

Effects of Combat Stress on Performance

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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.

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 but 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 eliminated 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 others, 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 heart 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. An 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:

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- 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.

The Science of Combat Point Shooting

By Bruce K. Siddle

S. L. A. Marshall observed "There can be no true economy of men's power on the battlefield unless there is respect for the natural physical limitations of the average individual." In his 1950 classic, *The Soldier's Load and the Mobility of a Nation*, Marshall became one of the first to document the deterioration effect of survival stress on combat performance.

Since Marshall's observation in the 1950's, a substantial body of research has developed providing a framework for designing combat skills. Science now understands how a threat perception activates the sympathetic nervous system (SNS), which has catastrophic effects on the visual system, fine and complex motor skills, as well as the failure to cognitively process threats. Unfortunately, very few combat instructors have taken the time to review the research or consider how the implications affect the design of combat systems. We often find that skill validation is based on nothing more than the new trend or the one which gets the most press. A case in point is the debate over Weaver and the Isosceles Point Shooting systems.

For the last 15 years the Weaver stylists have claimed that their shooting system was unquestionably superior to any other system, especially the Isosceles Point Shooting system advocated by Col. Rex Applegate. Weaver stylists attempt to substantiate their claims predominantly on two points; increased platform stability due to the split stance (strong leg to the rear) and increased accuracy by focusing or sighting the front blade. In fact, Jeff Cooper (April 1997) stated that "the idea that one is quicker without the front sights has been thoroughly disproved." However, it is important to note that the Weaver system originated from the competition shooting environment – an environment which is relatively free of sympathetic nervous system activation.

In contrast, the isosceles – One hand Point Shooting systems originated in the early 1920's by W. E. Fairbairn and E. A. Sykes. In *Shooting to Live*, they record the systems development as a method to surviving close quarter combat. Bill Burroughs (1997) observed "the thrust of their findings was to promote the concept of Point Shooting as a means of employing the handgun in spontaneous, violent events without the need or use of the front sights. Their observations (crouching, pointing and one hand techniques) were found to be reproducible during periods of life threatening violence. Most important was the acquisition of greater speed in response as a result of not consciously being involved in using the sights of the weapon as a prerequisite for firing."

After working with Sykes and Fairbairn in 1942, the Isosceles and Point Shooting system was later refined by Col. Rex Applegate at the U. S. Army Military Intelligence Training Center at Camp Ritchie, Maryland through 1943-1944. He refined the system to enhance combat accuracy for the military and intelligence community. His system was proven to be highly effective and is credited with saving the lives of countless U. S. personnel. Col. Applegate first wrote about this system in 1943 in his book *Kill or Get Killed*, which is now in its sixth edition and 28th printing.

This debate has been raised to new levels in the last several years. Officers, who had been unfortunate enough to get in a shooting, began reporting that they reverted to an Isosceles Stance in response to a spontaneous threat. The most interesting aspect of these reports, is that the officers stated they had never been trained in isosceles.

These reports have been viewed with extreme criticism by many Weaver advocates, with the opinion that an officer's post incident reactions are subjective, due to the nature of survival stress. However, the popularity of stress firearms training (through dye marking rounds) has developed a mechanism by which trainers can observe the dominance of Isosceles for sighted shots in a controlled environment. But it is important to note, that the isosceles dominance surfaces when an individual is confronted with a spontaneous and unexpected threat stimulus.

This “startle response” is the single most important distinction between the two systems; for one system was conceived from combat stress environments, while the other was developed from competition shooting. This distinction is the focal point of this article. The research will show that trained behavior is inhibited for economy in movement when survival reaction time is minimal.

The purpose of this article is not to discredit the Weaver System, but an attempt to provide an objective foundation for designing combat firearms training. This article will examine combat stance selection from two perspectives. First, we will examine how the sympathetic nervous system effects vision. This research will show that sympathetic nervous system (SNS) activation causes the pupils dilation, a decrease in blood flow to the periphery of the retina and the inability to use the dominant eye. The result is the loss of near vision and the ability to focus on the front sight, the focusing on the threat and the collapse of the peripheral vision, and forced binocular vision. This latter SNS controlled response causes the head and body to square on the threat, a foundation of the Isosceles Stance.

The second portion of this article will review new stress firearms studies. These studies were part of a continuing effort to advance survival by observing how individuals respond to low level stress.

Sympathetic Nervous System:

The dominance of the SNS (and the startle response) is a function of the autonomic nervous system. The autonomic nervous system controls visceral bodily functions and is divided into parasympathetic and sympathetic systems. The parasympathetic nervous system is in control in non-stress environments. But when someone perceives that their life is in jeopardy, the sympathetic nervous system is automatically activated.

We now know that the sympathetic nervous system (SNS) is activated anytime the brain perceives a threat to survival, resulting in an immediate discharge of stress hormones. This “mass discharge” is designed to prepare the body for what has been recognized as the “flight or fight response” (also known as the startle response). The response is characterized by increasing arterial pressure and blood flow to large muscle mass (resulting in enhanced gross motor skill and strength capabilities), vasoconstriction of minor blood vessels at the end of the appendages, pupil dilation, cessation of the digestive process, and muscle tremors.

The activation of the SNS is automatic and virtually uncontrollable. It is a reflex triggered by the perception of a threat or fear. Once initiated, the SNS will dominate all voluntary and involuntary systems until the perceived threat has been eliminated, performance deteriorates, or the parasympathetic nervous system activates to reestablish homeostasis.

One of the most interesting aspects of SNS activation, centers on the debate of using the front sights. Many have been led to believe that Applegate’s Isosceles System is based on Point shooting system from the hip. This is far from the truth, for Applegate describes his system in the following manner, “point shooting, as I advocate, involves a stiff arm, locked elbow and wrist, plus a convulsive grip. The weapon is raised to eye level like pointing a finger and instantaneously fired. Eyes are always on the target, not the sights. The gun is raised with a rigid arm (like a pump handle) and the arm pivots at the shoulder. The system is accurate at distances up to 15 yards” (Applegate, 1997).

Col. Applegate further refines the debate by segmenting shooting principles into “sighted and aimed shooting. Sighted shooting is the visual process of focusing on the front sight and picking up the threat in a fuzzy peripheral picture. The aimed shooting principal is a technique where the shooter focuses on the threat. The firing sequence of the aimed fire is completed by raising the handgun to eye level and firing as the weapon intersects the visual line to the threat” (Applegate, 1998).

Applegate points out in combat that there isn't time to find the front sight and one will instinctively focus on the threat. This position is correct from the perspective of visual science. For example, perceptions are delivered to the brain through the basic senses of sight, sound, touch, taste, and smell. Each system provides the brain with a constant source of information about the environment and physical activity through a complex neural receptor network. But when the brain perceives a threat, the brain will tune into the system that can provide the most relevant information at that given second. This is referred to as perceptual narrowing.

Perceptual narrowing in combat will result in the visual field becoming the dominant source of information about the threat. Keep in mind that the SNS is now activated and the eye goes through automatic changes to enhance survival. One of these changes is the phenomenon of peripheral narrowing (also known as tunnel vision).

Research by Sports Optometrist Hal Breedlove; found that SNS excitement causes vasoconstriction to the specific blood vessels of the retina. The retina is comprised of photoreceptors which innervate into the optic nerve, which leads to the visual cortex. The photoreceptors are divided into rods and cones. The cones provide color reception, resolution and acuity, and are densely populated in the center of the eye. The rods are concentrated on the periphery of the retina and are higher in number than the cones. The rods are responsible for light/dark sensitivity, as well as the detection of subtle and gross movements. Since there are more rods than cones, the optic nerve will receive more information about threats or the environment from the rods.

Unfortunately, SNS excitement causes vasoconstriction to the blood vessels on the periphery of the retina. The reduced blood flow inhibits the photoreception of the rods, leading to a collapse of peripheral field. Dr. Breedlove states that the visual field can be expected to narrow by 70%, as well as failing to detect subtle threat movements.

Dr. Breedlove's research provides us with a scientific basis for tunnel vision and a defense for officers in the courtroom. Just as important, this research provides part of the reason why officers will not be able to focus on their front sights when the SNS is activated. This partially explains why officers state they could only focus on the threat and not the sights.

The ability to focus on close objects is a function of the parasympathetic nervous system. This system controls visual operations during non-stress conditions and facilitates pupil constriction, pupil dilation, the focusing action of the lens through the ciliary muscle, and blood flow to the smaller capillaries leading to the rods of the eye. However, the parasympathetic controls are inhibited when the SNS is activated.

Cannon (1915) found that SNS excitement triggers pupil dilation, leading to the loss of near vision. The SNS also disrupts the ability to focus, which is a function controlled by the tension on the ciliary muscle. This muscle maintains the convex shape of the lens, which is necessary for clarity and focus. But when the SNS is activated, the ciliary muscle relaxes and the contour of the lens changes from a convex to a flattened state. This results in a loss of depth perception and the ability to focus on close objects. Therefore, the ability to focus on the front sights of a handgun is not possible when the SNS is activated.

Finally, the continuing debate over the importance of dominant eye also becomes a mute issue when the SNS is activated. This debate centers on the practice of using the dominant eye for precision shooting. Optometrists refer to this as monocular vision, in contrast to using two eyes which is binocular vision. But again, the SNS inhibits monocular vision and forces an individual to square the head on the threat and focus with binocular vision. Occurring simultaneously to forced binocular vision is the "lid lift" response of the eye lids. This function of the SNS serves as a method to increase the light into the retina. It is probably the basis for the century old adage of "waiting until you see the whites of their eyes".

Dr. Breedlove believes that binocular dominance is the primary reason why individuals in combat square off on their target in the Isosceles Stance. His theory is consistent with kinesiology studies stating that the body will resort to the path of least resistance and the most economical when under stress. This is also consistent with Applegate's insistence on one handed Point Shooting, which was designed around by the body's natural response to a survival threat.

Practical Stress Firearms Research

Some instructors read physiology research and don't consider it valid until it has been applied with practical research. However, there have been several studies whose findings are consistent with Applegate's theories of Point Shooting and the dominance of the SNS and vision. The following three studies examined the effect of stress on stance selection and vision.

Westmoreland (1989) was first to examine which sighted shooting stances were more suitable for the effects of combat stress. His study examined ninety-eight shooting scenarios that were either spontaneous or non-spontaneous in nature. To induce stress, the scenarios consisted of dynamic training exercises where the officers confronted a role playing subject. The majority of the participants proclaimed to be Weaver practitioners. To enhance stress, the participants used ammunition that had been modified to shoot cotton projectiles. The result of Westmoreland's research is as follows:

Spontaneous under 10 feet: 39 total scenarios

96.7% Isosceles.....(29 events)
3.3% Weaver..... (1 event)
62.1% One-handed stance (Isosceles)...(18 events)
23.1% Failed to respond.....(9 events)

Spontaneous over 10 feet: 27 total scenarios

92.6% Isosceles..... (25 events)
7.4% Weaver..... (2 events)
14.8% One-handed stance (Isosceles).. (4 events)

Non-Spontaneous under 10 feet: 27 total scenarios

74.1% Isosceles.....(20 events)
25.9% Weaver..... (7 events)

Non-Spontaneous over 10 feet: 5 total scenarios

60.0% Isosceles..... (3 events)
40.0% Weaver..... (2 events)

Study Totals

56.1% Two-handed Isosceles stance...(55 events)
12.2% One-handed Isosceles stance....(12 events)
22.5% Two-handed Weaver stance.... (22 events)
9.2% Of the officers failed to respond...(9 events)

Westmoreland identified three reasons why the officers in his study reverted to the squared off point shooting stance. First, he classified the weaver as a fine motor skill which deteriorates at a relatively low heart rate of 115 beats per minute. (For more information on motor skill classifications and survival stress, see *Sharpening the Warrior's Edge* by Siddle, 1995.)

Second, Westmoreland linked the "sudden injection of stress" as the critical consideration. And finally, he references "the inborn reflex to squarely face the attack." Westmoreland accurately connects the inborn reflex to the fight or flight syndrome. He observed that when suddenly attacked in close quarters, it is natural to "face our opponent squarely with our hands and arms extended out in front of us. This natural stance is assumed by all animals that defend themselves on two legs. Add a handgun and you have an isosceles stance" (Westmoreland, 1988).

Westmoreland's study stood alone and was subjected to heavy debate until Bill Burroughs completed his study in late 1997. Burroughs is an internationally respected firearms trainer who was previously an instructor at the Smith & Wesson Academy and the former Assistant Director of the Sig Arms Training Academy.

The Burroughs Study set out to examine two issues; what stance does the average trained officer resort to when confronted with a simulated and spontaneous life threatening assault, and how does this response compare to the officer's previously trained shooting stance.

The study involved 124 officers participating in 155 life threatening scenarios. The officers and the role playing aggressors were issued weapons fitted with Simunition Technologies FX marking cartridges. Each officer was given a survey prior to the scenario requiring them to identify the shooting stance they were trained in while in the academy and then later through in-service training.

The primary survey reported 59% of the officers were Weaver trained, 21% of the officers were trained in Isosceles and 20% stated they used a Natural Stance. However, these percentages changed significantly when the officers participated in the study. Burroughs found that the percentages changed to 20% Weaver, 61% Isosceles and 3% Natural. Burroughs states, "By observation, those that remained in the Weaver had the opportunity to pre-select their stance before the scenario became critical. Most, however, were so shocked by the suddenness of the scenario that they demonstrated a pure survival response of squaring the body, extending and locking the arms, crouching the posture and viewing the threat binocularly to fire. Of the 462 shots fired, (Simunition Technologies FX marking cartridges) 63% recorded hit and 43% were considered lethal."

The Westmoreland and Burroughs studies both focus on the link between spontaneous stress and the body's natural response by squaring off on the target. In reviewing Westmoreland's research Sports Psychologist Robert Weinberg Ph.D. offered, "One principle which seems appropriate is the individuals usually return to their preferred or instinctual mode of behavior (in this case a movement pattern) especially under stress. When put into a stressful situation (in a police officer's job, sometimes a life threatening one) it is instinctual to face your opposition rather than turn to the side. This is a strong instinct since it's part of the fight or flight response to anger."

Both studies found that when an officer is confronted with a spontaneous threat or startled, the body will uncontrollably square on the target and assume a point shoulder position. The most interesting aspect of this study is that it is consistent with the Fairbairn/Sykes and Applegate research, which was based on the observation of men's natural positioning in actual combat.

The study also highlights the fact that officers will not use their front sights if the SNS is activated. Many believe that training to use their front sights will be ingrained as a muscle memory, which will dominate an officer's action during combat. Applegate points out that in combat it is natural to focus on the threat and the ability to "focus" on the front sights is not combat based. And as we discussed in this article, science sides with Applegate.

A 1997 study conducted by Doug Ashton and Jay Quinlin of the Peel Regional Police, Canada, examined this very issue. Ashton and Quinlin placed 100 recruits in dynamic training scenarios using Simunitions cartridges. The scenarios placed the recruits in a situation where they were confronted with a knife yielding subject who spontaneously attacks the officers. Each student was given web gear complete with a simunitions converted firearm. The students were not allowed to inspect the weapon before the scenario.

Each scenario was videotaped for record keeping and documenting the students' response. After the scenario, the students were given a verbal post incident report asking them if they had seen or used their front sights, and did they hear the verbal response of the aggressor before the attack. This report was then cross-referenced with the video tape for accuracy. Ashton and Quinlin found that 98 out of 100 recruits reported they didn't see their sights. Most stated they didn't have time. This is an interesting observation and can be validated by a fourth study conducted by Sgt. Tom Hontz of the Scottsdale, Arizona Police Department.

Hontz study set out to explore the average response time needed to draw a weapon from different starting points. His comprehensive study examined the time needed to draw a firearm from a holstered position, a front draw from the pants, a rear draw from behind the back and a simple raise and fire exercise. Of particular interest, is the finding of the average time needed to raise and fire a handgun.

With 20 officers participating in a pure movement time study, Hontz found the average time needed to raise and fire a handgun is 0.59 of a second, Hontz then contrasted the movement time findings with the average time an officer would need to draw a weapon from a holster and fire a single round. For this section of the study, he used 76 officers and found the average response time was 1.9 of a second. The implications of this study are unparalleled when defending officers in court. The research shows that the average assailant will have at least an advantage of 1.31 seconds over the officer.

Once again, we find the research is consistent with the effects of the SNS and vision. We have already discovered that SNS activation dilates the pupils, which inhibits the ability to focus on the front sights. But we must also recognize that when the SNS is not activated, the visual system takes about one second to switch from far/distant vision to the near vision (Guyton's Medical Textbook). So even if the SNS isn't activated, there still will not be sufficient time to gain "focused" sight alignment and return fire. (Here is another example of how the human body will adapt when survival is threatened and time is minimal.) The Peel study did surface another side of survival stress. Two recruits insisted they had seen their front sights. However, the researchers were quick to note that this wasn't possible, since they issued a weapon that had the front sights removed. Ashton speculates the two were trying to reflect they had followed the department's firearms training program, which encourages the use of the sights with all weapon discharges. (All of the students but one experienced total auditory exclusion.)

Accuracy

One of the more fascinating findings of the Burroughs Study is the increase percentage of shooting and hitting a live target. He found that 63% of the 462 shots fired hit their target, while 43% would have been considered lethal. This data would suggest that there is a direct relationship between increased accuracy and the simplicity of the Isosceles Point Shooting systems.

This hypothesis was tested by Steve Barron and Clyde Beasley of Hocking College in Ohio. Barron and Beasley are the firearms managers for the regional police academy training and had noticed the discrepancy between static range activities and dynamic role playing (dynamic role playing was conducted with Simunition cartridges). Barron notes "We noticed that stance and technique, more often than not, would suffer a total breakdown in any of the shooting exercises that applied some stress on the trainee. This phenomenon occurred with such frequency that we knew something was very wrong. This reinforced our earlier observations. It seemed as though our trainees would display an excellent command of the new technique (Weaver) on the static firing

range; but when the stress factor was raised and they were put in a more realistic training environment, technique and stance deteriorated dramatically.”

Barron goes on to note that his staff followed up with remedial training and noticed improvement on the static firing line. However, “their reinforced basic skills crashed and burned” when the students were exposed to the stress of dynamic training. After a review of the deteriorating effects of stress on Weaver, Barron and Beasley decided to find a system which was more compatible to combat stress. This investigation led them to Col. Applegate and after attending his instructor school, they implemented the Apple Point Shooting System.

Barron and Beasley have now trained more than 500 students in the Applegate System of Point Shooting. They reported to the author that scores have increased to 95% and higher, from 90-95% on the static firing line. He states “this system is equal or superior in accuracy”. But more importantly, the students are maintaining the simple Point Shooting system when they are participating in the stress induced dynamic training exercises. Barron attributes this improvement to the simplicity of the Applegate System.

The study of skill complexity can be traced back to the Civil War. As research methods and technologies have advanced, scientists found that physical or mental stress reacted differently on different types of motor skills. Researchers began to classify motor skill on a progressive continuum from fine to gross, according to muscle size, task, complexity, task effort/fatigue, and how levels of stress affect performance by monitoring escalating heart rates (Cratty,1973). Scientists continued to refine their research and found that SNS activation triggered the deterioration of fine and complex motor skills.

Today, motor skills are divided into the following three basic classifications.

Gross motor skills: are skill which involve the action of large muscle or major muscle groups. An 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.

Fine motor skills: 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 precision shooting a firearm accurately.

Complex motor skills: 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 (Weaver), or a takedown that has more than multiple independent components.

By using escalating heart rates as a medium to chart performance, scientists found that high or even moderate levels of stress interfere with fine muscular control and decision-making. In contrast, motor skills dominated by large muscle groups, which have minimal fine motor control and very little decision making or cognitive complexity, are not affected by high levels of stress. Studies have also found that fine motor skills deteriorate at 115 BPM; complex motor skills deteriorate at 145 BPM, while gross motor skills were performed optimally at higher levels of stress.

Weaver falls into the complex motor skill category and will generally degrade once the heart rate peaks to 145 beats per minute. This is important, since a deadly force threat will drive heart rate well above 200 beats per minute. (This research is consistent with SNS vasoconstriction to the hand and fingers, which deteriorates the dexterity needed for precision shooting skills, combat reloading or the operation of a vehicle.)

Summary

In an attempt to summarize this research paper, consider the following:

1. The SNS will be automatically and uncontrollably activated when an officer or soldier is confronted by a spontaneous or unexpected threat stimulus. However, the SNS may also be activated when an individual is not confident in their ability to manage the threat or apprehensive about the pending situation.
2. Once activated, the SNS will inhibit vital survival functions involving near vision, and fine and complex motor skills. Shooting skills which require precise hand/eye coordination and asymmetrical stances are not stress compatible and should be avoided for spontaneous combat responses. However, when SNS is not activated, personnel will be able to focus on their front sights and use the more complex Weaver system. (The author has been able to refine this position in more detail. He has found that the SNS rarely activate when the officer soldier has time, distance or cover. All three are perceptions of control, and subsequently deters SNS activation.)
3. Despite what many have been told, the body does in fact have "instinctive" responses which appear to be preprogrammed into our neural networks. This includes squaring off on the threat and bringing both arms out in front in a point should position. Research in motor learning sciences and kinesiology supports the notion that economy in movement is in direct proportion to skill simplicity. The selection of a combat shooting stance should not be reduced to which system offers the best biomechanical support or the best sight picture. What is important, however, is whether we teach skills which are the most compatible to survival stress. It has often said that combat training will ultimately evolve towards simplicity and economy in movement. This axiom speaks volumes once you understand the dominance of the SNS on combat performance. Understanding the implications of the SNS in combat is fundamental to selecting a combat firearms system. The research clearly substantiates Point Shooting principles and the system advocated by Col. Applegate.

About the Author

Bruce Siddle is a 20 year law enforcement veteran, the Executive Director of PPCT Management Systems, one of the largest research based use of force training organizations in the world. Mr. Siddle has been an active consultant for hundreds of criminal justice agencies, including special operations/warfare units for the U.S. Dept. of Navy, U.S. Dept. of Army, U.S. Air Force, the FBI's hostage Rescue Unit, the U. S. Secret Service, the 22nd SAS, and the Queen of England's personal protection unit (Royal Protection Group). Mr. Siddle is also the author of *Sharpening the Warrior's Edge*, the first text to provide a scientific explanation into survival stress responses, such as visual narrowing, auditory exclusion, hypervigilance and why survival performance often deteriorates.

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