

Improving Visual Processing During Deadly Force Encounters and Recommendations for Office Training

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Improving Visual Processing During Deadly Force Encounters and Recommendations for Officer Training

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Abstract

Purpose

The purpose of this paper is to analyze what occurs to an officer's visual field at the moment he or she engages a deadly threat. By exploring the limits of vision and attention, recommendations can be made that improve the decision-making process, reduce cognitive processing errors, decrease reaction time, and allow for greater survivability during a deadly force encounter. Action is predicated on information obtained from one's eyes (Miller, 2009). However, visual and observation skills are frequently left out of many training curriculums. When vision and observation are spoken of it usually falls along the lines of, "Look for these behaviors" or "Watch the hands." Exactly how to look or use one's visual field most effectively is completely left out of the conversation (Awerbuck, 2009).

The Illinois Police Standards Board outlines over seventy required courses for officers to study but observation is not one of these mandates. If officers are not taught how to observe or how vision works, they can fall prey to the many shortcomings of attention. Therefore, the purpose of this paper is to provide recommendations on how to teach officers to make better use of their field of view and take in information that may have been previously left out.

Methods

This paper uses secondary sources, books, government publication, and other relevant sources to demonstrate the extent of the problem, its underlying causes, and factors that influence officer decision making during a deadly force encounter. An in depth review of current literature explores the dynamics of an officer involved shooting and its correlation to visual processing is provided. Following a review of literature is an analysis of theory that can promote efficiency in how officers navigate their visual field. In particular the quiet eye theory and attentional control

theory will be used to provide recommendations for officer training, intended to improve observation skills.

Key Findings

Officer's reactions during a deadly force encounter are influenced by a myriad of factors stemming from limitations of visual processing and the body's natural stress response. Training officers to increase their quiet eye duration can aid officer decision making and reduce the impact of stress on performance. This external focus of attention also deaccelerates heart rates which slows the body's stress response and allows for superior performance. In order to increase the quiet eye duration, it is then recommended that officers be taught to focus on the target rather than their front sight. Sight alignment should occur only after the pistol is brought into the line of gaze between the officer and the target. By increasing the quiet eye duration, the officer increases the number of fixations to areas of task relevance which provide critical information about whether to fire or suppress a trigger pull. This small and easily trainable difference can allow officers to perform more efficiently under pressure and widen the decision-making window.

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Section 1: Introduction

Introduction

All actions taken by law enforcement personnel must be reasonable. When mistakes are inevitably made, lives are lost, careers are ended, and millions of dollars are spent in litigation (Vickers, 2015). By nature, policing is reactive. Officers must perceive a threat prior to deciding on an appropriate course of action. One fallacy that persists is the notion that police are “trained observers.” The public expects the police to work with Sherlock Holmes precision and ability. However, when studied, the police often fare no better than the public in terms of observation ability (Smart, Berry, & Rodriguez, 2014). Training academies teach officers what to look for, but rarely speak of how to look (Awerbuck, 2009).

Mistakes related to observation proliferate law enforcement across the nation. In March of 2018, two Sacramento Police Officers responded to a call of a male subject breaking into vehicles. When confronted, the subject would not comply with commands to show his hands. Once he finally pulled his hands out, one officer yelled, “Gun!” and fatally wounded the subject. Shortly after, the officers realized the subject had actually pulled out a cell phone (Pardo, 2018). A similar incident occurred to Texas Officer David Hofer after approaching a suspicious person. This time, the subject had gun and not a cell phone. Following the command to show his hands, Officer Hofer was shot and killed (Steele, 2016). Cases such as this will be chronicled throughout this paper as they highlight the extreme time officers must operate under and how their ability to observe influences the outcome of a deadly situation.

The law surrounding deadly force rests on the notion that an “imminent danger” must first exist (Graham v Connor, 1989). Simply put, before the option to use deadly force can be made, a threat must be observed. However, it is this observation that allows for the greatest

potential for mistake. An officer can observe a knife, but may not see the offender put the knife down during the moment they align the sights on their pistol. Alternatively, an officer may focus so intently on the knife, he or she fails to observe the subject reaching for the gun behind his or her back. Officers go through extensive training in deploying their tools and spend hours learning the legality of these force options. Officers learn to distinguish between a passive or active resistor and learn what situations warrants verbal commands or a taser deployment. However, officers do not spend any time learning how to observe or how their attention can be misguided. The State of Illinois does not mandate “observation” as a required skill, yet observation is a critical skill because vision drives action (Land, 2009).

Problem Statement

Many police officers consider themselves “trained observers.” It is often believed police will see things what civilians often miss. (Awerbuck, 2003). New police officers in Illinois attend a police training academy where they are equipped with the necessary skills and given the appropriate tools to use throughout their career. Given to police officers is the legal authority to use force and have a duty to intervene, even if it means taking another life. Given the gravity of carrying a firearm, it would be assumed police officers are given all the tools they need to effectively use a firearm. However, many officers miss important cues in their environment while using a firearm. Developing proper observation skills and the effective use of attention is often an area of concentration left out of many police training curriculums. This is evidenced by case examples and recent empirical studies. For example, one study compared police officers and lay persons ability to perceive a large change while watching a short recording of a traffic stop. During the viewing of the video, the subject and officer step off screen and when they return the subject was a different person wearing a different shirt. The researchers discovered that the non-

police participants were more likely than the police officers to notice the change (Smart, Berry, & Rodriguez, 2014). If change blindness can occur while watching a traffic stop, what is to stop it from occurring during a fire fight. In addition, while expert officers do “see” more than new officers, almost 20% of expert officers failed to discern the difference between a wallet and a firearm in mock scenarios (Vickers & Lewinski, 2017). Furthermore, incidents abound where police often mistake non-harmful objects as threats, therefore facilitating the use of deadly force. Officers mistake victims for assailants (Jordan, 2018), shoot at other officers (Markel, 2013), and mistake common items for deadly weapons (Coen & Richards, 2016). All these issues are attentional in nature. A misdirection of attention influences mis-perception which can have deadly repercussions.

Methods

This paper uses secondary sources, books, government publication, and results from other relevant sources to demonstrate the extent of the problem, its underlying causes, and factors that influence officer decision making during a deadly force encounter. An in-depth review of current literature explores the dynamics of an officer involved shooting and its correlation to visual processing is provided. Following a review of literature is an analysis of theory that can promote efficiency in how officers navigate their visual field. In particular the quiet eye theory and attentional control theory will be used to provide recommendations for officer training, intended to improve observation skills.

Limitations

All research used for this paper is derived from secondary sources. Inherent in all studies of human processing and performance are errors resulting from sample size, procedure, design, interpretations, and inconsistent measures and definitions of independent and dependent

variables (Maclin & Solso, 2008). While generalizations are made from a wide body of research, this current paper carries with it the limitations of each study it utilizes. In addition, this paper is limited to how visual input influences officer action during deadly force encounter. In the real world, all five sense work in conjunction to help an officer decide on an appropriate course of action. Since four of the five senses are not addressed in this paper, all final conclusions and recommendations can only be based off of one physiological response. That being said, this paper is not comprehensive enough to address all firearms training, but merely one aspect of it.

Section 2: Literature Review

The following review is divided into seven parts. The first part discusses how often police encounter a deadly force situation, their willingness to engage in deadly threat, and the case law that allows officer to take action against a deadly threat. This is followed by an analysis of training requirements for officers and implementation of this training. Section four and five review how accurate officers are during a deadly force encounter and the extreme time limitations they face. The last two sections provide an overview of the visual system, its importance in action, and how objects are selected in a visual space.

Prevalence, Reluctance, and the Law

Being involved in a gunfight is one of the rarest things a patrol officer will do. However, officers must be ready to engage in a deadly threat at all times given the nature of their working environment (Heck, 2017). In 2017, police killed approximately eighteen people a week, of which 93% were in possession of a deadly weapon (Tate, Jenkins, & Rich, 2017). When an officer involved shooting does occur, it captures the nation's attention despite its outcome.

The legal authority to use force to prevent or stop a threat is the upper limit of police authority (White, 2006). However, the least likely event for an officer to be involved in, can have

the greatest impact on their life and career. Aside from the possible emotional toll taking the life of another citizen may invoke, the effects of an officer involved shooting span across the country. A deadly force incident in Baltimore can inspire riots in Chicago. A shooting in Sacramento or Minneapolis can start movements and serve as a call to action. Rarely does an officer involved shooting remain isolated to the officer involved and the community where it occurred.

Since officer involved shootings fill headlines everywhere, the media often depicts officers as trigger happy and cold blooded killers (Levin, 2016; Witte, 2015). However, research has shown an innate reluctance of human to take the life of another (Williams, 1999; Wittie, 2011). Studies conducted on the military showed that during World War II, only 15-20% of infantry soldiers fired upon exposed enemy soldiers (Williams, 1999). While not operating in a war zone, every officer understands that deadly force may have to be used during their career. In addition, officers are keenly aware of the political, social, and personnel impacts their use of deadly force may cause. This awareness has even lead some officers to hesitate in a deadly force encounter. In August of 2015, a Birmingham, Alabama officer was attacked during a traffic stop and refused to use deadly force. The officer was subsequently disarmed and “pistol-whipped” with his own weapon. The officer was lucky to survive the encounter and after, he stated he did not shoot because he feared a “country wide backlash” (Chan, 2015). While initially unarmed, the offender clearly posed a very deadly threat. However, perhaps no greater officer involved shooting invokes more outrage in a community than the shooting of an unarmed subject.

“Mistake of fact” shootings strike a cord with communities around the country as it is commonly believed the shooting could and should have been prevented (Lopez, 2017). Instead of focusing on the behaviors and actions of the subject, the media prefers to shine a light on all

the alternatives presumably available to the officer, in hindsight (per *Graham v Connor* (1989) as discussed below). As the officer in Birmingham, Alabama learned, an unarmed assailant can pose a very deadly threat. However, it is beyond the scope and outside the focus of this paper to address how unarmed individuals can pose deadly threats to officers and the public. Shelby (2016) in his book, discusses in detail all cases in 2015 where the police killed an unarmed subject and explains the how and why behind each case.

Research conducted by Tate, Jenkins, and Rich (2017) indicates 987 people were killed by the police in 2017. Of these, 893 offenders were in possession of a known weapon while 68 or 7% were classified as unarmed. In the majority of incidents depicted by the research, officers showed an appropriate response to the presence of a deadly threat. This shows officers across the country do an excellent job at observing and reacting to a deadly threat under high stress and in real world conditions (i.e. at night, in bad weather, while ambushed, etc). However, over 50 officers die each year as a result of a gunfire (Officer Down Memorial Page, 2018) and many more are injured. Furthermore, these statistics are incomplete as it does not chronicle incidents where an officer shot at a subject but did not fatally wound him or her. As indicated by the number of protests followed by these shootings, it is clear the public does not believe shooting an unarmed subject to be justified, especially when the item being presented is a cell phone or wallet. However, many of these shootings are determined to be justified and no charges are brought against officers. This typically further infuriates an already upset community.

One case out of Kansas highlights these issues. On December 28, 2017, the Wichita Police Department began to respond to a residence after receiving a call indicating a man had been shot and killed by his son and hostages were being taken. Once police arrive on scene, Andrew Finch opened the front door to his residence, where the incident was reported to have

taken place. Finch initially complied with officer commands but at one point dropped his hands and reached for his waist band. Officers on scene, being informed that this subject may have just killed someone and was in possession of a firearm, fired at Finch and fatally wounded him. Finch never had a firearm, nor had anyone been murdered and taken hostage in his home. This entire incident was the result of a prank call referred to as “swatting.” There was no emergency at Finch’s residence and the Deputy Police Chief of Wichita, referred to Finch as an “innocent victim,” (Rosenberg & Wong, 2017).

Further distressing the already upset community of Wichita was Sedgewick County District Attorney Marc Bennett’s refusal to indict the officer who fatally wounded Mr. Finch (Johnson, 2018). District Attorney Bennett stated to reporters that the officer was operating in the context of a false call under the notion that Mr. Finch was armed and had just committed a murder. District Attorney Bennett advised that to charge the officer would require evidence and not 20/20 hindsight. Attorneys for Mr. Finch’s family argued he was “unjustifiably and unconstitutionally executed in his home” (Johnson, 2018).

It is understandable why an incident such as this would enrage a community and the nation. A trained law enforcement officer did kill an innocent unarmed individual. Although tragic and no officer wants to injure an innocent person, the shooting is reasonable as District Attorney Bennett stated. In fact, the U.S. Supreme Court addressed this very issue in 1989 with their opinion delivered in *Graham v. Connor*. In delivering the opinion of the court, Justice Rehnquist settled several disputes. Prior to this case, there was no settled upon standard to judge the actions of an officer during a deadly force encounter. Some courts used the Fourth Amendments “reasonableness” standard while others preferred the Eighth Amendments “cruel and unusual punishment” to pass judgment. Justice Rehnquist settled the debate indicating that

since a person's intrinsic motivation is central to deciding if cruel and unusual punishment exists and thus violates the Eight Amendment, it cannot be used to judge the actions of an officer. An officer's action must be "objectively reasonable" and free from internal motivations. This objective reasonableness must be determined in the light of the facts and circumstances presented to the officer at the time of the incident (*Graham v. Connor*, 1989). However, Justice Rehnquist takes this reasonableness a step further and indirectly speaks about the limits of cognitive processing. Justice Rehnquist stated reasonableness cannot be judged with "20/20 vision of hindsight" and allow "for the fact that police officers are often forced to make split-second judgements in circumstances that are tense, uncertain, and rapidly evolving- about the amount of force that is necessary in a particular situation." In a dramatic departure from past cases, the U.S. Supreme Court in 1989, acknowledged how dynamic law enforcement can be and the limitations of cognitive processing on action.

Despite what protestors and defense attorneys argue, *the Graham v. Connor* decision does not give officers a free pass to shoot anyone they please (Force Science Institute, 2018). Rather it factors in many of the facets that will be discussed in the paper. In September of 2015, Fresno officers shot and killed a man who rapidly pulled a dark colored, garden hose nozzle out of his pocket, fearing it was a firearm (Lopez, 2017). The district attorney did not in charge officers in this case and the shooting has been deemed justified. While criminal charges were not filed, Judge Dale A. Drozd, has allowed the case to proceed as a civil rights violation (Lopez, 2017). This motion is important for several reasons. First, Judge Drozd indicated that a jury could conceive that Mr. Centeno was no threat to the officers and that deadly force was unwarranted. In addition, the judge stated alternative measures could have been taken such as taking cover or using a stun gun. Furthermore, Judge Drozd stated the evidence showed Mr.

Centeno had a history of mental health issues and the officer should of known they were dealing with a mentally disabled subject. However, all these facts named by Judge Drozd would require 20/20 hindsight and does not rest solely on the facts presented to the officer. No one disputes the tragic nature of this incident, but it is reasonable to believe a garden hose in its appearance and demeanor of how it is held, can be a firearm. How the officer's natural stress response and training can influence their perception of this object will be detailed in later sections.

Current Training

Illinois law outlines over seventy different training topics that must be addressed during officer training at an academy. However, not one of these topics include vision or observation. The area of the greatest likelihood of a deadly consequence is the use of a firearm. When it comes to firearms training, state legislature calls for 40 hours of firearm training. Training academies are allowed to use this time as they see fit, as long as students pass the state qualifying course. During this training it is common for instructors to teach students to focus first on the sights of their gun, then the target (Hendrick, Paradis, & Hornick, 2008). The only other mention of a visual search pattern is the scanning that is conducted after downing an adversary and searching for other potential threats. However, how to do this is not necessarily directly taught.

Instructors ingrain into new officers the importance of sight picture and sight alignment. This refers to the need to properly align pistol sights that influence the trajectory of the bullet. As Hall (2015) argues, the front sight is the most important point to focus on because it ultimately decides the direction of the fired round. Many modern semi-automatic handguns used by police have two sets of sights used to align the pistol. The rear sights sit on the end of the gun closest to the user, while the front sights are positioned closest to the muzzle. When the rear and front sights on a pistol are aligned, meaning the front sight is centered between the rear sight, the gun

is referred to as properly 'sighted' and is ready to fire. After each shot is taken, officers are instructed to regain the sight picture and fire another round until the threat is no longer present. To help see the sights, many officers instinctively close one eye while shooting. Officers are told to shoot with both eyes open only after achieving a heightened ability and are rarely told this during initial training.

Sight alignment presents several issues for a rookie officer regarding where to focus. If an officer, focuses on the target, the front and rear sights become blurry. If attention is directed solely to the rear sight, the front sight and target are out of focus. It is generally accepted to place focus on the front sight, while keeping the rear sight and target in the periphery (See Appendix A). Morrison and Villa (1998) found this emphasis on sight picture and sight alignment helps new officers achieve high accuracy scores but does little when in an actual gun fight.

Often these issues do not resolve themselves unless an officer seeks out additional training. While in-service training standards vary from department to department, Morrison and Garner (2011) found the average allotment of total hours dedicated to firearm training was eight hours annually regardless of department size. In addition, the researchers found these hours are primarily spend on meeting yearly qualification standards. These findings are distressing because it appears firearm training largely stops post training academy. What this means for new officers leaving the academy is that the habits they create while at the academy will stay with them for their career unless more advanced training is provided or sought out by the officer.

Accuracy and Distance

Considerable amount of research indicates officers are likely to miss their target during a deadly force encounter (Cerar, 1990; Copay & Charles, 2001; Meyer, 1980; Pate & Hamilton, 1991). Copay and Charles (2001) indicate what while rates vary across the nation, rarely do hit

rates exceed 50%. In other words, when an officer does decide to use a firearm, it is very likely the officer will miss their intended target. The repercussions of these findings are extreme. For instances where an officer is trying to save a life or prevent the infliction of great bodily harm, the officer's actions will be fruitless. Their actions may even cause more harm as rounds missing their intended target have the potential to strike a bystander or another officer at the scene. This mistake was tragically witnessed in December of 2017, when 6-year-old, Kameron Prescott, was killed by an errant round fired from a Texas police officer (Siemaszko & McCausland, 2017).

Adam et al. (2009) and Aveni (2003) explain that during training officers fire single rounds at a stationary target at varying distances. While this makes for good control over the training environment, it is in stark contrast to actual gun fights which involve multiple shots and very close distances (Kelly, 2011; Lewinski, Avery, Dysterheft, Dicks, & Bushey, 2015). White (2006) found fatal shootings typically occur when the offender was within 10 feet of the officers. From 10-20 feet, a large drop in accuracy occurs and shootings are typically non-fatal. For instance, at 10-20 feet, rounds are likely to miss critical target zones such as the head/upper body and strike the extremities or other non-life-threatening areas. Beyond 20ft, officer accuracy takes another considerable decline resulting in nearly all shots being missed. Interestingly, while 10 feet seems to be the ideal threshold for a well-placed lethal shot, as officer and offender close this 10 foot gap, accuracy actually declines. Shots taken within 3 ft often miss (White, 2006). Miller (2009) found 81% officers killed in the line of duty occur within 7 yards. Half of these occurred within 5 feet.

Research has shown more than half of officer involved shootings occur within 3-15 feet (Kelly, 2011). The Illinois Firearms Qualification Course-of-Fire (See Appendix B) highlights the disconnect between current standards and what the research has shown. This Illinois Firearms

qualification course of fire has officers fire two rounds within a specific time restraint. Each phase of the course gets progressively farther. Officers begin the course of fire at 15 feet and end it at 45 feet with the option to shoot as far as 75 feet. The course is scored by number of hits to a 8.5in x 14in paper target attached at center mass of a larger target. As long as officers achieve a score of 70%, they will pass the state qualification and be allowed to execute the duties and responsibilities of being an officer. The firearms course of fire used in California is slightly more stringent than the one used in Illinois. The California PC Arrest and Firearms Course begins at 9 feet and is completed at a maximum of 45 feet. Officers must achieve a score of 80% to become certified. Florida uses the same 80% grading criteria and similar distance requirements (9-45ft), but has officers complete the course under much tighter time constraints during the initial stages. Decreasing the time available for officers to complete each stage can give further reaching benefits for the officer.

Time and Speed of a Deadly Force Encounter

Officers must act within extremely narrow time windows while expected to perform at the highest levels. These narrow windows demand officer's observation and visual scanning to be without error. Research conducted by Lewinski, Dysterheft, Seefeldt, and Pettitt (2013) found an armed subject, during a traffic stop, can draw their weapon and fire at an officer in 0.23 seconds. With a handgun held and aimed, an offender can fire their first round in .06 seconds and subsequent rounds are fired within a quarter of a second (Lewinski et al., 2014). Officers who are then charged with handling this extremely stressful event will take between .46 to .70 seconds to begin a response (Lewinski et al., 2014; Vickers, 2007). This delay is compounded because once a response is generated (at .70 seconds), an officer must then initiate movement, draw their weapon, and begin returning fire. Furthermore, while going through the moving, drawing, and

sight alignment phase in order to return fire, the officers must be cognizant of an ever-changing dynamic environment. For example, it is possible for a subject to shoot at an officer in a quarter second. That officer then takes nearly a full second to realize what has occurred and begin a response. Drawing from a holster takes the officer approximately 1.5 seconds (Lewinski, Dysterheft, Bushey, & Dicks, 2015) and then return fire is initiated at similar rates seen by the offender (Lewinski et al., 2014). Summed up, assuming the officer is mentally and physically prepared for such an encounter, his or her return of fire begins nearly three full seconds after the first of the offender's rounds are fired. In other words, the officer is able to fire their first round only after already being fired at twelve times.

Once the officer's action is initiated it is very difficult to stop. At best, during controlled experiments in non-stressful environments, officers required approximately .30 seconds to stop shooting once a stop stimulus was given (Lewinski, Hudson, & Dysterheft, 2014). In real life, a stop stimulus would be the cessation of a threat such as an active shooter. In total, from the point of first contact, an officer takes three seconds to begin returning fire. If an officer does not perceive an action (during this three second response) such as the offender dropping his weapon, severe legal repercussions begin to arise. The issues presented here are all predicated on the officer's ability to visually search his or her environment and give proper attention to areas of high interest under the tightest of time restraints.

Aside from being able to observe a threat, numerous factors influence reaction time which makes quick observation that much more paramount. For instance, Welford (1980) found fatigue slows reaction time especially during complex tasks. Given officers typically work between 8-10 hours shift plus overtime and overnight, fatigue is a real cause for concern. Increasing age can influence reaction time. Honig and Lewinski (2008) state the ability to

integrate information obtained from the senses decreases with age compounded with increased physical reaction time to a stimulus. In addition, given the dynamic environments officers work within, distraction forces an officer to discern importance from unimportance which further increases reaction time. Luckily, Lewinski and Hudson (2003) found anticipation can improve reaction time. Anticipation can also improve efficiency of a visual search which allows for improved reaction.

Vision

Godnig (2004) explains vision is typically defined as the ability to see a sharp, clear image. The classic notion of “20/20 vision” provides a common framework. However, understanding how vision operates, derives meaning, and directs action from light energy will provide a better framework to direct law enforcement training. Human vision is based on light intensity. The amount of light received through the eyes determines what information is sent via the optic nerve for interpretation (Godnig, 2004). Vision is deeply connected with light intensity and undergoes several changes while operating in different environments. This is especially important since an officer’s working environment is rarely static. Light intensity can generally be divided into daylight (photopic), twilight (mesopic), and low light (scotopic). What the eyes do while working within these three domains and understanding what light does to vision is paramount to an understanding of using vision efficiently.

Within the eyes are neuroceptors consisting of cones and rods. During daylight (photopic), cones are responsible for responding to bright light and are densely populating in the retina (Martini, 2006). When cones receive light coming from an object, they in turn, transfer this light into neural energy which is how information about forms, shapes, and textures are sent to the brain. So cones are responsible for high acuity information about the world around an

observer. The tradeoff of precise vision during daylight is that cones do not operate under low light conditions. As a result, vision is the richest during daylight hours and night time vision suffers as a result of inactive cones. In addition, visual tracking operates best during daylight being able to make the most of information received from cones (Godnig, 2004).

During low light conditions rods are the brains primarily source of visual information. Rods are highly sensitive to light but do not discriminate colors (Martini, 2006). This high sensitivity is what allows for vision to exist in dimly lit rooms. Where cones are concentrated in the fovea, rods are located across the peripheral retina and primarily responsible for movement detection and spatial orientation. While rods and cones can operate simultaneously, the adaptation of rods and cones to adjust to quick changes in light is not fast. When an immediate change from daylight to darkness occurs, it can take up to five minutes for the eyes to fully adjust (Martini, 2006). Godnig (2004) argues the switch between seeing in daylight and darkness is not only time consuming but results in poorer visual ability. Accompanying darkness adaption is reduced depth perception/contrast sensitivity and the inability to detect fine details. These limitations have practical and immediate effects for officers who constantly work in settings where light sources are consistently changing. It is not uncommon for an officer to be driving in daylight and forced to respond into a dark building or residence for an emergency call. Knowing how light affects their vision can help the officer understand physiological changes that are occurring.

Vision and Stress

Duress also has significant implications regarding the ability to see. During the body's natural fight-or-flight response, the sympathetic system prepares the body for action by dilating the pupils to allow more light in and changes the eyes lens to adapt for distant vision (McCory,

2007). This improved ability to see at distance, 20 feet and beyond, may have evolutionary origins and comes at the cost of near vision (Honig & Lewinski, 2008). Godnig (2004) argues this stress response makes focusing on the sights of firearm nearly impossible during a high stress incident. In addition, up to 70% of a visual field is reduced by constriction of vessels in the periphery of the eye (Easterbrook, 1959). This reduction in visual field is commonly referred to as tunnel vision.

Alternatively, during period of rest, the parasympathetic system will contract the pupil, narrowing the amount of light allowed in and changes the lens to favor near vision (McCory, 2007). These sympathetic and parasympathetic responses not only influence the officers reactions, but also sets the stage for officer readiness. An officer who is too relaxed or complacent puts himself at a mental and physiological disadvantage. Aside from obvious dangers of complacency, this relaxed state puts the officer to optimally operate with a narrow vision and slows down their ability to perceive a threat that does not occur within their immediate area. However, too much arousal manifesting as hyper-vigilance cannot be sustained for long periods and begins to be detrimental to the officer's efforts after prolonged use (Lewinski & Hudson, 2003).

Understanding how states of arousal influences one's ability to react and their accompanying physiological changes can help put officers in the most advantageous physical state. Kane and Wilder (2011) refer to different states of arousal based on a codified color system developed by Colonel Jeff Cooper for the Marine Corps. Five colors are associated with different levels of awareness: white (oblivious), yellow (aware), orange (alert), red (concerned), black (under attack). Throughout an officer's shift, they can operate in various degrees in each of these conditions. Since constant vigilance is physically and emotionally draining, it is recommended

officers operate in a lower condition of awareness. While on patrol, officers should be in a constant yellow or aware condition. This level of awareness is not as physically demanding, and it prepares the officer for action should it be needed. Upon observing something suspicious or a possible crime in progress, the officer would then move upward through the different awareness levels. If an officer operates in condition white or is oblivious to their surroundings, they are not only in a tactical disadvantage, but their visual system is also adapted to this relaxed state. Effective reaction is then dramatically slowed due to the body's need to process and physiologically adjust.

McCory (2007) showed these physiological responses are also indicative of heart rates. As heart rates increase the eyes adjust for far vision in anticipation of direct action. As heart rates fall, the eyes contract optimizing near vision. It is then paramount that the officer be able to control their heart rate and be aware of their bodily responses to stress. Stress inoculation training has been shown to help officers gain control of anxiety (Nieuwenhuys & Oudejans, 2011). If an officer is able to minimize the effects of stress, their heart rate can be reduced and thus their vision improved.

One technique that is gaining momentum in police training circles is the idea of "tactical breathing." Tactical breathing is taught as a way to minimize the body's stress response, normalize blood flow, and decrease high heart rates. Tactical breathing consists of mentally focusing on a 4 second inhale, followed by a controlled 4 second exhale and repeating this process two to three times. Kessler and Bothwell (2016) tested the effects of tactical breathing on emergency medicine personnel and their time to intubation during a simulated stressful and non-stressful event. Time to intubation was not affected by tactical breathing, however, success rates were dramatically different during the stressful event. Those who did not use tactical breathing

were successful in 85% of intubation attempts, while the tactical breathers were successful 100% of the time. In addition, self-reports by the participants indicated their breathing to significantly improve their success rate. Intubation is highly specialized skill that medical personnel used to control a patient's airway. The procedure is performed in very close proximity to the patient which relies on near vision and excellent hand eye coordination to properly place the breathing tube. Tactical breathing has been shown to mitigate the effects of the sympathetic nervous system and optimize performance.

Object Selection

Since the retina is densely packed with cones, human vision is best at the point of fixation (Henderson, 2003). It is the responsibility of the visual attention system to direct gaze towards objects of importance in the environment (Itti & Koch, 2001). What determines the importance of objects is a combination of bottom-up and top-down processing (Henderson, 2003; Theeuwes, 2012). Bottom up processing hinges on the saliency of an object in a visual field. For example, if an officer approaches a vehicle and observes a handgun sitting next to the driver, the salient features of the handgun cause it to be observed. Top-down processing is the conscious decision and or effort driven by a task when looking for an object (Shinoda, Hayhow, Shirvastava, 2001). Top down processing is also influenced by prior experience (Miller, 2000). Using the previous example, if the officer was informed by dispatch the driver may have a weapon and the officer has a prior experience with the driver carrying a firearm, the resulting visual search would be predicated on top down factors.

In real life, there are cognitive and time costs associated with each type of attentional processing (Itti & Koch, 2001). Bottom up processing is fast and requires minimal effort. This is due to the features of the object being attended to that can result in a 'pop out' effect. A salient

object based on features is one that stands out from the environment it is in. These objects are then inherently easier to see. A top down visual search can require significantly more time to achieve and require more effort. When attentional resources are already limited, top down processing further reduces attentional availability. According to Itti and Koch (2001), top down processing can take 200 milliseconds or more to achieve a desired result. This is due to the fact that observers are consciously processing and evaluating what is in front of them which takes time. Complicating a visual search using bottom up or top down processing is that both processes can work in parallel (Crick & Koch, 1998). The brain must then decide which pieces of the scene enter short term memories that signal importance to the observer and, ultimately, enter the observer's visual awareness. Once entered into visual and conscious awareness, an observation can then be acted on or reacted to. Thus, Miller (2000) states attention is intimately related to cognition and acts as a behavioral trigger.

Before an object enters visual awareness and there is a reaction to it, it must first be selected. Selection of objects in the visual field can occur either covertly or overtly (Theeuwes, 2006). Covert and overt selection are highly correlated but provide valuable information for a discussion on threat recognition. Attention is commonly understood to be the culmination of a two-part process (Broadbent, 1958; Itti & Koch, 2001). The two stages of attention are aptly named pre-attentive and attentive (Theeuwes, 2006). Pre-attentive is referred to all things in a visual field or environment while attentive is regarded as the one or few things that can be actively attended to in a visual field. Selection is then defined as those objects or things that pass through pre-attention and make it to the attentive phase of attention. Overt selection is selection of an object that induces a subsequent eye movement or 'saccade' to that object's location. In other words, when an observer moves their eyes to a location in space or onto a specific object,

that object can be said to be overtly attended to way of this saccade. As the names imply, objects that are not overtly selected can also be covertly selected by way of the periphery (Theeuwes, 2012). Research has found observers can give attention to things not directly being looked at. While studying misdirection in magic tricks, Kuhn, Tatler, Findlay and Cole (2008) found identification of a disappearing object is independent of where the observer was looking at the time the disappearance occurred. This give evidence that items not being overly attended can be noticed.

As discussed, vision is essential for observation and more importantly action. During a gun fight or prior to the decision to use a gun, the brain relies on information gathered from the eyes. Beyond the point of fixation, images become more and more difficult to process as they become distant from the fovea. To help make sense of dynamic scenes, the brain uses a series of rapid eyes movements, called saccades to piece a scene together. Henderson (2003), states the eye moves about three times a second in order to reorient itself through a scene. Saccadic suppression allows for the overall pattern to emerge while these rapid eyes movements are ignored. Gaze control is then the process of directing points of fixation to meet the various needs or goals of the observer. Theeuwes (2012) provides evidence that once the observer decides on a course of action, the visual search supporting that action becomes automatic. Selection and thus the cessation of the visual search occurs based on experience and working memory. This automaticity aspect is important for officers. If a visual search is conducted for the sights of a pistol (as trained) during the draw phase, the search and coupling action will not stop until the sights are found and aligned. Following this is usually a reflexive trigger pull causing the pistol to discharge. This momentarily emphasis on pistol sights allows for an officer to potentially miss important cues from his environment.

Section 3: Theoretical Framework

The following theoretical framework section is divided into three parts. The first part introduces the quiet eye and how it can increase performance. The second part discusses the attentional control theory and explains the effects of anxiety on attention. Lastly, the third part links these theories and shows how they can work in tandem to benefit officer performance during a deadly force encounter.

The Quiet Eye

Officers are cognitively limited as to how much information they can process and therefore act upon. Success during a deadly force encounter hinges on deciding where to look and what to look at under the time constraints described earlier. Officers can only direct their gaze to one place at one time and must be able to select information or objects that determine their next move. Prior research has indicated the gaze behavior of elite performers is often different and distinct from that of intermediate or novice performers. Early research investigating these trends found skilled individuals orient their gaze toward a target sooner and maintain vision on the target longer than less skilled individuals (Ripoll, Bard, & Paillard, 1986). Ripoll, Papin, Guezennec, Verdy, and Phillip (1985) found elite pistol shooters fixate on a target throughout the aiming action while novices track the sights first then the target. A similar finding was discovered in elite golfers. Vickers (1992) found expert golfers tracked the ball throughout the putting stroke whereas novices fixated on the club head prior to contacting the ball. These differences do not seem to be domain specific as research found expert soccer players also use fewer fixations to more optimal target locations than nonexperts (Helsen & Pauwels, 1993). Vickers (1996) explains less skilled individuals appear to shift their gaze to more locations and fixate on less than optimal sources of information. However, at the time of these findings, it was

unknown whether these superior gaze behaviors were a result of expertise and how influential these visual behaviors were on superior performance (Abernathy, 1990).

To help settle the debate, Vickers (1996) introduced the idea of the quiet eye while studying visual control between expert and non-expert free throw shooters. First, Vickers defined the quiet eye as the final fixation on a specific object or location in a task environment within three degrees of visual angle for minimum duration of 100ms. Stated simply, the quiet eye is the last place a performer looks prior to initiating movement. Under experimentation, Vickers found expert and non-expert free throw shooters did not differ in terms of movement time, fixation frequency, or duration during the pre-shot and shot phases. However, experts consistently had longer quiet eye duration prior to movement. For example, experts fixated on the target for more than 970 milliseconds prior to initiating movement, while non-experts averaged less than 360 milliseconds. Vickers then argued visual behavior is vital for superior performance and experts are able to make better use of their visual field. Vickers (2007) indicated this final fixation prior to movement underlies higher levels of skill and performance with longer quiet eye durations resulting in greater expertise and accuracy. However, there does exist a threshold or ceiling where fixating for longer durations begins to impair performance. Since its inception in 1996, findings for the quiet eye have been robust, replicated in over seventy studies, and confirmed by meta-analysis (Gegenfurtner, Lehtinen, & Saljo, 2011; Vickers, 2011; Moore, Vine, Cooke, Ring, & Wilson, 2012).

Recent research has shown the quiet eye is also trainable and leads to increased performance (Causer, Holmes, & Williams, 2011; Vine et al., 2011). This training also affects performance under stress. Behan and Wilson (2008) found quiet eye durations decrease as stress is increased and will negatively impact performance. However, this can be reversed by being

taught to maintain quiet eye durations under stress. Research has found quiet eye training can buffer the negative performance effects stress induces (Vickers & Williams, 2007; Behan & Wilson, 2008; Wilson, Vine, & Wood, 2009).

Research has shown a clear link between the quiet eye and movement. For example, while training shotgun shooters to employ the quiet eye, Causer, Holmes, and Williams (2011) found aside from increased accuracy, participants also experienced reduced gun barrel displacement and reduced peak velocity although neither variable was directly trained. Moore et al., (2012) explained the quiet eye extends the critical period or window of response programming that creates expert like movements. Although conducted with competitive shotgun athletes, these findings are directly applicable to officers and their use of deadly force. By widening the perceptual window that officers have to respond to a deadly threat, they can better react and increase efficiency in their firearm preparation, presentation, and ultimately its discharge.

One study conducted by Vickers and Lewinski (2011) explored the gaze of elite and rookie police officers during a simulated deadly force encounter. During this study, officers entered a room and faced a subject whose back was turned to them. Upon the officer's commands, the subject quickly spun and presented either a cell phone or a firearm. The officers gaze behavior and subsequent trigger pull (if present) were then examined. The findings of this study present several implications for the current discussion. The researchers found, as expected, the elite officers performed with greater accuracy and made less decisional errors in the cell phone condition. Elite officers were found to fixate on locations where a weapon is hidden and did this earlier and for longer durations than the rookies. All officers took the same amount of time to draw, aim, and fire, but the elite did so sooner than the rookies. The researchers indicated

this showed a deficiency in anticipation, cue detection, and gaze control for the newer officers. Perhaps most importantly, as the events unfolded, the elite officers never lost sight of the assailant's weapon or cell phone. In comparison, the rookies shifted their gaze to their own weapon replicating those findings of Ripoll et al. (1985). Amazingly, approximately 62% of rookie officer participants fired in the cell phone condition.

When broken down further, elite officers focus and concentration increased as the event unfolded. When presented with the weapon or cell phone, elite officer percent of fixations increased from 18% to 71%. When confronted with a weapon and the officer fired their own weapon, this percent of fixation to object jumped to 86%, revealing an ever-increasing focus. Rookies did not show this same pattern and only allocated 34% of their fixations to the threatening object while 39% of fixations was diverted to their own gun. The author explains the most damaging behavior performed by the rookies was a saccade to their own weapon prior to final fixation. Rookies performed a saccade to their own weapon in 84% of trials while elites did so in 23% of trials. Furthermore, since information is suppressed during saccades (Bridgeman, Hendry, & Start, 1975), situational awareness and attentional allocation is severely hindered.

When visual search strategies were analyzed the differences became even greater and help speak to why officers may shoot an unarmed subject. When confronted with a rapidly spinning subject the elite officers used a series of six visual fixations that allowed them to optimally analyze the scene. All fixations were short in duration that allowed for a quick interpretation of the raising of the elbow and pivot (by the subject) signaling a possible attack. The elite officer then fixated on possible areas of weapon location and actually was fixated on the weapon/cell phone before it was presented. While still under immense time constraints, this anticipatory visual search allowed the officers the most leverage in the situation. This efficient

search gave the officers more time to either fire a shot or suppress a shot. In comparison, the rookies final six fixations were significantly longer in duration and the rookies struggled to keep up with and interpret the meaning of the subject's pivot and high elbow raise. Now stuck in a game of catch-up, the rookies only fixated on the object after it was presented. This action coupled with a final saccade to their own weapon put the rookies at a severe cognitive disadvantage resulting in decreased accuracy when firing and increased decisional errors. This disadvantaged state also resulted in short quiet eye duration then compared with elite officers. Having a longer quiet eye duration meant, for the elites, their visuo-motor system had more time to prepare and execute the action while under pressure.

Attentional Control Theory

Corbetta and Shulman (2002) explain attention can be seen as comprised of two systems. One system is goal directed and influenced by expectation, knowledge, and current goals while the other is stimulus driven and responds to salient or visible stimuli. The goal directed system involves top down processing while stimulus driven attention is based on bottom up processing (Posner & Peterson, 1990), similar to which objects are selected (as discussed in the literature review). In the context of anxiety and performance, Eysenck, Derakshan, Santos, and Calvo, (2007) proposed the attentional control theory. The attentional control theory rests of the notion that anxiety increases allocation of attentional resources to perceived threats rather than task relevant stimuli. Under this theory, while in an anxious state, attention is directed to threat stimuli whether internal or external. Often this manifests as worrisome thoughts or an actual threat. In terms of information processing, the attentional control disrupts information processing in favor of automatic processing of threat related stimuli (bottom up processing). Since attention

is limited, top down goal directed behavior suffers as emphasis is placed on stimulus driven bottom up processing (Fox, Russo, & Georgiou, 2005).

Expanding on this theory further, Miyaki et al. (2000) discovered several specific functions that are impaired as a result of anxiety. These researchers described these functions as inhibition, shifting, and updating. Inhibition is defined as the ability to filter out task irrelevant details while shifting refers to the ability to move between multiple tasks. Updating is described as the constant monitoring of working memory representations that change as task demands change. When in an anxious state, the ability to ignore task irrelevant stimuli is hindered along with a lack of ability to attend to many different things. Furthermore, the ability to hold these changing stimuli in one's working memory reduces.

In 2000, Nigg further divided inhibition into four subcategories. The researcher found inhibition can manifest as interference control, cognitive inhibition, behavioral inhibition, and oculomotor inhibition. Interference control refers to attentional resources being diverted to separating similar stimuli and cognitive inhibition is ignoring the task irrelevant stimuli. Behavioral and oculomotor inhibition is characterized as suppressing dominant behavioral impulses and reflexive saccades. These findings are critical for the effective performance by officers. The inability to distinguish similar looking objects while anxious is exactly at the core of the current discussion. An officer who shoots at a subject holding a non-threatening object may suffer from the cognitive inability to separate object features. In addition, rejecting behavioral and oculomotor impulse is paramount to officer safety. Today, police instructors refer to these automatic behavioral impulses as "training scars" and their impact is detrimental to a successful encounter. One of these behaviors as found by Vickers and Lewinski (2011), is the learned automatic behavior to look for gun sights while aiming. As previously discussed, rookie

officers consistently took their eyes off the target and looked for their sights. Elite officers did have this tendency and they, instead, brought the sights to where they were looking. In addition, this affect was exacerbated as rookie officers made saccades to more task irrelevant areas than elite officers did.

Attentional control theory can shine light onto why officers are likely to shoot a subject holding a non-threatening object. Discerning between a weapon and a cell phone is a conscience top down process that requires the observer to differentiate the characteristics of the two items. According to the attentional control theory, this task becomes more difficult while un an anxious state, because attention shifts from being goal directed to stimulus driven. What this means for the officer facing a deadly threat is that they are more likely to attend to the fact that the subject quickly pulled out a dark square black object rather to the fact that the object may be made of plastic and can possibly be a cell phone. Furthermore, the ability to distinguish between task irrelevant stimuli decrease. For the officer this can manifest as not being able to distinguish between material differences, say plastic vs metal, in high stress dark environments.

Intersectionality of the Quiet Eye and Attentional Control Theory

Longer quiet eye durations are said to extend the period of motor preparation in which the visuo-motor system sets the parameters for movement and coordinates gross and fine motor movements (Mann, Coombes, Mousseau, & Janelle, 2011). Anxiety aims to disrupt this top-down, task driven process by elevating the heart rate, activating the sympathetic system, and favoring a bottom up, salient search for threatening objects. For an officer this means looking for a weapon but reacting to the salient features of a cell phone or other harmless object. As previously discussed, the stress response changes depth perception, peripheral vision, and pre-disposes the eyes to see at distance. It has been proposed, through efforts such as tactical

breathing, controlling one's heart rate reduces the performance robbing effects of stress and anxiety. A growing body of research shows heart rates can also be controlled via the quiet eye.

According to Lacey and Lacey's (1980) Intake-Rejection Hypothesis, an external focus of attention induces a slowing of the heart prior to task execution. More recent research found this external focus of attention also reduces tension in activated muscles resulting in better task performance (Lohse, Sherwood, & Healy, 2010). Under the intake-rejection hypothesis, it is then possible that externally focusing attention via longer quiet eye durations can also result in lowering heart rates. Moore et al, (2012) investigated this possible connection through measuring athletes heart rates pre- and post- task execution in normal versus pressured conditions and with one group receiving quiet eye training and the other group receiving standard task instruction. The researchers found those who received quiet eye training had dramatic heart rate deceleration during task execution. These results stayed consistent with retention analysis. Furthermore, the quiet eye trained group experiences a relaxing of involved muscles prior to initiating movement thus replicating the results found by Lohse, Sherwood, and Healy. Most important, it was concluded that quiet eye training greatly reduced the affects of anxiety.

These findings suggest that the benefits of the quiet for officers are numerous. First the quiet eye has been shown to give officers more time to interpret, anticipate, and react to an ever-changing environment. These moments are tense, uncertain, and deadly for officers which causes a stress response in the body. Cognitive processing then becomes automatic as saliency of objects takes precedent over task goals. However, a deliberate external focus that the quiet eye provides will slow the heart rate, reverse the stress response, decelerates the heart, and improves overall motor function. As a result, the officer sees with more clarity, is better able to

cognitively process the scene, has improved decision making ability, and, if needed, can return fire more accurately due to improved motor ability.

Section 4: Conclusion

Summary and Recommendations

Officers work in tense, uncertain, and deadly environments. Perhaps the greatest responsibility of the police is protecting citizens from acts of violence by deadly force intervention. During these incidents, every moment and every decision carries with it life and death repercussions. The officer's situational awareness and ability to operate against a deadly threat is put to the test. While in these situations, an officer must rely on information gained from their senses in order to properly react to a deadly threat. While all five sense are used to build a cognitive roadmap of the scene they face, the greatest source of information gathering is the officer's eyes. Information received via the optic nerve is transmitted to the brain and prepares the body for direct action.

As shown in previous sections, the human eye is susceptible to a host of changes because of environmental or stress factors. Vision during the daylight is best due to cone activation which sends valuable information to the brain regarding forms, shapes, and textures. Cone activation is responsible for color vision and is greatly reduced at night resulting in a decreased ability to see the same forms, shapes, and textures. During darkness, the rods of the eye are activated and are best for periphery vision and movement detection. However, when under stress the vessels of the eye are constricted in the periphery resulting in a near 70% reduction of visual field. These finding has help explain why approximately 60% of officers who are killed in the line of duty occur between 6:00 pm and 6:00 am (Federal Bureau of Investigation, 2013). Night vision is best at the periphery because cones that lose their ability to function are densely populated in the

fovea. This can result in a near blindness for the officer that is forced to confront an assailant at night. The result is having to make extremely difficult decisions relating to deadly force with a greatly reduced clarity. In addition, cognition transitions visual searches to favor bottom up processing based on object saliency rather than top-down, task driven visual searches. This again handicaps the officers because their visual system is being driven to focus on object saliency rather than deciding what the object is. This process can set forth an automatic deadly force response without full ability to define what an assailant is holding or presenting. However, research has shown this response is not permanent and can be reduced with training.

Since initial training dictates later performance (Schmidt & Lee, 2005) it is recommended that training be changed at the academy. First, visual and cognitive processing should be a mandated training course at training academies. Curriculum would focus on the eyes structures and oculomotor responses to differing environments and conditions. By understanding what occurs to vision in different settings, officers can be better prepared to deal with their limitations. Second, quiet eye training should be included and become a standard feature of the training repertoire. In order for rookie officers to perform like elite officers, elite officer behavior should be taught at the academy. In regard to firearms training, since time to draw and fire a weapon does not differ between rookie and elite officer (Vicker & Lewinski, 2012), the mechanics of the draw and presentation do not need to be altered. The change that needs to be made is one of visual gaze and specifically attempts to increase the quiet duration of rookie officers. As supported by the literature (Vicker & Lewinski, 2012), it is recommended that officers be taught to focus on the target rather than their front sight. Sight alignment should occur only after the pistol is brought into the line of gaze between the officer and the target. This marks a dramatic change in firearm training where officers present their firearm and look for the sights by taking

attention off the target on placing it onto their pistol. Once the sights are seen, the officer then goes back to the target. By changing this practice to the one process recommended here, the officer never loses sight of the target and increases their quiet eye duration. By increasing the quiet eye duration, the officer is ensured focus to areas of task relevance and provide information to the officer about whether to fire or suppress a trigger pull. By staying focused on the target and increasing the quiet eye, officers also thwart the performance robbing effects of stress that accompany a deadly force encounter.

For a perceptual and attentional training program, such as the quiet eye, to be successful, four conditions must be met (Gopher, 1993). First a training opportunity needs to exist that shows gaze control can increase performance. Second, a population has to be identified that struggles with gaze control and attention resulting from training. Third improvements must be shown to be possible and finally, it must be shown that more optimal gaze strategies exist. All these conditions have been met by a review of available literature. These findings indicate a quiet eye training program should have success in a law enforcement training environment. After these conditions are met, Vickers (2009) outlines seven steps that once completed narrows the gap between novice and elite performers. The first step involves identifying the gaze control strategies used by elite performers. In regard to law enforcement, these gaze behaviors have been identified by Vickers (2012). Second, the participant or officer is tested and recorded using a mobile eye tracker while performing job related task. For officers, this could be a mock scenario or video simulator used for police training. Third, the novice participant is taught the gaze of elite performers and where fixations should be optimally placed. The goal of this step is to reduce total fixation locations and place the quiet eye on a mission critical location. Fourth, the novices visual tracking pattern is compared to that of the elites. This step serves the purpose of

showing how erratic the novices visual search pattern is and then gives them concrete examples of a more optimal pattern. Fifth, the novice chooses one aspect of their visual search pattern they would like to change, and subsequent trials are conducted attempting to instill one of the quiet eye attributes. The sixth and seventh steps involve conducting drills to encourage the use of this new search strategy and follow up testing over time to instill these behaviors. Given the wide spread use of video bases and force-on-force simulator training in use by police departments and training academies (Bennell, Jones, & Corey 2007), it would not be difficult to implement a quiet eye training program of this type.

It is clear the importance of the visual system has been overlooked by modern police training. Visual search strategies and the importance of cognitive processing is not discussed amongst the myriad of other topics training academies have limited time to teach. Firearms training has remained largely static with improvements being few and far between. However, research exists today that can fill in training gaps previously left out of curriculums. The findings presented here along with the simple recommendation of bringing the pistol sights to the officer line of gaze rather than bring their gaze to their pistol has significant implications. This small and easily trainable difference can allow officers to perform more efficiently under pressure and widen the decision-making window. When every second counts, training should optimize these precious moments.

References

- Abernathy, B. (1990). Expertise, visual search, and information pick-up in squash. *Perception*, 19, 63-77.
- Alpert, G. P. (1989). Police use of deadly force: The Miami experience. In R.G. Dunham & G. P. Alpert (Eds.), *Critical issues in policing*: 480-496. Prospect Heights, IL: Waveland
- Aveni, T. (2003) Following standard procedure: a long-term analysis of gunfights and their effects on policy and training. *Law and Order* 51(8):78-87.
- Awerbuck, L. (2003). The overlooked aspect of fighting. *S.W.A.T.* Retrieved from <http://www.snipercraft.org/training.html>
- Behan, R. M., & Wilson, M. (2008). State anxiety and visual attention: The role of the quiet eye period in aiming to a far target. *Journal of Sport Sciences*, 26, 207-215.
- Bennell, C., Jones, N. J., Corey, S. (2007). Does use-of-force simulation training in Canadian police agencies incorporate principles of effective training? *Psychology, Public Policy, and Law*, 13(1), 35-58.
- Bridgeman, G., Hendry, D., & Start, L. (1975). Failure to detect displacement of visual world during saccadic eye movements. *Vision Research*, 15, 719-722.
- Broadbent, B. R. (1958). *Perception and communication*. Oxford: Pergamon.
- Causar, J., Holmes, P. S., & Williams, A. M. (2011) Quiet Eye training in a visuomotor control task. *Medicine and Science in Sports and Exercise*, 43, 1042-1049.
- Cerar, J. C. (1990). *Firearms discharge assault report, 1990: New York City Police Department Academy Firearms and Tactics Section*. Unpublished annual report by New York Police Department, New York

- Chan, M. (2015). Pistol-whipped Alabama cop didn't shoot attacker for fear of making headlines: union. *Daily News*. Retrieved from <http://www.nydailynews.com/news/national/pistol-whipped-didn-shoot-suspect-fear-backlash-article-1.2325772>
- Cohen J., & Richards J.S. (2016). In 14 cases, no gun is found after Chicago police shot someone they said was armed. *Chicago Tribune*. Retrieved from <http://www.chicagotribune.com/news/watchdog/ct-chicago-police-shootings-no-gun-20160914-story.html>
- Copay, A. G., & Charles, M. T. (2001). Handgun shooting accuracy in low light conditions: The impact of night sights. *Policing: An International Journal of Police Strategies and Management*, 24(4), 595-604.
- Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience*, 3, 201-215.
- Corell, J., Urland, G. R., & Ito, T. A. (2005). Event related potentials and the decision to shoot: The role of threat perception and cognitive control. *Journal of Experimental Social Psychology*, 42:120-128
- Crick, F., & Koch, C. (1998). Constraints on cortical and thalamic projections: the no-strong-loop hypothesis. *Nature*, 391(245-250)
- Derrick, B. (2009). The illusion of seeing. *Tactical Response*. Retrieved from <http://www.snipercraft.org/training.html>
- Easterbrook, J. A. (1959). The effects of emotion on cue utilization and the organization of behavior. *Psychological Review*, 66, 183-201.

- Eyessenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7*(2), 336-353.
- Federal Bureau of Investigation (2013). *Law Enforcement Officers Killed or Assaulted*. Retrieved from <https://www.fbi.gov/about-us/cjis/ucr/leoka/2013>
- Force Science Institute. (2018). California Assembly Bill 931 seeks to establish a “necessity” standard for the legal use of deadly force by peace officers. *Police One*. Retrieved from <https://www.policeone.com/legal/articles/477927006-Force-Science-assesses-proposed-necessary-deadly-force-standard/>
- Fox, E., Russo, R., & Georgiou, G. A. (2005). Anxiety modulates the degree of attentive resources required to process emotional faces. *Cognitive, Affective, & Behavioral Neuroscience, 5*, 396-404.
- Gegenfurtner, A., Lehtinen, E., & Saljo, R. (2011). Expertise differences in the comprehension of visualization: A meta-analysis of eye tracking research in professional domains. *Education Psychology Review, 23*, 523-552.
- Geller, W., & Scott, M.S. (1992). *Deadly Force: What We Know*. Washington, DC: Police Executive Research Forum
- Godnig, E. C. (2004). Vision and shooting. *The Police Policy Studies Council*. Retrieved from http://www.theppsc.org/Staff_Views/Godnig/vision_and_shooting.htm
- Gopher, D. (1993). The skill of attention control: acquisition and execution of attention strategies. In D. Meyer & S. Kornblum (Eds.), *Attention and Performance XIV*. Cambridge, MA: MIT Press.
- Graham v Connor. (1989) 490 U.S. 386. Retrieved from <https://supreme.justia.com/cases/federal/us/490/386/>

- Heck, G. (2017). Safely reducing the use of deadly force by law enforcement officers: An analysis of three prominent training programs. *UW-Platteville Minds*. Retrieved from <https://minds.wisconsin.edu/handle/1793/77373>
- Helsen, W., & Pauwels, J.M. (1993). A cognitive approach to visual search in sport. In *Visual Search*, 2(379-388). London: Taylor Francis
- Henderson, J. M. (2003). Human gaze control during real-world scene perception. *TRENDS in Cognitive Sciences*, 7:11
- Hendrick, H. W., Paradis, P., & Hornick, R.J. (2008). *Human factors issues in handgun safety and forensics*. London: CRC Press/Taylor Francis.
- Honig, A., & Lewinski, W. J. (2008). A survey of the research on human factors related to lethal force encounters: Implications for law enforcement training, tactics, and testimony. *Law Enforcement Executive Forum*, 8(4).
- Horvath, F., & Donahue, M. (1982). *Deadly force: An analysis of shootings by police in Michigan, 1976-1981*. East Lansing: Michigan State University.
- Itti, L., & Kock, K. (2001). Computational modeling of visual attention. *Nature Reviews: Neuroscience*, 2.
- Johnson, A. (2018). Wichita officer who killed Andrew Finch in 'swatting' mistake won't be charged. *NBC News*. Retrieved from <https://www.nbcnews.com/news/us-news/wichita-officer-who-killed-andrew-finch-swatting-mistake-won-t-n865626>
- Jordan, J. R. (2018). Texas police shoot man who disarmed possible church shooter. *Chron*. Retrieved from <https://www.chron.com/news/houston-texas/texas/article/Texas-police-shoot-man-who-disarmed-possible-12704202.php>

- Kane, L., & Wilder, K. (2011). *How to win a fight: A guide to avoiding and surviving violent*. New York, NY: Penguin Books
- Kelly, R. W. (2011) Annual firearms discharge report. *New York City Police Department*.
- Kessler, G. L., & Bothwell, M. K., (2016). Implementation of tactical breathing during simulate stressful situations and effects on clinical performance. *Annals of Emergency Medicine*, 68(4S).
- Koivisto, M., Hyona, J., & Revonsuo, A. (2004). The effects of eye movement, spatial attention, and stimulus features on inattention blindness. *Vision Research*, 44:3211-3221
- Kuhn, G., Tatler, B. W., Findley, J. M., & Cole, G. G., (2008). Misdirection in magic: Implications for the relationship between eye gaze and attention. *Visual Cognition*, 16(2/3):391-405
- Lacey, B. C., & Lacey, J. L. (1980). Cognitive modulation of time-dependent primary bradycardia. *Psychophysiology*, 17, 209-2210
- Levin, S. (2016). Footage of California police killing unarmed teen prompts claim of ‘trigger-happy’ officers. *The Guardian*. Retrieved from <https://www.theguardian.com/us-news/2016/jul/13/body-camera-footage-released-dylan-noble-police-shooting>
- Lewinski, B., & Hudson, B. (2003). The impact of visual complexity, decision making, and anticipation: The Temple study, experiments 3 and 5. *The Police Marksman*, 28(6), 24-27.
- Lewinski, W. J., Avery, R., Dysterheft, J., Dicks, N. D., & Bushey, J. (2015) The real risks during deadly police shootouts: Accuracy of the naïve shooter. *International Journal of Police Science & Management*. 17(2), 117-127.

- Lewinski, W. J., Dysterheft, J. L., Seefeldt, D. A., & Pettitt, R. W. (2013). The influence of officer positioning on movement during a threatening traffic stop scenario. *Law Enforcement Executive Forum, 13*(1), 98-109.
- Lewinski, W. J., Hudson, W. B., & Dysterheft, J. L. (2014). Police officer reaction time to start and stop shooting: The influence of decision-making and pattern recognition. *Law Enforcement Executive Forum, 14*(2), 1-16
- Lohse, K. R., Sherwood, D. E., & Healy, A. F. (2010). How changing the focus of attention affects performance, kinematics, and electromyography in dart throwing. *Human Movement Science, 29*, 542-555.
- Lopez, P. (2017). Fresno police justified fatal shooting of Freddy Centeno. A judge says they may be wrong. *The Fresno Bee*. Retrieved from <https://www.fresnobee.com/news/local/crime/article171645017.html>
- Maclin, K. M., & Solso, R. L. (2008) *Experimental Psychology: A Case Approach*. Boston, MA: Pearson
- Mancero, G., Wong, W., & Loomes, M. (2009). Change blindness and situational awareness in a police C2 environment, presented at European Conference on Cognitive Ergonomics. Helsinki: VTT Technical Research Centre of Finland
- Mann, D. T. Y., Coombes, S. A., Mousseau, M. B., & Janelle, C. M. (2011). Quiet eye and the bereitschafts potential: Visuomotor mechanisms of expert motor performance. *Cognitive Processing, 12*, 223-234.
- Markel, P. (2013). Blue on Blue Shootings. *Officer.com*. Retrieved from <https://www.officer.com/on-the-street/body-armor-protection/article/11151312/blue-on-blue-shootings>

- McCory, L. K. (2007). Physiology of the autonomic nervous system. *American Journal of Pharmaceutical Education, 4*(71).
- Meyer, M. W. (1980). Police shootings of minorities: The case of Los Angeles. *Annals of the American Academy of Political and Social Science, 452*: 98-110.
- Miller, E. K. (2000). The prefrontal cortex and cognitive control. *Nature Reviews: Neuroscience (1)*: 59-65
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H. Howerter, A., & Wagner, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49-100.
- Moore, L. J., Vine, S. J., Cooke, A., Ring, C., Wilson, M. R. (2012). Quiet eye training expedites motor learning and aids performance under heightened anxiety: The roles of response programming and external attention. *Psychophysiology, 49*, 1005-1015.
- Morrison, G., & Garner, T. (2011). Latitude in deadly force training: Progress or problems. *Police Practice and Research, 12*, 341-361.
- Morrison, G., & Vila, B. (1998). Police handgun qualification: Practical measure or aimless activity? *Policing: An International Journal of Police Strategies and Management 21*, 510-533
- Nigg, J. T. (2000). On inhibition/disinhibition in developmental psycho-pathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin, 127*, 571-598.
- Officer Down Memorial Page. (2017). Honoring Officers Killed in 2017. *Officer Down Memorial Page*. Retrieved from <https://www.odmp.org/search/year?year=2017>

- Oudejans, R. R. D. (2008). Reality-based practice under pressure improves handgun shooting performance of police officers. *Ergonomics*, *51*, 261–273.
- Pate, A., & Hamilton, E. E. (1991). *The Big Six: Policing America's Largest Cities*. Washington, DC: Police Foundation
- Posner, M. L., & Peterson, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, *13*, 25-42.
- Reaves, B.A. (2009) *State and local law enforcement training academies*. Darby, PA: Diane Publishing
- Rensink, R. A. (2002). Change detection. *Annual Review Psychology*, *53*:245-77
- Ripoll, H., Bard, C., & Paillard, J. (1986). Stabilization of the head and eyes on target as a factor in successful basketball shooting. *Human Movement Science*, *5*, 47-58.
- Ripoll, H., Papin, J. P., Guezennec, Y., Verdy, P. & Philip, M. (1985). Analysis of visual scanning patterns of pistol shooters. *Journal of Sports Sciences*, *3*:2
- Rosenberg, E., & Wong, H. (2017). A police officer fatally shot a man while responding to an emergency call now called a 'swatting' prank. *The Washington Post*. Retrieved from https://www.washingtonpost.com/news/post-nation/wp/2017/12/29/a-police-officer-fatally-shot-a-man-while-responding-to-an-emergency-call-now-called-a-swatting-prank/?noredirect=on&utm_term=.aa31f1efd943
- Schmidt, R. A., & Lee, T. D. (2005). *Motor control and learning: A behavioral emphasis (4th ed.)*. Champaign, IL: Human Kinetics Publishers.
- Shelby, N. (2016) *In context: understanding police killings of unarmed civilians*. CIAI Press.

- Siemaszko, C. & McCausland, P. (2017). Texas boy, 6, killed in deputy-involved shooting days before Christmas. *NBC News*. Retrieved from <https://www.nbcnews.com/news/us-news/texas-boy-age-6-killed-deputy-involved-shooting-days-christmas-n832166>
- Simons, D. J., & Rensink, R.A. (2005). Change blindness: past, present, and future. *Trends in Cognitive Sciences*, 9:1
- Smart, S. M., Berry, M. A., & Rodriguez, D. N. (2014). Skilled observation and change blindness: A comparison of law enforcement and student samples. *Applied Cognitive Psychology*, 28(4), 592-596
- Steele, T. (2016). Slain Eules officer David Hofer was shot while telling gunman to show his hands, police accounts show. *Dallas News*. Retrieved from <https://www.dallasnews.com/news/crime/2016/03/17/slain-eules-officer-david-hofer-was-shot-while-telling-gunman-to-show-his-hands-police-accounts-show>
- Theeuwes, J. (2012). Automatic control of visual selection. In *The Influence of Attention, Learning, and Motivation on Visual Search*, 23-62. New York: Springer
- Vickers, J. N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology: Human Perception and Performance*, (22)2, 342-354.
- Vickers, J. N. (2007). *Perception, cognition, and decision training: The quiet eye in action*. Champaign, IL: Human Kinetics.
- Vickers, J. N., & Williams, A. M. (2007). Performing under pressure: The effects of physiological arousal, cognitive anxiety, and gaze control in biathlon. *Journal of Motor Behaviour*, 39, 381-394.
- Vickers, J. N. (2011). Mind over muscle: the role of gaze control, spatial cognition, and the quiet eye in motor expertise. *Cognitive Processing*, 12, 219-222.

- Vickers, J.N., & Lewinski, W. (2011) Performing under pressure: gaze control, decision making and shooting performance of elite and rookie police officers. *Human Movement Science*, 31, 101-117
- Vine, S. J., Moore, L. J., & Wilson, M. R. (2011). Quiet eye training facilitates competitive putting performance in elite golfers. *Frontiers in Psychology*, 2, 1-9.
- Welford, A. T. (1980). Choice reaction time: Basic concepts. In *Reaction times*. New York: Academic Press.
- Wickens, C. D., Hollands J. G., Banbury J. G., & Parasurman, R. (2013). *Engineering psychology and human performance*. United States: Pearson Education, Inc.
- Williams, G. T. (1999). Reluctance to use deadly force. *FBI Law Enforcement Bulletin*, 68(10).
- Williams, M. A., Singer, R. N., & Frehlich, S. G. (2002). Quiet eye duration, expertise, and task complexity in near and far aiming tasks. *Journal of Motor Behavior*, 3:2, 197-207
- Wilson, M. R., Vine, S. J., & Wood, G. (2009). The influence of anxiety on visual attentional control in basketball free throw shootings. *Journal of Sport and Exercise Psychology*, 31, 152-168.
- Wittie, G. (2015). What can US trigger-happy cops learn from Britain's gunless police? *Independent*. Retrieved from <https://www.independent.co.uk/news/world/americas/what-can-us-trigger-happy-cops-learn-from-britains-gunless-police-10316119.html>
- Wittie, M. C. (2001). Police use of force. *Politics, Bureaucracy, & Justice*, 2(2).

Appendix A

Focus In Aiming

Instructor will address issues relating to focus during the aiming of a pistol by telling officers to focus on the front sight while keeping the rest of the environment in the periphery. The third photo from the left shows what this looks like from the perspective of the officer. As indicated in section 2, this presents numerous issues for the effective use of attention and vision.

Image retrieved from www.google.com/images



INCORRECT

Shooter Focused
on Target.



INCORRECT

Shooter Focused
on Rear Sight.



CORRECT

Shooter Focused
on Front Sight.

Appendix B

TITLE 20: CORRECTIONS, CRIMINAL JUSTICE, AND LAW ENFORCEMENT
CHAPTER V: ILLINOIS LAW ENFORCEMENT TRAINING AND STANDARDS BOARD
PART 1720 ILLINOIS POLICE TRAINING ACT
SECTION 1720.APPENDIX C FIREARM QUALIFICATION COURSE-OF-FIRE

Section 1720.APPENDIX C Firearm Qualification Course-of-Fire

- 1) Target Scoring Area: 8½ x 14 inch overlay/center mass of target. The defined firearm types are: Semi-auto/Revolver handgun; minimum capacity 5 rounds
- 2) For Duty Handgun Qualification, all stages of fire will commence from a secured holster. For Off Duty/Retired Officer Qualification, all stages of fire will commence with the handgun in hand from the "low ready" position. A passing score is 70% = 21 hits on center mass.
- 3) Where indicated below, the word "DRAW" requires the shooter to withdraw the handgun from a secured holster on the command to fire. The word "PRESENT" means that the shooter has the handgun in the shooting hand in low ready (depressed muzzle) position and stands ready for the command to fire under the following conditions:

5 Yard line – Total of 12 rounds

- Stage 1 Draw/Present and fire 2 rounds in 6 seconds
- Stage 2 Draw/Present and fire 2 rounds in 6 seconds
- Stage 3 Draw/Present and fire 2 rounds in 6 seconds
- Stage 4 Draw/Present and fire 2 rounds in 6 seconds
- Stage 5 Draw/Present and fire 2 rounds in 6 seconds
- Stage 6 Draw/Present and fire 2 rounds in 6 seconds

Shooters will reload without command as needed between stages of fire.

7 Yard line – Total of 12 rounds

- Stage 7 Draw/Present and fire 3 rounds in 7 seconds
- Stage 8 Draw/Present and fire 3 rounds in 7 seconds
- Stage 9 Draw/Present and fire 3 rounds in 7 seconds
- Stage 10 Draw/Present and fire 3 rounds in 7 seconds

15 Yard line – Total of 6 rounds

- Stage 11 Draw/Present and fire 3 rounds in 10 seconds
- Stage 12 Draw/Present and fire 3 rounds in 10 seconds
- Stage 12 <OPTIONAL> 25 Yard line-: Draw/Present and fire 3 rounds in 15 seconds
(in lieu of the second 10 second /three round string at 15 yards)

- 4) The above course-of-fire is the minimum standard required. Any agency may include any modification that increases the level of difficulty such as reloading, alternate hands, movement, time restriction, or other job related skills.

(Source: Added at 30 Ill. Reg. 7925, effective April 11, 2006)