Survival Scores Research Project

FLETC Research Paper

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Homeland Security

offered the opportunity to participate in this research study. A realistic scenario was developed that required the use of skills acquired during training. This study was designed to address the following research questions:

- Can we validate our training scenarios as being realistic/highly stressful? Trainees are asked to perform law enforcement skills in scenarios that replicate real world situations that are stressful. This component will compare the stress response of trainees in this study to the stress response measured in other studies designed to elicit an acute stress response.

- Can specific psychological factors be identified that predict performance in a highly stressful law enforcement encounter?

- Can specific physiological factors be identified that predict performance in a highly stressful law enforcement encounter?

- Can specific physiological factors be used to identify an "optimum stress level for optimum performance" as suggested by various authors?

- What effect does high stress have on decision-making (cognitive processing)?

Once specific factors have been identified and the results of this study discussed with the many trainers and subject matter experts, we will then focus on the second phase of this research endeavor which will attempt to answer the more far-reaching question:

- How can these identified factors be used to improve/modify instruction at FLETC, and thereby, improve performance under stress?

Of significant interest to this research project is the role that psychological stress has on human performance. There is a limited amount of research in this area as few research institutions allow scientists to intentionally expose subjects to high levels of stress, anxiety, and fear. This is, however, the type of training environment we wish to situationally create for our trainees in order to safely replicate dangerous and stressful situations they may experience on the job.

In order to assess the performance of numerous law enforcement skills during a high stress encounter, a scenario was developed that required specific law enforcement skills, abilities, and knowledge during stressful situations.

as being personally dangerous or threatening and to respond to such situations with elevations in state anxiety. The stronger the anxiety trait, the more often the individual has experienced state anxiety in the past, and the greater the probability that intense elevations in state anxiety will be experienced in threatening situations in the future (Spielberger et al., 1995).

In order to reduce the ambiguity of the terms anger, hostility, and aggression (Spielberger et al, 1983), developed the following working definitions:

- The concept of anger usually refers to an emotional state that consists of feelings that vary in intensity, from mild irritation or annoyance to intense fury and rage. Although hostility usually involves angry feelings, this concept has the connotation of a complex set of attitudes that motivate aggressive behaviors directed toward destroying objects or injuring other people.... While anger and hostility refer to feelings and attitudes, the concept of aggression generally implies destructive or punitive behavior directed towards other persons or objects. (p. 16)

Acute Stress Versus Chronic Stress

Our study examined the effects of acute stress on performance in simulated law enforcement scenarios. Acute stress can be defined as stress that is "sudden, novel, intense, and of relatively short duration, disrupts goal-oriented behavior, and requires a proximate response" (Salas, 1996). Such acute stress in law enforcement is the result of the decision-maker's response to a threat situation. Salas summarizes the stressful situation as one in which the perception of danger exceeds one's resources to respond.

In contrast to acute stress is chronic stress. The human body, when confronted with any type of stressor does not return to a baseline condition immediately when the stressor is removed. This causes a change in the homeostasis of the person. The change can be short term (acute) or long term (chronic). Chronic stress is manifested when long-term homeostatic changes lead to alterations or breakdowns in any number of body functions. Through repeated exposure to acute stress or low stress situations, an individual can experience chronic stress symptoms. Stress reduction programs are basically designed to minimize the effects of chronic stress.

State/Trait Anxiety –Anger Inventories

Among the many instruments available to evaluate anxiety, the State-Trait Anxiety Inventory (STAI, Spielberger, 1983) is clearly the most frequently used and is generally considered the standard in the field. We will be using the STAI in this project, and are fortunate to have the developer of this instrument, Dr. Spielberger, working with us.

Early Physiological Research

Not only did Darwin and Freud record behavior patterns in response to emotions such as fear and rage, but also physical reactions such as facial expressions (clenched teeth, reddened face) increased heart rate, respiration, muscle tension, and other distinctive signs. Harvard physician-scientist Walter Cannon (1915, 1989) first termed the "fight or flight" response as a result of his research on the emotions of fear and rage in animals. These emotions disrupted the body's stability or balance (which he later termed "homeostasis") and triggered the release of adrenaline. Cannon was the first to suggest that the brain was the controlling center for a two-fold response to an undesirable stimulus, e.g.: the robber is dangerous (interpretation) and run from the robber (reaction & movement). The Canadian physician and endocrinologist, Hans Selye (1936, 1978), described these external pressures with the term "stressors" and the biological response as "stress" during his development of the "General Adaptation Syndrome"

(GAS). His definition of stress as the non-specific response of the body to any demand made upon it is consistent with the research studies of stimulus-response (S-R) psychology. Selye defined GAS as three distinct stages:

- Alarm Reaction: Similar to fight or flight.
- Resistance: Struggle to overcome, hard work, limited rest/sleep.
- Exhaustion: Body systems crash, fatigue, errors, irritability, vulnerable to illness (colds, flu, acne).

Selye's theory was that injury, overload and fear all produce the same body reaction. He believed that both eustress (positive) and distress (negative) produced the same initial response in the body (hence the general adaptation). Although Selye fashioned the term "stress response," many researchers classify Selye's research as actually describing "strain" as opposed to stress. Stress in many disciplines (biology, physics) is an outside or external stimulus acting on an object or individual, whereas strain would more accurately describe the internal reaction of a body or object to that stimulus.

Selye's original work has been extended and modified through ongoing stress-related research. Studies have shown that a fear (anxiety) response may not produce the same physiological response as anger. For example, John Mason (1985) showed unique cardiovascular and endocrine responses specific to a variety of different types of fear and anger stressors. Robert Eliot (1989) used selective measures (e.g. cardiovascular, muscular, gastrointestinal responses) for testing stress to evaluate those prone toward excessive responses to intellectual challenge or routine crises, and to describe individuals who over-react to mild stressors. Eliot characterized these individuals as "hot reactors."

Psychological perception frequently generates strong physiological manifestations. The body has been designed from its primitive origins to be alert to danger and respond if necessary. In this context, the psychological and physiological profiles are equally key and complex. Not only does the brain house the psychological orientation of an individual, but also the command center that directs the manifestations of those desires or emotions. This would certainly be the case with the fight or flight response. This response is reflexive in that it requires no thought or analysis but only the basic motor capacity to attack or flee. The physical display of psychological processes provides researchers with objective indicators for the measurement and analysis of arousal, anxiety, anger, fear, and other emotional processes that often appear subjective.

Neural Response to Stress

The central nervous system (CNS) has the complex task of collecting information, interpreting it, and responding in an appropriate manner. The interpretation of the event by the brain may dictate that no response is necessary (you see exactly what you expected to see) or that a dramatic response is necessary (an oncoming car is in your lane). The manner in which the body responds to a stimulus is determined by the configuration of the CNS (nature) and what information we have stored in it (nurture). It is important to understand how the brain is designed to respond in order to make modifications to the response process should the need arise.

Basic Wiring of the Nervous System

The nervous system is traditionally divided into two general parts based upon their location: the CNS and the peripheral nervous system (PNS). The brain and the spinal cord comprise the CNS and are protected by the skull and the vertebrae of the spinal column. The role of the CNS is to perform two complex functions for the body: 1) transmit to the brain information received from the environment and/or the body (input); and 2) transmit from

the brain information to control muscles, glands, vessels, etc. thereby producing movement or bodily adaptations to environment (output). The PNS consists of all nerve fibers that enter or leave the CNS. The PNS essentially provides the lines of communication throughout the body whereas the CNS performs the operations of analysis, coordination, and determination of an appropriate response to the stimulus.

As the focal point of the CNS, the human brain is divided into three major parts: the cerebrum, cerebellum, and brainstem. The cerebrum constitutes the largest segment of the human brain, and is divided into two large sections called hemispheres. The outermost layer of the cerebrum is known as the cerebral cortex and controls three vital functions for the body: 1) collection and interpretation of sensory input, 2) organization of complex motor actions, and 3) decision making, memory, rational and moral thought. The basal ganglia are neuron cell bodies located deep within the cerebrum. This area serves as the relay station for motor nerve signals and is a production site for neurotransmitters.

The cerebellum communicates with the CNS through three major nerve tracts and serves to monitor and coordinate complex patterns of motor activity. Sensory input on body position and posture is received and corrections made to provide fluid, accurate movements. At the base of the cerebrum is a complex region of nerve tracts and nuclei (gray matter) termed the brain stem. This combination of structures links the spinal cord to the higher brain areas previously discussed. The brain stem is comprised of numerous structures including the optic nerve tracts, pons, pineal gland, thalamus, and hypothalamus. The thalamus serves as a primary relay station for all senses except for smell, and channels the sensory information to the cortex for analysis. The hypothalamus, though smaller in size than the thalamus, plays one of the primary roles in regulating homeostasis through its control of several body functions and serves as a key link between the nervous and endocrine systems. Some of the more prominent actions of the hypothalamus are:

1. Regulation of heart rate and arterial blood pressure.

2. Regulation of body temperature.

3. Regulation of water and electrolyte balance.

4. Regulation of sleep and wakefulness.

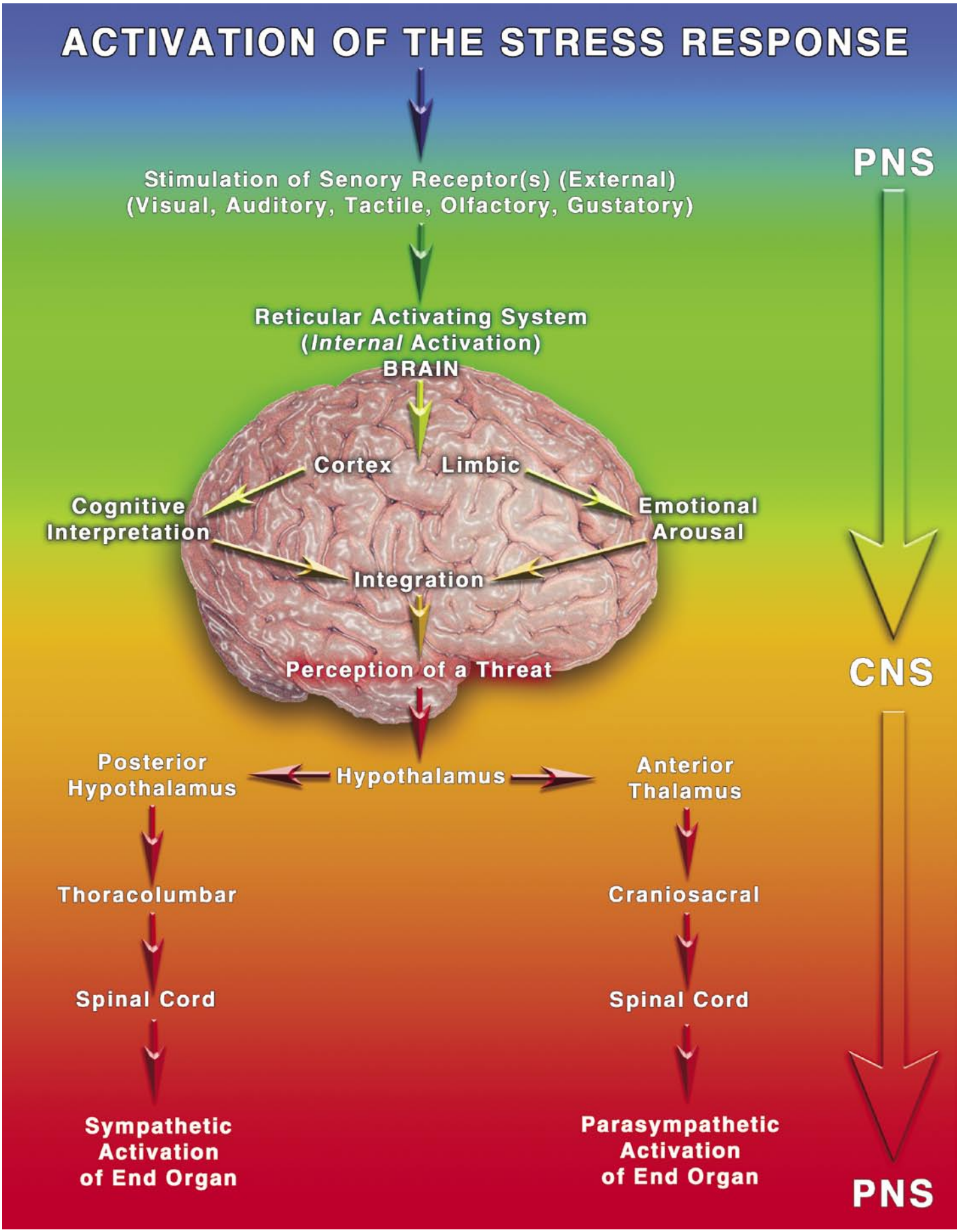
5. Control hunger and regulation of body weight.

6. Control of movements and secretions in the digestive system.

7. Production of hormones that stimulate the pituitary (the "master" gland) affecting growth, other endocrine glands, reproductive glands.

Since many body functions that are modified by the stress response are the very functions that were just identified as being under the direct or indirect control of the thalamus and hypothalamus, it is clear that the brain stem plays a dominant role in the body's stress response.

Although the anatomical areas of the CNS are relatively easy to identify by their location and function, it is vital to recognize that all CNS regions are linked to other specific areas and regions. Typically, a neural response is the compilation and integration of numerous neural regions. The response to a highly stressful event is generally the blend of one or more CNS areas (previously mentioned) that interact with other systems and organs throughout the body. Another method of discussing the operation of the CNS is by comparing the type of challenges (input)


ACTIVATION OF THE STRESS RESPONSE
Stimulation of Senory Receptor(s) (External)
(Visual, Auditory, Tactile, Olfactory, Gustatory)
Reticular Activating System
(*Internal* Activation)
BRAIN
Cortex
Limbic
Cognitive Interpretation
Emotional Arousal
Integration
Perception of a Threat
Posterior Hypothalamus
Hypothalamus
Anterior Thalamus
Thoracolumbar
Craniosacral
Spinal Cord
Spinal Cord
Sympathetic Activation of End Organ
Parasympathetic Activation of End Organ
PNS
CNS
PNS

to the type or level of response required by the CNS. This pattern of operation or analysis is frequently identified as a system. With regards to the stress response, two of the most prominent systems in the CNS are the limbic system and the reticular activation system.

The limbic system includes the hypothalamus, thalamus, hippocampus, septum, and amygdala structures. These structures center around the diencephalon and commonly include the pituitary gland. The limbic system is involved in the process of emotional expression and to a limited extent, arousal. The limbic system modifies the emotions of anger, fear, pleasure, and sorrow. It is through the perception of a threat to the well-being or homeostasis of the body that the CNS triggers a "fight-or-flight" response in an attempt to increase the body's likelihood of survival. The reticular formation extends from the brain stem to the diencephalon region. Although this lower portion of the brain typically deals with basic reflex and basal body functions, this system monitors passage of emotional stimuli to the cortex. The collective innervation of key areas including the cortex is known as the reticular activating system (RAS). The term "arousal" is associated with the RAS and is synonymous with other terms such as anxious, tense, or even "psyched-up." Only specific stimuli are allowed to pass through the RAS to activate cortical (and sub-cortical) areas for an appropriate response. For example, the average individual upon hearing gunshots nearby would duck or run for the closest cover. If, however, that same individual is a firearms instructor, the sound of shooting may produce virtually no noticeable reaction due to the reticular formation filtering out stimuli and not activating numerous systems throughout the body. At bedtime, this filtering process can be elevated (sleeping through a storm) or on selective "standby" such as a parent being able to sleep but still capable of hearing a child down the hall call for them when they are sick.

Neural Regulation of the Cardiovascular System

The autonomic nervous system subconsciously controls basic functions of the body such as heart rate, blood pressure, respiration, metabolism, digestion, and endocrine balance. These controls take place without conscious effort and most of these functions are amplified through emotional factors. As mentioned previously, most organs receive dual innervation from both the sympathetic and parasympathetic branches of the autonomic nervous system. In times of stress, it is the autonomic system that prepares the body to meet the demands that may be placed upon it.

The rate and manner in which the heart beats provides meaningful information as to how the central nervous system (CNS) reacts to a stressor. Combined with heart rate (HR) are the cardiovascular components of systolic blood pressure (SBP) and diastolic blood pressure (DBP). Numerous studies have examined the relationship between a high degree of cardiovascular reactivity to stress and premature development of coronary artery disease. The extent of this relationship of HR, SBP, and DBP response to stress has been well documented and summarized in Sherwood and Turner, (1992). Friedman and Rosenman (1959) identified specific behavior patterns (Type A & B personality types) and indicated that the individual with the type A characteristics of hostility, time urgency, and high competitiveness comprise a risk factor for coronary heart disease (CHD). It is well documented that the psychological perspective of the individual (i.e. psychological trait; personality type A/B) plays a critical role in how a challenging event is perceived by the complex CNS and responded to by that individual. Numerous studies have compared these psychological profiles to the intensity and longevity of the reaction and recovery to a stressor.

Stress Related Hormones

The hypothalamus serves as the activation center of the brain that controls the various body systems associated with fight or flight. Although the nervous system and the endocrine system work in tandem during the stress response, they are quite dissimilar in how they function. The nervous system is very precise in activating specific tissues during a perceived threat and most structures receive direct innervation by way of the sympathetic and parasympathetic pathways. In contrast, the endocrine system secretes hormones into the circulation and their unique chemical structure allows them to activate the intended target structure and leave other structures essentially unaffected. Although direct neural stimulation can activate a structure instantaneously, the effect quickly wanes due to the depletion of the neurotransmitter. The body's chemical messengers, hormones, continue the sustained activation

of the tissues (see chart). Adrenaline and noradrenaline are produced by the adrenal medulla (atop the kidneys) and produce effects similar to those of the sympathetic nervous system. The cortex of the adrenal glands produces aldosterone and cortisol. Cortisol promotes increases in the concentration of blood amino acids, release of fatty acids, and formation of glucose from non-carbohydrate sources. These hormones are released into the bloodstream as part of the normal response to exertion or psychological stress. Because of its role in regulating blood glucose levels, cortisol is referred to as a "gluco-corticoid" to distinguish it from other adrenal cortical steroids. Through this multi-dimensional process, the sympathetic nervous system activates numerous body systems (both neural and hormonal) in preparation for fight or flight, while cortisol supplies the cells with amino acids and additional energy that may be required during times of stress. Cortisol also plays a key role in the maintenance of an adequate blood pressure during times of stress in order to avoid collapse. Cortisol can be measured in blood or in saliva.

In order to maintain a smooth flow of action in the research scenario and to avoid psychological stress relating to venipuncture, cortisol measures were obtained through salivary analysis. The Research Group was fortunate to work jointly with James Meyerhoff, MD, Chief, Department of Neurendocrinology at Walter Reed Army Institute of Research. Dr. Meyerhoff has used the salivary cortisol procedure in numerous stress-related research endeavors (J. L. Meyerhoff et al., 1990, 1998, 2000).

Stress and Decision-Making

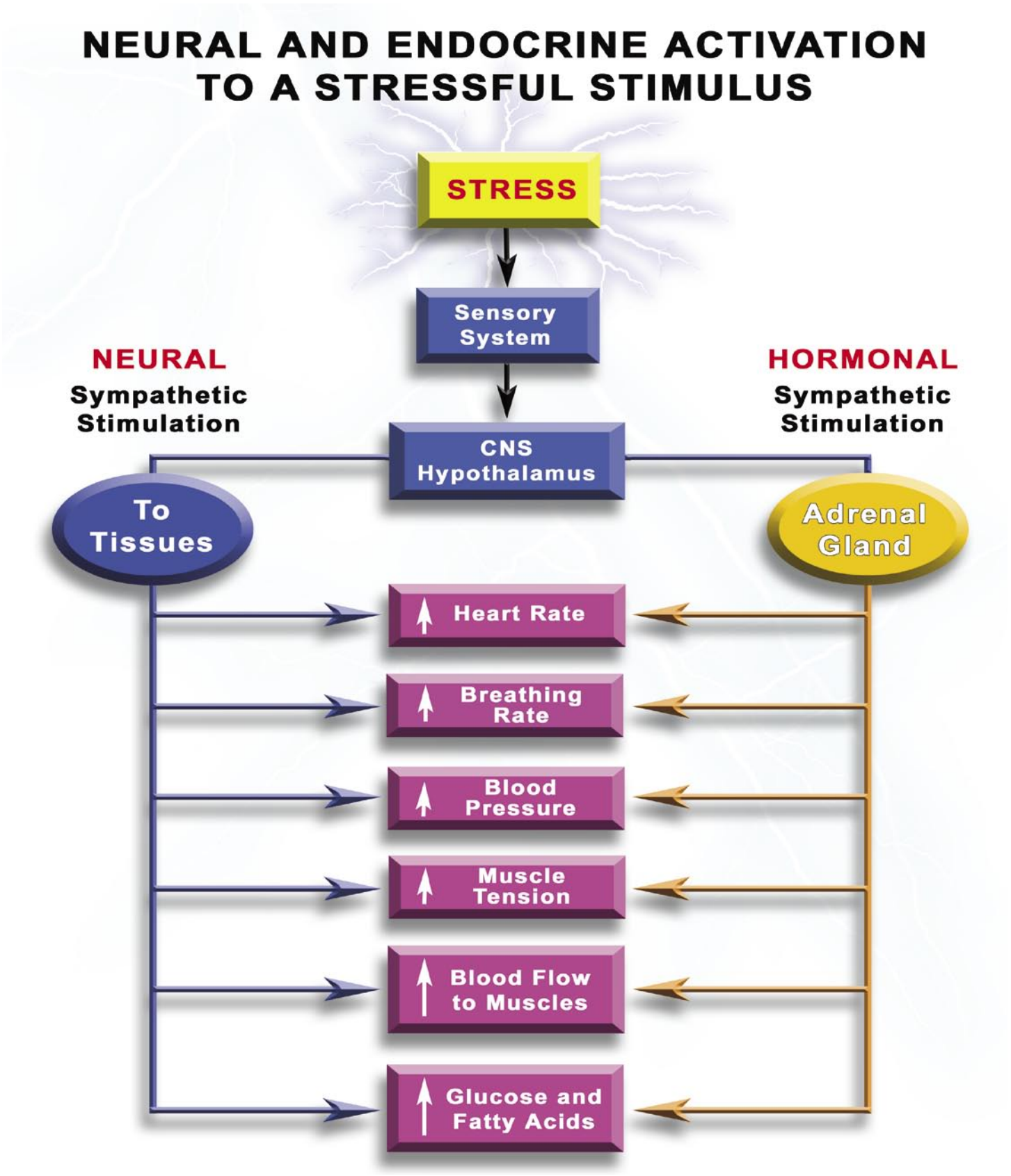
Not only is the brain involved in the emotional perception of stress, but it also provides the vital services of thought, analysis, decision making. The ability to make decisions (and to make those decisions under stress) is a critical skill for law enforcement officers. Officers must routinely face acutely stressful situations and make decisions that can ultimately determine life or death. Unfortunately, "emotional" stress responses often compete with "rational" decision-making process to create a quandary for the brain with regard to actions and desired outcomes. Rational decision making attempts to methodically examine options and then select or perform the best one. The stress response is more time urgent by nature, and focuses on preparing the body to "fight or flee" with little concern for rational thought.

Decision-making is the process of identifying the alternative actions, weighing the potential benefits, and selecting the option with the greatest potential for a positive outcome (Salas, 1996). Most decisions are based on life experiences, and how they fit into what we know. Pierce Howard cites an example of the typical "image" drawn in the mind of people hearing the statement; "The doctor's son greeted his father." The image typically created is one of a son meeting and greeting his father, when in fact, the doctor could be his mother. Our life experiences cause us to see things and make them fit into what we already know. Most learning appears to be a process of fitting newly received information into one of our old memories.

The decision-maker will tend to immediately classify a situation, clarify the goals, determine what is likely to happen next, and what courses of action are typical for the situation. This process is usually instantaneous and is not consciously deliberated. The decision-maker with experience in this situation will classify it as familiar, and will react less to stressors and have a higher expectation of the outcome.

In his book Stress and Human Performance, Salas identifies various types of decision-making. First, there is analytical decision making (rarely used in stressful situations), where options are weighed and outcomes evaluated. Second, there is diagnostic decision making which occurs when the decision-maker cannot quickly classify a situation based on life experiences. In these situations, the effects of stress become involved in the decision-making process. When subjected to stress, the decision-maker adapts by resorting to simpler decision strategies and a perceptual narrowing.

A simple model of performance (or behavior) includes input, decision-making, and output. Input includes all stimuli that affect an individual at any one time. This includes relevant stimuli (those that are important) and



irrelevant (stimuli that have no significance). Decision-making describes the process of interpreting and integrating input and selecting appropriate responses. Output is the response, behavior, or performance. Feedback refers to the information that is provided during or after the performance. Feedback can be isolated to the specific action itself (such as firing a weapon and receiving visual, auditory, olfactory, proprioceptive stimuli, etc.) or after the

performance (from partners, bystanders, forensics, etc.). The output is typically the culmination of numerous processing (decision making) steps by the CNS. (Salas, 1996)

The analysis of incoming information (sensory input) can range from the simple analysis of one sensory modality (is the room too warm?), to a complex analysis of many forms of sensory input integrated with memory and higher brain analysis. In this second, more complex situation involving the performance of critical skills (such as making a vehicle stop), the brain is constantly receiving, analyzing, and integrating multiple streams of data second by second in order to make appropriate decisions. As the communication center for the body, the CNS performs the complex process of decision making with split-second speed and sends out a fusillade of commands to multiple body sites for appropriate responses.

Hypervigilance

Stressors increase the likelihood that decision-makers will choose the first option they consider. While this does not necessarily result in poor decision-making, it certainly increases the probability that the decision-making process will be less than optimal. Once again, the amount of experience the decision-maker has directly affects the consequences of the decision. Johnston and colleagues found that decision-making does not necessarily suffer when the decision-maker is under stress. In a research project involving computer simulations of combat missions, they sought to differentiate the performances of military personnel making decisions under conditions of vigilant and hypervigilant decision-making. The term vigilant decision making refers to decisions made in an organized fashion with consideration of all the alternatives, whereas hypervigilant decision-making occurs under a sudden or unexpected threat or time pressure where limited alternatives are considered due to heightened perceptual narrowing. Hypervigilance is the term often used to characterize someone in a state of panic. In Johnson's study, the stressors of task load, auditory distraction, and time pressure were added to force hypervigilant decision-making. The findings indicated that hypervigilant decision-making resulted in more effective performance than vigilant decision-making.

These results, however, are not fully supported by other research in this area. Janis and Mann (1977) characterized hypervigilant decision making as "impulsive and disorganized" where the decision maker tends to "search frantically for a solution, [consider] a limited number of alternatives, and then latch onto a hastily contrived solution." They did agree that hypervigilant training more closely duplicates real-world situations, and promotes the learning of adaptive behaviors.

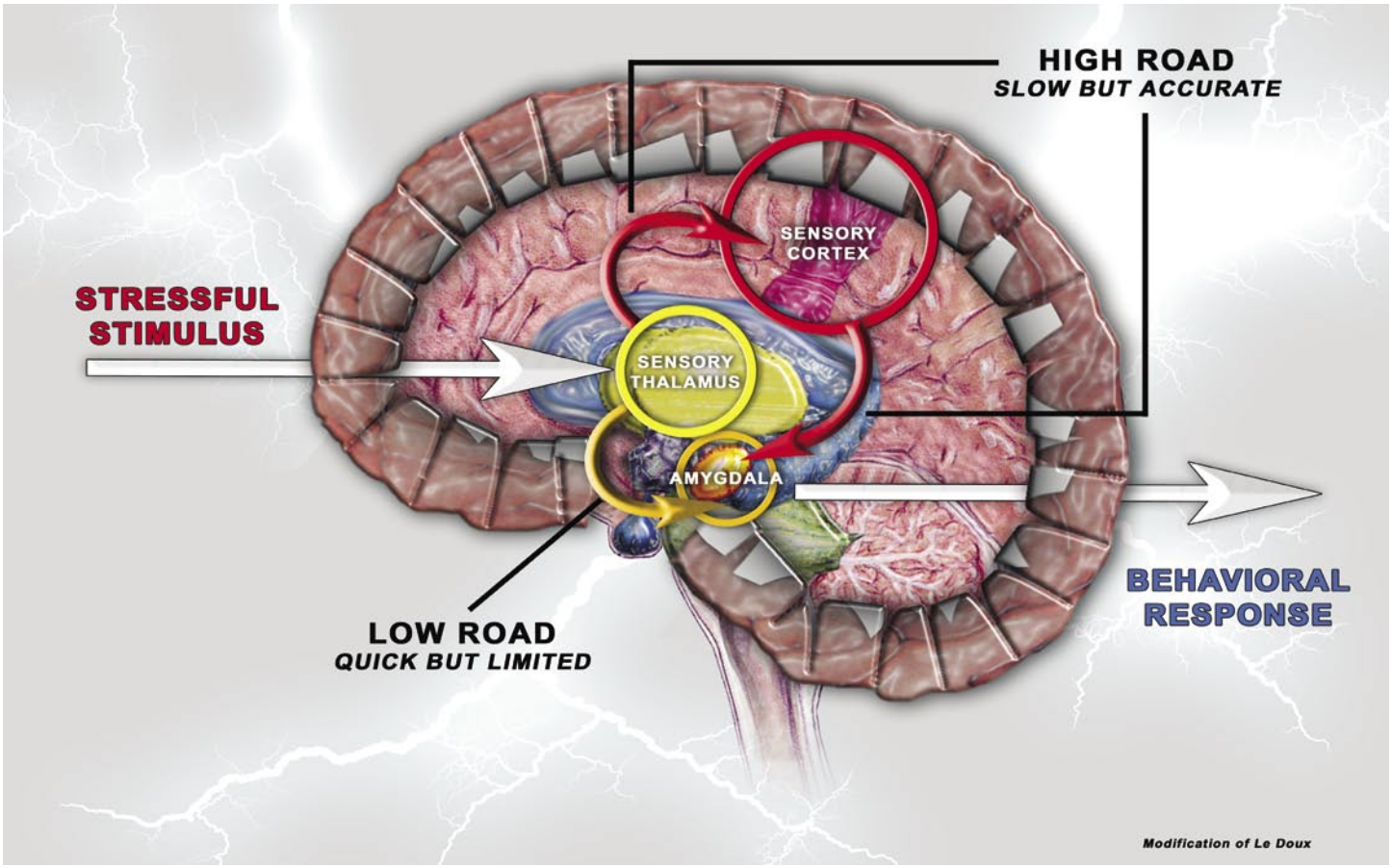
Since the perception and assessment of a threat are crucial to the decision-making process, it is vital to understand how the decision-maker views the threat. If a situation is familiar and the individual has successfully handled similar situations, the threat may be perceived as a challenge rather than a threat. In order to differentiate between a threat and a challenge, "Individuals evaluate an event as threatening when the perceived danger exceeds the capacity to respond." Thus, threat appraisals focus on the potential harm of an event and are associated with primarily negative emotional reactions. Individuals evaluate an event as challenging when they perceive the possibility for gain to outweigh the potential for harm." (Salas, 1996)

Section 1: Summary

Numerous factors affect performance under stress. Due to the broad nature of the concept of "stress," this study will focus on situations producing acute stress, which is sudden, novel, intense, and of short duration. Acute stress conditions replicate many law enforcement situations that involve the critical components of decision-making and use of force. Rational, appropriate, and well-trained responses that are stored in memory can be compromised and overruled by the emotional, survival-oriented instincts of the brain. Through the identification of factors that have a positive or negative influence on performance under stress, it is hoped that this knowledge can be used to improve the capabilities and safety of law enforcement officers

perception of the situation and had not identified the noise as a threat (LeDoux 1999). Thus, the body, based on this advanced sensory system of the amygdala is prepared to take action if the cortex subsequently confirms the threat, or stand down if there is no danger.

A key implication for training is that once the brain learns a coping strategy for a specific threat, the amygdala drops out of the circuit. When you know how to cope successfully, you no longer need the amygdala as fear is no longer aroused. (LeDoux 1999). Interestingly, physiological signs of amygdala stimulation such as increased heart rate also disappear.



Creating Memories for Training Applications

Numerous studies by Robert Sapolsky, Bruce McEwen, Gus Pavlides, David Diamond, Tracy Shors, and Jeansok Kim indicate that stress impairs memory. This memory impairment is the result of the disruptive effects of cortisol on hippocampal activity, resulting in diminished ability to form explicit memories. Hormones released as a result of a stressful encounter have an adverse impact on the prefrontal cortex, contributing to bad decision-making under stress and these hormones also enhance the amygdala's contribution to fear (LeDoux, 1999). These hormones, then, reduce our ability to form memories, inhibit our ability to regulate fear by thinking and reasoning, and, via the amygdala, amplify our reactions to fear as well our memories of the stressful situation. Two key training implications are:

- We can store memories about potentially harmful situations
- Since we don't know what we learned from those memories due to the hormonal inhibition of thinking and reasoning, we may only learn a fear response that triggers a reaction that has not been adapted to deal appropriately with the stimulus.

Let's look at an example of this. An emotional arousal such as the sound of a large dog growling provides us with an emotional stimulus. This sound triggers the stimulus to the brain based on our memories of that stimulus. We perhaps remember the fear of a large dog, a bad encounter with a large dog. These cause an emotional arousal to the amygdala. Our previous experience with dogs does not alone trigger any specific response. The fear response is initiated only when the amygdala is stimulated. This translates into the amygdala transferring the cognition of the stimulus (the growling dog) into an emotional event. At this point, we have no working memory of how to deal with the growling dog, just the memory of the noise as something to be feared. Thus, our previously learned fear tells us to react with fear, but has not equipped us with an appropriate response to that fear. Here again, our emotions monopolize our consciousness. The brain's focus becomes dominated by the fear stimulus, and reduces our ability to process other bits of information that are coming at us (Ratey, 2002).
In the present context, our goal as trainers is to enhance our trainees' future effectiveness and safety by creating memories of appropriate reactions to stressful law enforcement scenarios that will enable trainees to draw on coping experiences that are effective.

When examining the process of memory development, there are essentially two types of memory that must be considered (LeDoux, 2002). There is working memory or short term memory and long-term or stored memory. Working memory is best depicted as that memory we use as we accumulate and assimilate information as it arrives, is sorted, categorized, and then "discarded" or "filed." An example of this would be a phone number you receive from the operator and immediately dial without benefit of writing it down. If you become distracted and focus on new activities before dialing, you will not recall the numbers. Experiments have shown we can only keep a few things in this short term memory "filing cabinet." An accepted number is seven items (LeDoux, 2002). Fortunately, the brain is able to group ideas together and create a "chunk" of information, thereby calling this "chunk" one of the seven items of information (LeDoux, 2002, Howard, 2000). Thus, the caller's name of Betty Phillips becomes not two, but one chunk of information, and the seven-digit phone number becomes one chunk of information. Consider a decision-making task. The brain has the ability to draw information out of long-term memory into working memory as we focus on the task at hand. In complex tasks this "executive" function allows us to switch from activity to activity as needed.

Learning Processes

This executive function allows us to sequence information in an organized fashion so we may integrate new information with previously learned experiences and return it to long term storage as a new memory. This process is learning, whereby an action to be carried out is actually a "memory" of already formulated plans stored in long term memory. In order to have "memories" of future actions, we must have rehearsed a variety of mental actions (Ratey, 2002). Thus, we are constantly manipulating our memories and adding new data derived from experiences to expand and refine our repertoire of potential future responses. Skills learning requires us to practice, rehearse, and integrate our physical skills and resources as necessary to formulate learned responses. With repetitive practice, we can develop our memories and our skills. Testing learners helps them remember and retrieve these memories with greater ease. Ron Fisher of Florida International University (Howard, 2000) summarized his findings of testing learners:

- Learners who take pre-tests do better on their final exams.
- Learners who take pretests using fill-in-the-blank questions perform better than those taking multiple-choice exams.
- Learners who take tests with inferential multiple choice questions do better than those who test with factual multiple-choice questions.

appropriate learning memories. So how effective is the training we provide? What considerations should be taken into account regarding training and performance under stress?

Training Methods

Below are several considerations put forth by Keinan and Friedland (1996) for training students to perform effectively under stress:

Information Training

What should a trainee know before participating in training? Keinan and Friedland found various studies examining the effects of students' knowledge (or lack of knowledge) about what to expect in training. Though results were mixed, there were strong indications that trainees performed better in training when fully and accurately informed as to what to expect. In this context, the knowledge extends to informing individuals what is likely to occur in stressful events and advising them of common performance errors while under stress. Recall for a moment that memories (and thus potential responses to threats) require us to modify experiences. By providing visual examples in our verbal presentations, we can help the student "wire the brain" to have on hand a perception of what might happen in the stressful situation. While they will lack the emotional experience in memory, the visual memory should enhance their ability to cope with the stimulus. Such knowledge gives trainees a perception of control. Equally important to the trainees' success is the knowledge that their stress is a normal reaction and that others have performed the tasks successfully under the stressful conditions. Such information leads to greater confidence in accomplishing challenging tasks. Keinan and Friedland suggested that information on what to expect should heighten perceived control and generate reassuring messages (emphasizing stressful reactions as normal), thus contributing to improved performance in stress training.

An example of this type of training would be the explanation of what might occur to a student encountering a role-player who suddenly charges towards them with a knife. In training, the student is told to react by drawing their weapon. In reality, the student, due to innate responses, may freeze, flee, or draw the weapon. All are natural responses in the time-frame immediately following the stimulus. Knowledge of these natural responses is essential to providing a positive learning experience.

A benefit of inclusion of this training philosophy in scenario based training is the ease with which it can be added. Creating visual images and identifying potential responses takes little time and may provide tremendous learning benefits for the student.

Intensity Training

The literature on this subject describes studies with very diverse results. Some studies of task performance under stress demonstrated improved performance under similar conditions and that training under non-stressful conditions did not improve performance under stressful conditions (Lazarus, 1966, Keinan and Friedland 1966). Conversely, other studies showed that training conducted under no especially stressful conditions produced better results than training conducted under intense stress, which resulted in decreased trainee confidence in performance. Based on their research, three elements were identified as important to successful stress training. These were 1) familiarization with potential stressors involved in the training, 2) exposure to stressors without hindering trainee confidence, and 3) stress exposure training that does not interfere with skills acquisition. They identified several training methods that meet these requirements

First is the practice of graduated training wherein the trainee starts with mild levels of stress, and is gradually

exposed to more intense stress. However, research clearly indicates the trainee should not progress to a higher level of intensity unless an acceptable level of proficiency is demonstrated at the next lower level. Also emphasized is the inherent requirement to inform the trainee, in advance, of the highest level of stress that may be reached in training.

Second is the practice of phased training. Phased training first allows the trainee to learn the skills in a no-stress environment. Then the trainee is exposed to stressors without having to perform the skills. In the third phase the trainee is required to demonstrate the skills while exposed to the stressors. This method allows the trainee to become proficient in the skills, exposes the trainee to the typical stressors where performance would be expected, and finally, allows the trainee to perform the learned skills in the stressful environment. (Salas, 1996)

Overlearning

The arguments for and against overlearning are numerous. Keinan and Friedland's review of the literature found overlearning an advantage where complex tasks are concerned. Overlearning could simplify these tasks and thus make them less subject to stress. Overlearning could create automatic responses that would create less demand for attentional consideration by the performer and thus, should be less stressful. Overlearning could also instill a sense of control, thereby creating a lessened stress response for the individual. However, the potential pitfalls of overlearning are disconcerting. Research indicates overlearning may limit trainees' responses, thus inhibiting their ability to improvise. Also, overlearning tends to induce boredom and reduces motivation. Finally, overlearning may result in a number of competing dominant responses that could cause negative performance under stress.

While overlearning still may be a viable training option, Keinan and Friedland identified some safeguards that should be considered:

- Overlearning should be limited to tasks that will not change as the circumstances change. If the task varies depending on the circumstances, overlearning can prove detrimental to the decision making process and ultimately detrimental to performance.
- Overlearning of different responses to similar stimuli should be avoided as performance proves difficult under stress.
- Fatigue and boredom often accompany overlearning. Training should be challenging. Competitiveness can assist the trainer in creating the challenge.

Skill training

Skill training is used to lessen the effects of stress by producing overlearned behavior. "Well-rehearsed tasks are less prone to degradation under conditions of stress; well rehearsed tasks become 'automatic', thus requiring less of the individual's attention; and well drilled tasks enhance a person's sense of predictability and control" (Driskell and Salas, 1991; Logan, 1985; Salas). This was found to be true for procedural tasks such as disassembly of an M60 machine gun in a study conducted by Schendel and Hagman. The results showed an overtrained group made 65% fewer errors than a control group when retested after 8 weeks. While physical skills are readily responsive to repetitive testing, cognitive skills apparently are more perishable. Consider the findings of Driskell, Willis and Copper that found, "the longer the delay between the overlearning and performance, the weaker the overlearning effect, with the benefits in performance reduced by one-half after 19 days" (Orasanu and Backer, 1996).

Another benefit of skill training is that it helps to generate students' perception of the benefits of the training. Two studies cited by Orasanu and Backer indicate that the type of training may motivate individuals to perform under

stressful conditions. In one study a group soldiers were aware their training would involve lethal agents. The other group was trained in a non-lethal environment. On written exams both groups achieved similar scores. The first group however, had the perception that they were better prepared to perform if under chemical attack. A second study concluded "exposure to serious physical threats during training yielded better training results than training that did not involve such threats only when the soldiers concluded their training with a feeling of success." From this study, it appears that individual perceptions and differences are strongly related to performance under stress (Orasanu and Backer, 1996).

Stress Exposure Training (SET)

The Naval Air Warfare Center (NAWC) and Dr. Joan Hall (1996) have been pro-active in developing training models that train for high stress tasks. Stress Exposure Training (SET) was designed to answer the need to teach cognitive/behavioral stress coping skills to service personnel. This training embodies three basic components. These are 1) coping skills to re-channel negative thoughts into positive thoughts and reactions, 2) problem-solving skills, and 3) the use of deep breathing to counter physiological effects of stress. These skills are then practiced in simulated stressful environments. The NAWC cited 17 studies showing SET training had a positive effect on cognitive or psychomotor performance (Development of Instructional Design Guidelines for Stress Exposure Training. J. K. Hall et al., NAWC).

Important to the development of SET training is the clear identification of the types of stressors encountered and the performance objectives. Hall, et. al. outlined the need for a stress analysis, akin to a task analysis, to identify typical stressors encountered, performance deficiencies likely to occur, knowledge, skills, and abilities required to perform the duties, and any cues in the environment that trigger use of stress coping skills.

Stress Inoculation Training

Stress Inoculation Training includes the following educational, rehearsal, and application stages (Orasanu and Backer, 1996):

- Education phase - "People learn about the different ways in which people respond to different types of stress."
- Rehearsal stage - "individuals learn one on a number of stress management techniques most applicable to their particular situation." These include relaxation, deep breathing, guided imagery, and stretching.
- Application stage - "individuals apply techniques they have learned. First in a simulated environment, then an actual stressful environment."

Scenario Training

Many basic skills can be learned in classroom situations and in field practice. The majority of successful models examined here require individuals to train and

be tested under realistic, stressful conditions in order to assure effective performance under stressful conditions. Feedback should be provided promptly to students during this realistic training, directing them toward the desired responses. This feedback is held in short term (electrical and neurotransmitter-mediated) memory circuits, and may or may not be consolidated into long term memory to be available for future challenges. Consolidation and retention involves lasting synaptic modification, which requires protein synthesis. The occurrence of consolidation can only be confirmed by testing for specific recall of the training material. Appropriate re-testing can reinforce the learning, as it strengthens synaptic connectivity (de Kloet, 1999).