Effects of Combat Stress on Performance

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Course Overview:

Scientific research has demonstrated that the physiological effects of combat stress can have a significant, negative impact on task performance in life-and-death scenarios. Combat stress can have a profound, negative impact on what you hear (auditory exclusion), what you see (tunnel vision, and loss of near vision), how you think (irrational behavior), and what you do (loss of motor control). It can even determine how you bleed (vasoconstriction). This process can never be completely negated, but properly prepared officers will be able to anticipate and identify these responses in themselves and others, and can initiate some safeguards to limit or control the effects of combat stress on task performance.

Course Outline:

1. Increased Heart Rate
2. Auditory Exclusion
3. Tunnel Vision and Other Visual Problems
4. Longer Reaction Time
5. Deterioration of Motor Skill Performance
6. Vasoconstriction
7. Preventing or Reducing SNS Activation

Key Terms

BPM: Beats per minute. The standard measure of heart rate.

Combat stress: The perception of an imminent threat of serious personal injury or death, or when tasked with the responsibility to protect another party from imminent serious injury or death, under conditions where response time is minimal.

SNS Activation: Sympathetic nervous system arousal, which mobilizes all the body's assets for fight or flight.

The Effects of Combat Stress on Performance

The following is a composite of several actual combat experiences:

Sgt. Smith quietly enters a warehouse where a silent alarm has been triggered. His partner, Officer Jones, crouches by the door with his weapon drawn and prepares to provide cover as Smith works his way carefully down the right side of the building. As he moves through the silent warehouse Smith is conscious of his heart thumping in his chest and the feeling that his hands are cold, but his thinking and vision are clear. He is a veteran officer and an expert shot. He is confident and alert. Suddenly someone pops up from 20 feet away and begins to fire at him.

Smith's heart rate immediately skyrockets. The sound of his opponent's shot booming out at him in the confined space feels like a physical blow, but after the first shot he is oblivious to all other sounds, and he barely hears the shooter's subsequent shots or his own returning fire. His vision has narrowed down until he sees nothing buy his opponent (and in particular his opponent's gun) and he does not even notice the presence or the actions of his opponent's companion. Afterward he would say that he was convinced that the shooter had moved closer to him, seeming to "zoom in." As he shoots it as though he were in a nightmare: he is unable to focus on his sights, they seem blurred, and he fires shot after shot without ever

hitting. After the first miss, Smith's shots get wilder and wilder and his target seems harder and harder to focus on. He is hit once in the shoulder but barely notices.

Officer Jones moves a short distance in order to get a clear shot, but when he does fire, from well over twice the distance that Smith was, every round sinks home, immediately killing the assailant.

Jones immediately moves up and checks Smith's shoulder wound. Bleeding is minimal and neither of them see cause for concern, so Jones moves up to cuff the surviving perpetrator which Smith covers him. By the time Jones turns back around Smith has collapsed and blood is flowing at a high rate from his shoulder wound.

In order to truly understand everything that has occurred in this scenario, you have to understand combat stress. Combat stress is defined as: The perception of an imminent threat of serious personal injury or death. Or when tasked with the responsibility to protect another party from imminent serious injury or death. Under conditions where response time is minimal.

Combat stress activates the body's sympathetic nervous system (SNS) in what is commonly known as the "fight or flight" response. The activation of the SNS is an automatic and virtually uncontrollable response to combat stress, dominating all voluntary and involuntary systems until the perceived threat has been eliminate or evaded.

SNS activation is a powerful survival mechanism shared by all mammals, enabling an animal to completely focus all of the body's resources on charging toward or running away from an opponent. This can be consistently effective for a charging lion or a fleeing gazelle, but for a law enforcement officer who has to make split-second, life-or-death decisions while accurately firing a weapon, the effect of SNS activation can be devastating.

Combat stress can have a profound, negative impact on what you hear (auditory exclusion), what you see (tunnel vision), how you think (slowed reaction time), and what you do (loss of motor control). It can even determine how you bleed (vasoconstriction). This process can never be completely negated, but properly prepared officers will be able to anticipate and identify these responses in themselves and other, and can initiate some safeguards to limit or control the effects of combat stress on task performance.

Increased Heart Rate

In many ways the heart rate drives all subsequent processes in SNS activation, since the pounding heart is the instrument which drives a mass discharge of stress hormones throughout the body via the bloodstream. SNS activation will drive the heart rate from a normal of 70 beats per minute (BPM) to over 200 BPM within seconds.

Normal hear rate is between 60 to 80 BPM. Above 115 BPM fine motor skills begin to deteriorate. Between 115 and 145 BPM is the optimal range for combat performance, since within this range complex motor skills, visual reaction time, and cognitive reaction time will all be at their highest. Thus an officer with a heart rate between 115 and 145 BPM will have great difficulty writing a report (a fine motor skill), but his mind will be sharp and clear, his reaction time will be at its best, and his close-range shooting skills will still be good.

Above 145 BPM complex motor skills begin to deteriorate, until at 175 BPM gross motor skills (I.e. charging toward or running away from an opponent) are the only actions that can be performed well. It is in this region (above 175 BPM) that the most significant symptoms of SNS activation occur. Vasoconstriction is at its highest, almost completely shutting down blood flow from surface wounds. Auditory exclusion usually results in a shutdown of hearing. Tunnel vision occurs, and near vision and depth perception deteriorates. A wide variety of irrational behavior can occur, to include freezing in place and submissive behavior. And voiding of bladder and bowels can occur as the body redirects energy away from "non essential" muscles such as bladder control and sphincter control. (It should be noted that

these effects are from hormonal induced heart rate increases, increases caused by exercise (such as wind sprints) will not have the same impact.)

If hormonal induced heart rate increase occurs there is absolutely no way to avoid the effects outlined above. If the heart rate goes up to a specific level, then specific things will occur. They should be expected, and measures must be taken in training and combat procedures in order to plan for, adapt to, and allow for these limitations.

However, it is possible to reduce the impact (and resultant heart rate increase) of a particular combat situation through stress inoculation in training, which will be addressed at the end of this block of instruction.

Auditory Exclusion

Each of the five sensory systems (the five senses, also referred to as the perceptual senses) provide the brain with a constant flow of information, but when the brain becomes focused on an activity or threat, the brain will "tune in" the sensory system that can provide the most relevant information at that given second. At the same time the brain will also "tune out" all other sensory input. This is referred to as perceptual narrowing or selective attention.

During SNS activation the perceptual narrowing process becomes very powerful. Usually sight is the sense which provides the most relevant information in a combat stress situation, and as a result the brain no longer processes information coming from any of the other senses, particularly the auditory or hearing system. This is referred to as auditory exclusion.

(Selective attention can also "tune out" all tactile sensation (the sense of "feeling" or "touch"), so that scratches, cuts, blows, and even bullets wounds often are not felt. It should also be noted that "visual exclusion" can occur when the auditory system becomes the dominant source of information, as in low or no light combat environments.)

Auditory exclusion is a powerful process that can cause officers in combat stress situations to fail to process critical information such as verbal orders, information shouted by a partner, or even shouts of surrender from an opponent in a gunfight. There is no real "solution" to be used when auditory exclusion occurs, but when trying to communicate by voice with an individual who is in a combat stress situation is sometime useful to first get his attention through visual methods, such as getting in front of him. This is one reason why successful combat leaders have always lead from the front.

Tunnel Vision and Other Visual Problems

The SNS induced vasoconstriction and hormonal processes that have such a profound influence on the rest of the body also affect the visual system. This has particularly devastating impact on task performance in a combat environment, since the visual system plays a vital role in nearly all aspects of combat performance.

The tactical implications of SNS activation on vision include:

Tunnel Vision: Tunnel vision (also called visual narrowing) is a phenomenon in which you lose all peripheral vision. Your vision literally narrows down as though you were looking through a tunnel, or a tube, with a 70% (or more) reduction of the peripheral field. Basically perceptual narrowing has caused all the senses to close down except for one (usually vision), and visual narrowing has caused vision to collapse down to a narrow field, so that ultimately the mind is only processing a minute fraction of all possible information, causing critical information (such as threats cues) to be missed.

Loss of Near Vision: The loss of near vision means that you will have great difficulty focusing on any object within four feet. This is a result of pupil dilation, which is a byproduct of SNS activation. Pupil dilation will affect the ability to see the sights of a firearm or close threats and visual cues.

Loss of Ability to Focus: SNS excitement causes relaxation and loss of control of the muscles that control the lens, which causes focusing on a target to become distorted. Thus even the tiny amount of sensory information that is being processed by the brain (due to perceptual and visual narrowing) is flawed, causing a significant decrease in accuracy skills and making reaction time longer.

Loss of Monocular Vision: Monocular (one eye) vision is primarily used in shooting situations where accuracy is critical, such as firing a handgun or rifle over extended distances or a sniper sighting a target with one eye. SNS activation inhibits monocular shooting and a subject cannot help becoming binocular. Although binocular (both eyes) vision enhances close accuracy events, we can expect binocular dominance to inhibit the accuracy of distance shooting skills.

Loss of Depth Perception: Loss of depth perception will cause an officer to incorrectly estimate range and believe that an assailant is much closer than actuality. Depth perception deterioration is usually seen when police officers are surprised by a spontaneous deadly force assault, and they have to quickly draw a holstered handgun to return fire. Loss of depth perception in this situation will often result in officers shooting low and to their dominant side.

Loss of Night Vision: The night vision receptors are located primarily in the peripheral field. (This is why officers are taught to “scan” or look around an object at night, in order to see it with their night vision receptors.) Loss of the peripheral field due to tunnel vision will also result in a loss of night vision.

If SNS innervation occurs, then these negative effects upon vision cannot be avoided, but they can be compensated for and planned for in training. For example, officers should be taught to develop the habit of pivoting their heads (rather than just darting their eyes) in order to compensate for tunnel vision. Similarly, shooting programs can emphasize instinctive shooting programs which reduce reliance on being able to focus on gun sights as closer ranges.

Longer Reaction Time

Combat performance is a network consisting of three operations: sensory perception (seeing), cognitive processing of sensory input (thinking), and motor skill performance (doing). Each system is connected to the other two, and combat performance can be expected to suffer when any of the systems are disrupted.

From the combat perspective, information processing is easier to understand as survival reaction time. A simple definition of survival reaction time is the process of perceiving a threat and initiating a survival response. This can be categorized into four steps.

1. Perception
2. Analyzing and evaluating the level of threat
3. Formulating a survival response
4. Initiating a motor response

These steps must be completed in sequence, with the execution of each stage being dependent on the amount of information presented by the previous stage. If any stage lacks sufficient information, reaction time can be expected to increase. Research has demonstrated that information processing (I.e. transition from state to stage) begins to deteriorate when the heart rate exceeded 145 BPM, and performance became very poor when the heart rate exceeded 175 BPM.

The survival time reaction model corresponds with the effects of SNS activation on vision. As the visual field collapses and sensory perception is disrupted (Step 1), the Brain’s ability to analyze and evaluate information (Step 2) is also impeded. And if these two steps are inhibited, response selection (step 3) and motor response (step 4) will not occur.

The overall tactical impact of SNS activation on cognitive processing and survival reaction time include:

- Survival reaction time can take more than four times longer,
- Disrupted concentration,
- Failure to develop a logical survival response,
- Irrational behavior,
- Repetition of actions (including clearly ineffective or inappropriate actions),
- Freezing in place,
- Submissive behavior (giving up)

Deterioration of Motor Skill Performance

The following is an overview of the three basic motor skill classifications, and how SNS activation will affect each:

Fine Motor Skills: These are skills which require hand/eye coordination and hand dexterity. In the survival skill category, a fine motor skill would include any action that requires precision hand eye coordination, such as writing a report, precision shooting skills, combat reloading, or the safe operation of a vehicle. At around 115 BPM the effects of vasoconstriction to the hands and fingers will deteriorate the hand dexterity required for fine motor skills.

Complex Motor Skills: These are skills which involve a series of muscle groups in a series of movements requiring hand/eye coordination, precision, tracking and timing. Survival skills that are complex would include shooting stances that have muscle groups working in different or asymmetrical movements (i.e. the Weaver stance), or a takedown that has multiple independent components. At approximately 145 BPM complex motor skills will deteriorate.

Gross Motor Skills: These are skills which involve the action of large muscle or major muscle groups. Am example of a survival gross motor skill would be simple actions such as straight punch, a forward baton strike or the isosceles shooting stance. Generally, gross motor skills are simple strength skills or skills involving simple symmetrical movements. Gross motor skills are the only motor skills classification that actually increases in effectiveness as SNS activated heart rate increases.

The effects of SNS activation on motor skills must be taken into consideration at all times. When possible, individuals who will be required to conduct fine motor skills tasks (snipers, over watch elements, electronic equipment operators, or drivers) should be protected from direct, front-line combat. If possible a unit should also maintain a “reserve” of individuals who have not been in direct combat and who can be called forward if a precision of fine motor skill is required.

Vasoconstriction:

Many of us have felt our hands go cold as a result of stress, or we have shaken hands with someone with cold hands, which we generally understand is an indication that they are feeling stress. Cold hand due to lack of circulation is one of the initial symptoms of vasoconstriction. If just a little vasoconstriction can create such a distinctive response imagine the impact of which levels of combat stress. At higher levels of SNS activation, vasoconstriction in the hands and fingers will reduce hand dexterity, and vasoconstriction in the eye inhibits the visual process, but vasoconstriction also has one other major implication.

Vasoconstriction seems to exist primarily as a survival trait to limit blood loss during combat. It must be remembered that during combat (i.e. during SNS activation) a body can endure major wounds without significant bleeding. This can be very deceptive since a few minutes after combat, when SNS activation winds down, there will be a backlash effect known as vasodilatation, which will cause greater than normal bleeding. Therefore it is critical that all gunshot wounds or knife wounds be treated with pressure dressing immediately after combat. If a wound is bleeding excessively during SNS activation it probably indicates arterial bleeding, and appropriate countermeasures (such as pressure point and/or tourniquet) should be given strong consideration.

Preventing or Reducing SNS Activation:

There are five major variables which have been identified as having an immediate impact on the level of SNS activation. They are:

- Perceived level of threat (ranging from risk of injury to potential for death, the physical distance from the threat is a key component of this variable).
- Time needed to prepare a tactical response (again, distance can be a key factor here, with greater distance usually permitting more reaction time).
- Level of confidence in personal skills and training.
- Level of experience in dealing with this specific threat.
- Physical stress (fatigue, lack of sleep, malnutrition) in combination with combat stress.

Note that most of these variables can be strongly influenced by training and proper prior preparation. It has been stated before that if SNS activation results in a specific heart Rate then there is no way to prevent the negative effects associated with that level of heart rate. But it is possible to reduce the impact (and resultant heart rate increase) of a particular combat scenario. This is done through training and the best training acts as a form of “stress inoculation.”

If a doctor wants to protect you from a disease he may give you a small dose of that disease in order to help you build up immunity, so that when you are faced with the actual disease it will not kill you. This is called inoculation.

In the same way, if you are faced with a potential combat stressor it is vital that your training include as exact a simulation as possible of that stressor. In the case of gunfights, extensive training with simunitions or participation in paintball engagements have been found to be among the most successful forms of stress inoculation.

Research conducted by PPCT involved the placement of heart rate monitors on combatants in simunitions or paintball scenarios. Veteran police officers very often had heart rates of well over 200 BPM (some even approached 300 BPM) in their first “combat.” But after several applications the heart rates of participants could almost always be brought into the “optimal survival range” of 115 to 145 BPM, where complex motor skills, visual reaction time, and cognitive reaction time are all at their highest.

One additional technique taught at PPCT involves monitoring your own heart rate. When your heart is pounding in your chest you will generally be aware of it, and using breathing technique (breath in (one, two, three), hold it (one, two, three), breath out (one, two, three), repeat three times) can force a reduction in heart rate.

Above all it must be understood, and it bears constant repeating, that the key is training. Consistent, dedicated training and preparation will make the difference between dying in the line of duty, or going home to you family on any given day.

Additional Reading:

Grossman, D. (1995, 1996). On Killing: The Psychological Cost of Learning to Kill in War and Society. Little, Brown, and Co, New York.

Holmes, R. (1985)/ Acts of War; The Behavior of Men in Battle. The Free Press, New York.

Marshal, S. L. A. (1950)/ The Soldier‘s Load and the Mobility of a Nation.

Siddle, B.K. (1995). Sharpening the Warrior’s Edge: The Psychology and Science of Training. PPCT Management Systems, Millstadt. IL.