01$. *** $p < .001$.

Table 41

Four Block Hierarchical Logistic Regression Model of Stable and Modifiable Abilities and Traits Predicting EOD Training Program Successful Completion

Model & Variables	R^2	Model χ^2	Block Added χ^2	B	SE B	O.R. (95% CI)
Model: Add Fourth Block	.11	41.71***	4.80*			
(Block 1 Control Variables)						
Age				-0.07	.04	0.93 (0.86-1.00)
Enlisted Pay Grade				0.34	.11	1.41 (1.14-1.73)**
Svc – Army				-0.24	.27	0.79 (0.46-1.33)
Svc – Navy					.55	3.09 (1.05-9.12)*
				1.13		
Social Desirability				-0.01	.03	0.99 (0.93-1.05)
(Block 2 Stable Abilities & Traits)						
E Conscientiousness				0.04	.04	1.04 (0.97-1.11)
E Trait Anxiety				-0.02	.03	0.98 (0.93-1.04)
E Social Performance Anxiety				0.03	.02	1.03 (0.99-1.07)
(Block 3 Modifiable Abilities & Traits)						
E Inattention				-0.60	.27	0.55 (0.55-0.94)*
E Impulsivity				-0.03	.05	0.97 (0.88-1.07)
E Problem Solving Skills				-0.14	.15	0.87 (0.65-1.17)
(Block 4 Interaction)						
E Inattention X E Problem Solving Skills				0.05	.03	1.05 (1.00-1.11)*

Note. Minimum pairwise N = 346

R^2 estimated using Cox & Snell R^2

Abbreviation: E = Enduring.

$p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 42

Table 42
Classification Table from Univariate Logistic Regression of Enduring Inattention Predicting Program Completion

Observed	Predicted		Percentage Correct
	Non-complete	Complete	
Non-completed	6	93	6.1
Completed	0	252	100.0
Overall Percentage			73.5

Note. The cut value is .500.

FIGURES

FIGURE 1

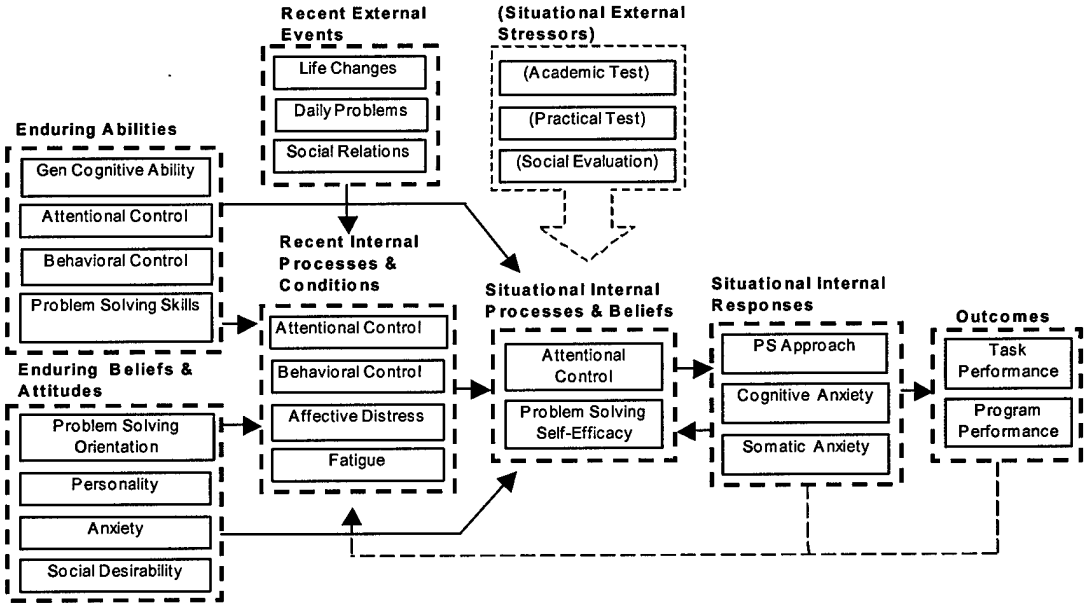


Figure 1. Proposed Model of Stress and Performance Variables

FIGURE 2
Assessment Time Points, Measures, and Variables

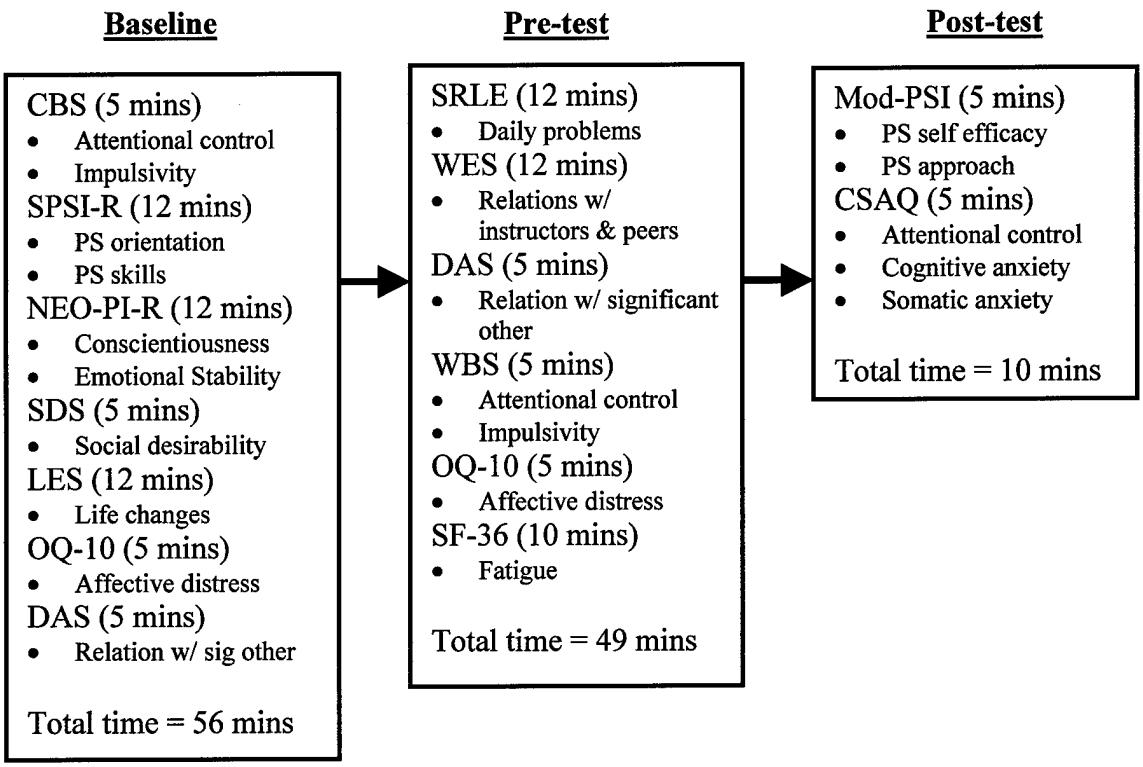
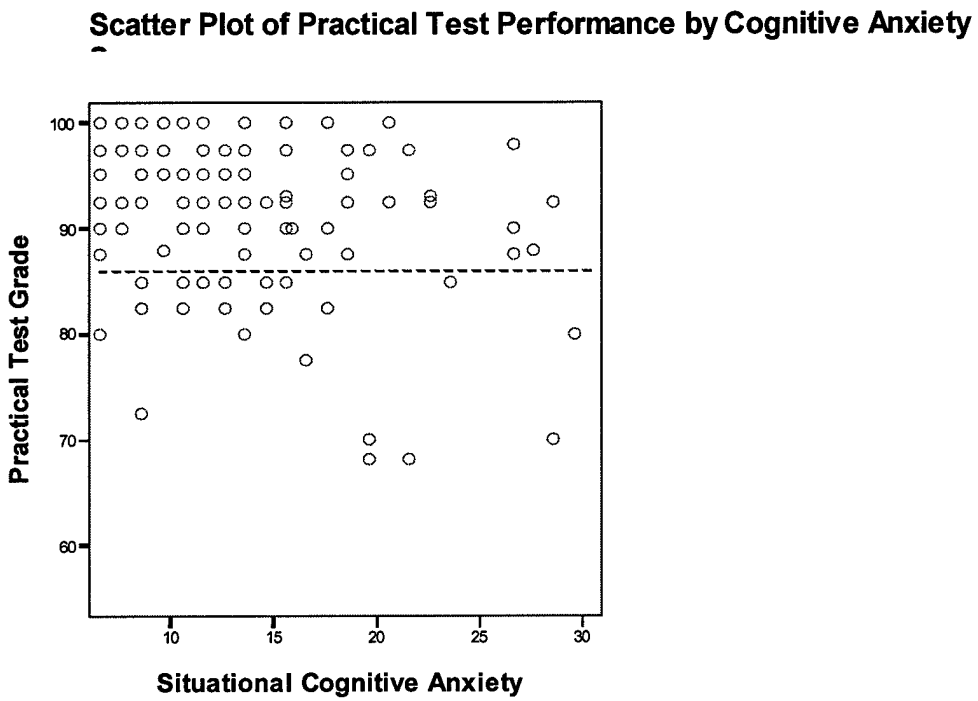
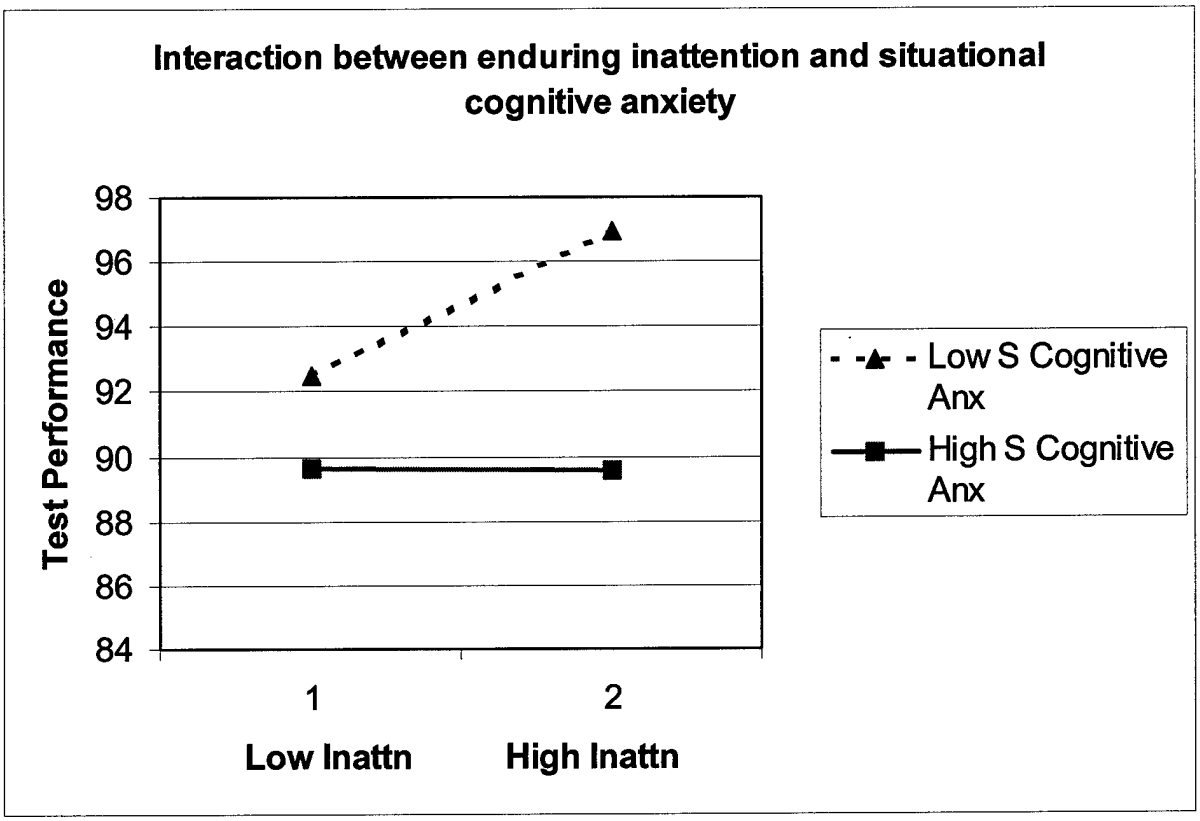


FIGURE 3



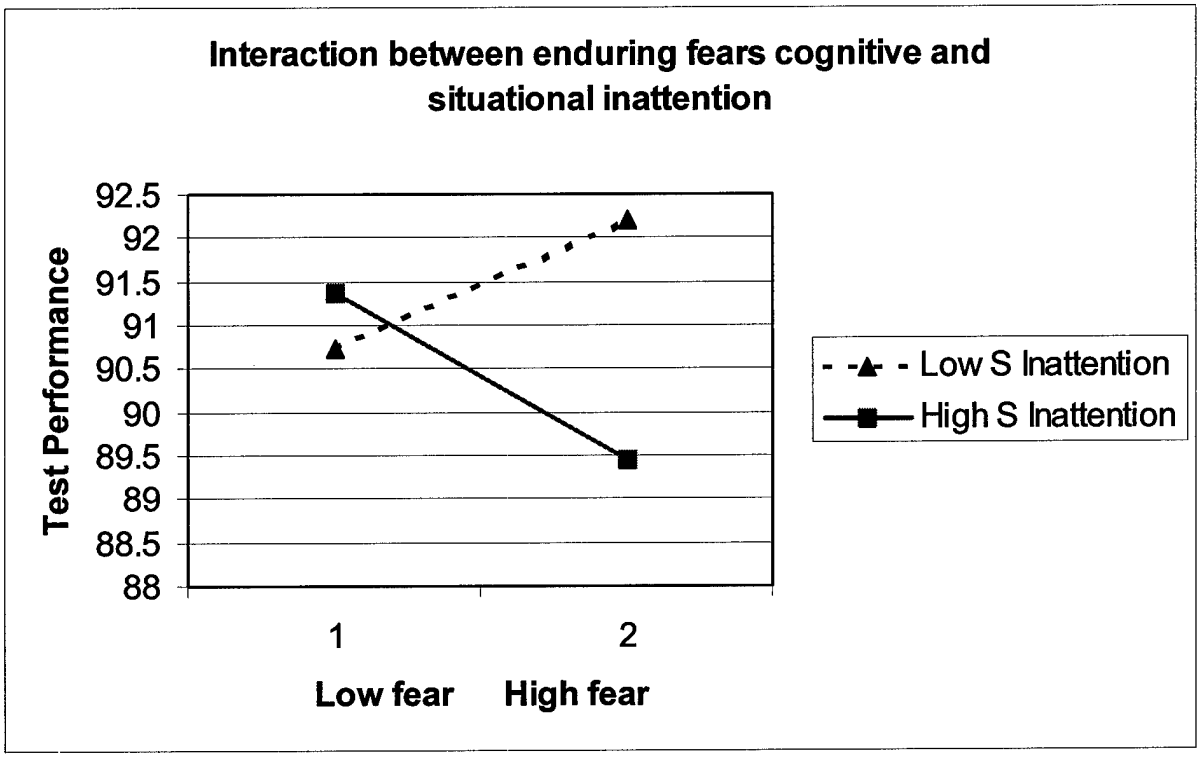
Note. Horizontal dashed line indicates pass/fail cutoff score of 85%. Scatter plot does not indicate number of students with identical pairs of practical test grades and cognitive anxiety scores.

FIGURE 4



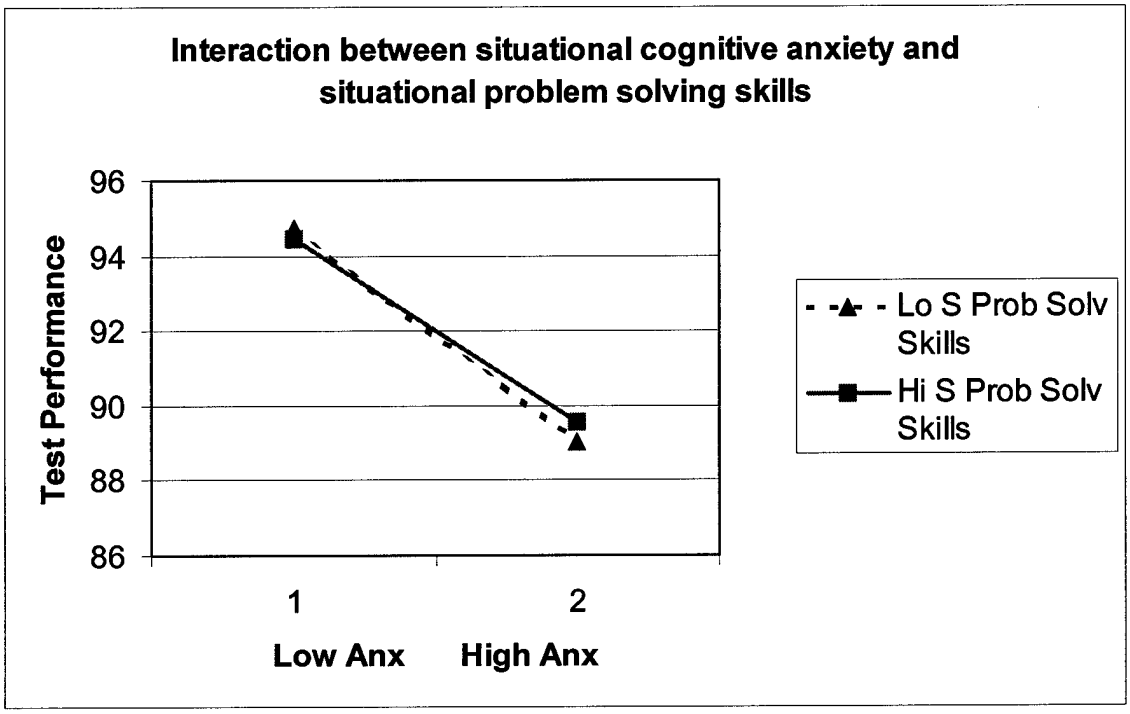
Note. High and Low values of both predictor variables (Enduring Inattention and Situational Cognitive Anxiety) were operationally defined as the mean plus and minus one standard deviation respectively. Points on the plot of this interaction were computed using the unstandardized regression coefficients from the regression analysis of the interaction. The outcome plotted on the Y-axis (Test Performance) represents the mean percentage score of students in each group of high and low Inattention and Cognitive Anxiety on the practical test.

FIGURE 5



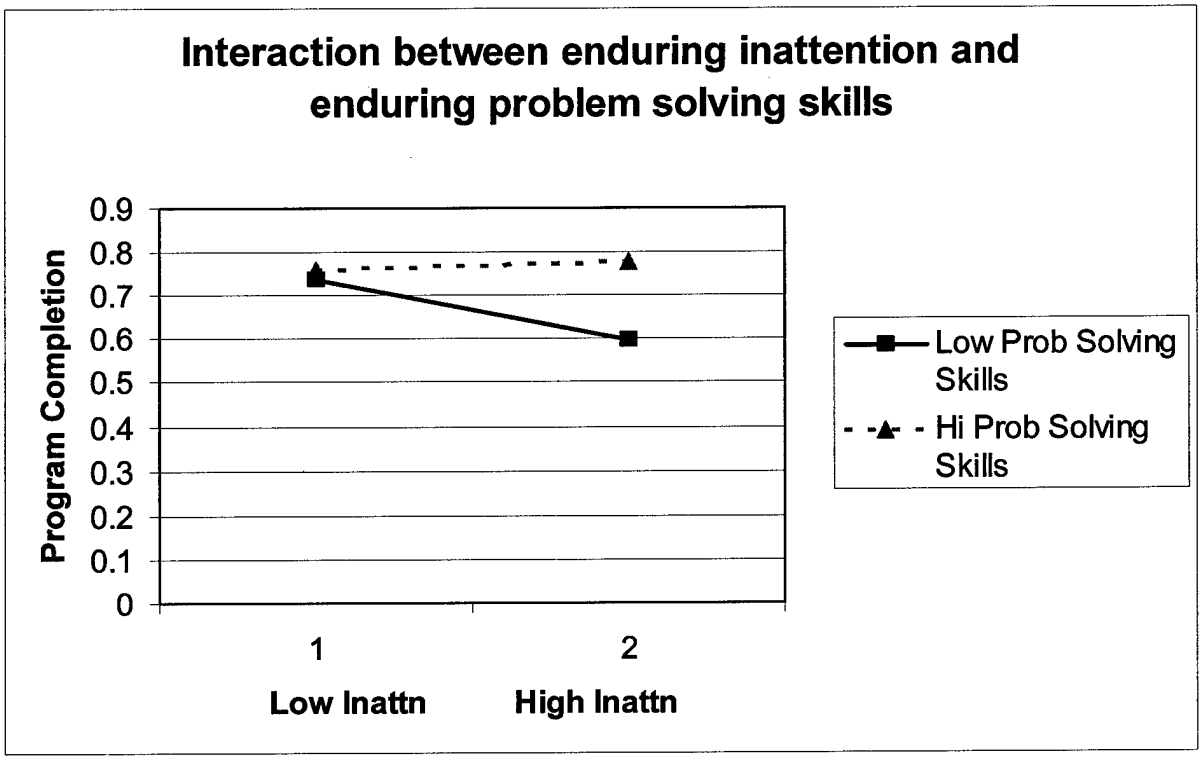
Note. High and Low values of both predictor variables (Enduring Fears of Cognitive Symptoms of Anxiety and Situational Inattention) were operationally defined as the mean plus and minus one standard deviation respectively. Points on the plot of this interaction were computed using the unstandardized regression coefficients from the regression analysis of the interaction. The outcome plotted on the Y-axis (Test Performance) represents the mean percentage score of students in each group of high and low Fears of Cognitive Symptoms of Anxiety and Inattention on the practical test.

FIGURE 6



Note. High and Low values of both predictor variables (Situational Cognitive Anxiety and Situational Problem Solving Skills) were operationally defined as the mean plus and minus one standard deviation respectively. Points on the plot of this interaction were computed using the unstandardized regression coefficients from the regression analysis of the interaction. The outcome plotted on the Y-axis (Test Performance) represents the mean percentage score of students in each group of high and low Cognitive Anxiety and Problem Solving Skills on the practical test.

FIGURE 7



Note. High and Low values of both predictor variables (Enduring Inattention and Enduring Problem Solving Skills) were operationally defined as the mean plus and minus one standard deviation respectively. Points on the plot of this interaction were computed using the unstandardized regression coefficients from the regression analysis of the interaction. The outcome plotted on the Y-axis (Program Completion) represents the proportion of students in each group of high and low Inattention and Problem Solving who completed EOD training program.

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