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An Evaluation of Light Positioning on Suspect Accuracy in Low Light Environments

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ABSTRACT

Police are sometimes required to conduct searches for hostile suspects or clear a building when an alarm sounds. These searches often times occur in low light conditions. Police will routinely use a flashlight to help with the search. This study evaluates three of the most commonly taught flashlight tactics to assess if any can reduce the likelihood of a police officer being shot by a hostile suspect. The study utilized a randomized controlled trial (n = 236) with random assignment to three test conditions. Ultimately, the study found the Dagger technique reduced the likelihood that participants playing the role of a hostile suspect would successfully shoot the officer in a controlled setting. This finding can directly impact how police officers are trained to operate in low light settings.

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Tactics evaluation; policing; low light

Police work entails unique occupational hazards. Although numerous professions are characterized by extensive risk (e.g., transportation and material moving occupations), such risk is overwhelmingly defined in terms of accidents. Indeed, the recurring threat of assault and homicide likely distinguishes police work from most other professions. That is, whereas many other occupations suffer more accidents and on-the-job fatalities, law enforcement is more likely to involve felonious assaults and homicides. For instance, data collected by the U.S. Bureau of Labor Statistics (BLS) indicate that in 2018, fatal work injuries to police occurred at a rate of 13.7 per 100,000 full-time equivalent workers compared to a rate of 3.5 for all occupations (BLS, 2020). Although this rate includes transportation and other accidents, the most common event leading to death among police in 2018 was homicide (BLS, 2020). Moreover, data obtained by the Federal Bureau of Investigation (FBI) on Law Enforcement Officers Killed & Assaulted (LEOKA) reveal that from 2015–2019, 480 officers were assaulted and injured with firearms, knives, or other cutting instruments (FBI, 2020a) and 257 officers were feloniously killed (FBI, 2020b).

While felonious attacks on police are statistically uncommon events (see e.g., White, Dario, & Shjarback, 2019), the threat of attack looms large in many police officers' minds. Ambush killings are among the most serious and traumatic forms of felonious

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attacks on police officers. Data analyzed by the International Association of Chiefs of Police (IACP) suggest that from 1990 to 2012, the proportion of ambush killings of police increased by over 30% (IACP, 2013). Further, despite long-term declines in ambush killings of police officers from 1970–2018, recent spikes in both ambush and non-ambush felonious killings of police arguably represent a "troubling trend" (White, 2020, p. 466). Clearly, policing is a dangerous profession.

This danger can be exacerbated by dim or low light conditions. In fact, police must operate in environments often characterized by diminished light. For one, many violent crimes are more likely to occur from sunset to sunrise. National Incident-Based Reporting System (NIBRS) data suggest that most robberies, homicides, assaults, and weapons violations reported in 2019 occurred between 6:00pm and 5:59am (FBI, 2020c, 2020d). Officers must respond to such incidents, in which natural light is either greatly diminished or nonexistent. Moreover, dark conditions can occur inside of structures at any time of day.

These low light situations can place officers at a disadvantage for a variety of reasons. For example, suspects may be more difficult to detect, or details (such as whether the suspect is armed) may be more difficult to observe. Research has clearly indicated that police officers are already at a reaction time disadvantage when responding to armed suspects (Blair et al., 2011; Blair & Martaindale, 2014). The inability to quickly detect suspects or observe details in low light environments might increase this disadvantage. LEOKA data reveal that a non-negligible proportion of felonious killings occur in such conditions. Specifically, these data show that approximately 30% of the 257 officers feloniously killed between 2015–2019 were killed in dark or low light conditions (FBI, 2020b).

Officers typically use flashlights to counteract some of the dangers they face when operating in low light environments. That is, flashlights can aid officers in navigating dark environments. Although flashlights furnish officers with more light to see, they can also signal the location of an officer to a suspect (i.e., indicating both the officer's position and the focus of their attention). Accordingly, the flashlight's signaling effect could place an officer at a significant disadvantage. A variety of flashlight techniques have been developed by police trainers to try and offset this potential disadvantage, yet these techniques have not been empirically validated. This paper seeks to correct this situation. We test the effect of three commonly used flashlight techniques on the accuracy of suspects shooting at police officers.

We begin with a discussion of flashlight techniques in the context of defensive tactics, followed by an examination of the assumptions underlying certain techniques. We conclude with an overview of the three commonly trained flashlight techniques evaluated in the current study.

Literature Review

Flashlights and Tactics

Police officers use a variety of flashlight techniques. Some techniques are designed for maximizing the officer's ability to shoot accurately while holding a flashlight (i.e., offensive tactics), others appear to sacrifice some shooting ability for officer protection (i.e., defensive tactics). Although there has been some research into offensive tactics (see e.g., Copay & Charles, 2001), we focus on the defensive aspects of flashlight use. Regardless of how the flashlight is used, however, the light can serve as a potential hazard to the safety of officers. Indeed, the flashlight serves as a signpost, telegraphing the officer's approximate location to any potential threats in the vicinity (Jones, 2002). This risk for officers is perhaps most pronounced when officers use the flashlight to navigate dark areas and to search areas in which suspects may be hiding. This is because the suspect is likely aware of the officer's position the moment the officer approaches an area using a flashlight (Santos, 2017).

Resilience Engineering

The failure of an officer to detect a suspect (or see that a suspect is armed) may be more likely in a low light environment and can have disastrous consequences for the officer. Rather than try to eliminate this risk entirely, which is unlikely, officers may be able to use tactics that assume such errors (e.g., assume that at least some suspects will not be detected before firing their weapon at an officer) and provide some resilience against negative outcomes. The concept of "engineering resilience," common in the safety science literature, assumes human errors are unavoidable and, in turn, promotes the development of practices that minimize the negative consequences of those errors (e.g., Perrow, 2011).

Recent use of force literature has applied this concept to policing (Shjarback, White, & Bishopp, 2021; Taylor, 2021). For instance, using a firearms training simulator, Taylor (2021) found that starting at a lower muzzle position increased officers' accuracy of shoot/no-shoot decision-making when faced with an ambiguously armed individual (i.e., an individual whose hands were not visible). At the same time, the lower muzzle position did slightly slow the officers' response to an eminent deadly threat (i.e., when the suspect pulled a gun out of their pocket and aimed it at the officer), but Taylor argued that the tradeoff was a minor cost compared to the cost of making an incorrect shoot decision. For police operations low light environments, we believe it may be possible to engineer resilience by changing how officers use flashlights.

Light as a Representation of the Officer

Although we were unable to find any relevant literature on perception or attention, at least one training manual proposes a theory that in low light environments the flashlight represents the officer to a suspect (Advanced Law Enforcement Rapid Response Training (ALERRT), 2013). They posit that because the suspect can see the flashlight and knows that it is being held by a person, but often cannot see the person, that the suspect treats the flashlight as if it is the person. That is, in dark or low light environments, the officer's flashlight is frequently the only visual indicator of the officer's location, and suspects are likely to react quickly based on the limited information that is available to them. Simply put, suspects may perceive the light as a visual representation of the officer, culminating in shots fired directly at the light.

A. Dagger Technique B. Neck Index Technique C. Harries Technique

Figure 1. Three most common light position techniques.

If suspects behave in this manner, officers can use this information to their advantage to engineer resilience. This assumption underlies flashlight techniques that introduce physical distance between the flashlight position and an officer's body (e.g., the dagger technique, described below). The idea is that by extending the flashlight outward, farther from the body, an officer may be able to draw gunfire away from center mass, in turn, reducing the ability of a suspect to shoot the officer. Our hypothesis is:

H1: Flashlight techniques that place the flashlight away from the officer's body will reduce suspect accuracy.

Flashlight Techniques Commonly Used in Law Enforcement Training

Dagger Technique

The dagger technique, often referred to as the FBI method, is a one-handed technique that has been used to train first responders for at least several decades (see A in Figure 1). Some discount this technique as outmoded and impractical (e.g., Jones, 2002), yet others argue for its potential to misdirect suspects shooting at an officer (e.g., ALERRT, 2013; Good, 2006). Indeed, the FBI academy currently relies on this method as a searching technique (P. Reid, personal communication, February 10, 2021). The dagger technique is employed by holding the flashlight in an "ice pick" grip and extending the arm above and well away from the body. The lens of the flashlight is held slightly in front of the body to avoid illuminating the officer (Good, 2006).

Neck Index Technique

The neck index technique, sometimes referred to as the Puckett technique, is another common flashlight technique used to train law enforcement officers to search in low light conditions (see B in Figure 1). This method was first described in print in a 1994 magazine article written by Brian Puckett (as cited in Good, 2006). In the article, the method was presented as an alternative to hands-together techniques. Puckett argued that flashlight techniques that require a firm, two-hand hold on the weapon are too complex and unnatural, and advocated for the use of one-handed approaches instead. The neck index technique is employed by holding the flashlight in an "ice pick" grip, elbow bent, with the flashlight hovering directly above the officer's support side shoulder. The light can be used to illuminate weapon sights, allowing officers to align eyes, weapon, and light on a potential threat quickly and easily (ALERRT, 2013). The light is not held in front of the officer's body in this technique, but it is still close to the officer's body. We were uncertain as to whether the displacement would be enough to affect suspect accuracy.

Harries Technique

The Harries technique is perhaps the most popular technique used by first responders (see C in Figure 1). It was developed in the early 1970s by Michael Harries, a combat shooting instructor (Jones, 2002). This technique is employed by holding the flashlight in an "ice pick" grip in the weak hand with the flashlight lens on the opposite side of the thumb. The gun hand is placed over the top of the flashlight hand, with the backs of the hands firmly pressed together. This creates isometric tension between the hands, providing a stable shooting platform (Good, 2006; Jones, 2002). The strengths of this method are that it provides support for the gun hand and aligns the flashlight beam and the barrel of the weapon. A potential downside of this method is that the flashlight is directly aligned with the officer's body (ALERRT, 2013; Good, 2006). In the current study, we predict that suspects will be most accurate when shooting at officers using this technique. Of the three methods presented in this section, the dagger technique has the greatest potential to draw any gunfire away from the officer. As such, we expect that suspect accuracy will be lowest in the dagger technique and the highest in the Harries technique. We turn now to the methodology.

Methodology

Design

The experiment followed a 1×3 design with random assignment to one of three test conditions. The three conditions were the officer holding the light in front of his chest (e.g., Harries style), the officer holding the light by his shoulder (e.g., neck index style), or the officer holding the light out to the side (e.g., dagger style). Participants were randomly assigned to test conditions and remained blind to the experiment throughout the process.

Participants

Participants were recruited from undergraduate criminal justice courses at a large southwestern university. Participants were only told they were playing the role of a murderer attempting to ambush responding police officers in a simulated night situation. We did not offer any incentives. As seen in Table 1 - a total of 236 students participated. Participants were of equal age in all conditions ($f_{(2,\ 230)} = 0.17$, $p = 0.84$). There was no observed difference between conditions in terms of participant sex ($x^2 = 2.36$, $p = 0.67$). One participant did not identify their sex. Additionally, there was no observed difference between conditions in terms of participant race (Fisher's exact: $p = 0.87$). Twelve participants did not provide their race. This sample results in a power of .94 to detect effects of a medium size within the f-distribution (Cohen, 1988,

Table 1. Sample descriptive statistics.

	Harries	Neck Index	Dagger
Age	21.21 (3.43)	21.04 (3.93)	20.88 (2.09)
Sex			
Male	33	36	32
Female	45	43	46
Race			
African American	7	7	5
Asian	3	2	2
Caucasian	24	31	27
Hispanic	40	34	38
Other	2	2	–

Standard deviations are presented in parentheses.

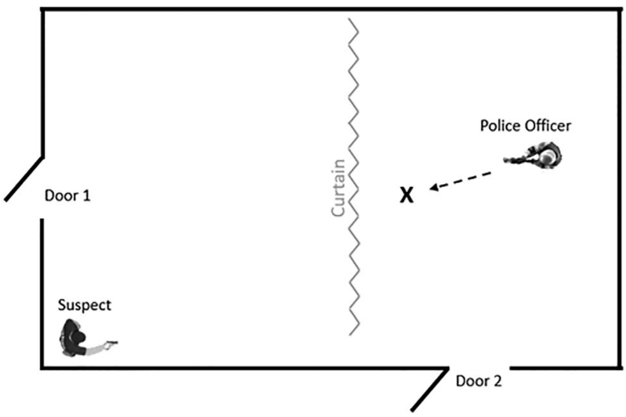

Figure 2. Room layout.

p. 314). Cohen (1988) defines a small effect as $f = 0.10$, a medium effect as $f = 0.25$, and a large effect as $f = 0.40$ (pp. 285–287).

Procedure

Participants began by completing the IRB approved consent form and providing demographic information. Participants were then given instruction on how to operate the Glock 17T Simunition gun. The Glock 17T fires a training projectile filled with brightly colored soap. The projectile breaks on impact and leaves a mark indicating shot placement. Participants each fired a practice shot so the research team could ensure each participant could safely operate the Glock 17T. The lab assistant then took the participants into the experiment room one at a time. The lab assistant and participant entered the room through Door 1 and were placed in the correct position identified by the letter A in Figure 2.

This room was dimly lit with a curtain hiding most of the room. The lab assistant then told the participants that they were playing the role of a suspect who just shot someone and then ran into this room to ambush the police officer that was chasing them. They were told that the lights would be turned all the way off to simulate nighttime, and the curtain would be raised to expose the rest of the room once the lights were turned off. Participants were informed that the police officer would enter the room at some point after the curtain was raised, and they should try to shoot the police officer as soon as possible. They were told the officer would only enter through Door 2.

The lab assistant handed each participant the Glock 17T (armed with a single shot as we were concerned with initial accuracy for this study) only after they acknowledged the procedure. At this point the lab assistant turned the lights off and exited the room through Door 2. Unbeknownst to the participant, the "police officer" (played by a lab assistant or retired police officer) was already in the room behind the curtain (see police officer position in Figure 2). The "police officers" were of similar size and underwent training to ensure consistency in presenting the light. The officer stepped forward to a mark on the floor that was approximately 12 feet away from the participant as soon as the lights were turned off (see X in Figure 2). The lab assistant kept talking while the officer moved to keep the participant from hearing his footsteps. The lab assistant could see the entire room via an infrared camera system, and she raised the curtain once the officer was in position.

The officer activated the flashlight in the position consistent with the randomly assigned experimental condition. In the shoulder condition, the officer held the light just outside his left shoulder at just above shoulder height. In the chest condition, the light was held directly in front of his sternum and about level with the bottom of his ribs. In the arm extended position, the light was held with the officer's left arm fully extended with the light at about the height of the officer's head. The officer turned the light off when the participant fired or after about two seconds if the participant did not fire (we limited this window to about two seconds because a police officer would be able to detect, scan, and react to the suspect in that amount of time). Participants who did not fire were excluded from the analysis. The officer then called a ceasefire, and the participant placed the Glock 17T on the floor. The officer was inspected to see if the marking cartridge hit him, and the participant was thanked for their time and escorted out of the room by the assistant.

Results

Of the 236 participants, 172 (73%) shot at the officer when he activated the light. We suspect that the suspects who did not fire at the officer were attempting to get a better fix on the officer before firing. These participants were roughly evenly distributed across the conditions (59 in the shoulder condition, 54 in the chest condition and 59 in the extended condition). The smaller sample reduced statistical power to 0.84 to detect medium effects, which is still above the established (albeit arbitrary) threshold of 0.80. Furthermore, the samples remained balanced after removing participants that did not fire (Age: $f_{(2,\ 166)} = 0.15$, $p = 0.87$; Sex: $x^2 = 2.64$, $p = 0.62$; Race: Fisher's exact: $p = 0.87$).

Seventy-one percent of the participants in the shoulder condition hit the officer when they shot (see Figure 3). Sixty-seven percent in the chest condition hit the officer, and 46% hit in the arm extended condition. These differences were statistically significant (Fisher's Exact Test = .012) suggesting that participants in the arm extended conditions were less accurate. Thus, our hypothesis was supported. Flashlight

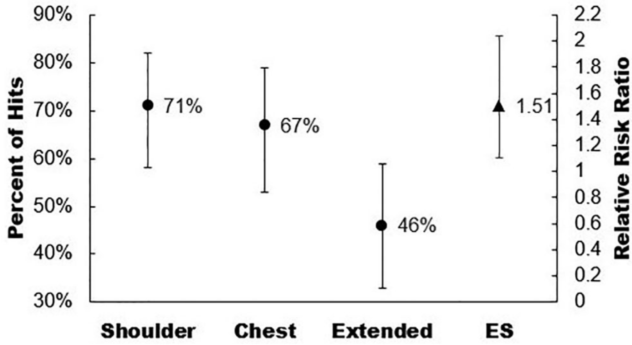

Figure 3. Percent hits by condition. *Note*: Error bars represent the 95% confidence intervals of the accuracy esimates for each condition.

techniques that place the light away from the officer's body reduce suspect accuracy. The differences also suggested a large effect size for the difference in accuracy based upon flashlight position. Collapsing the shoulder and chest conditions and then comparing this collapsed category to the arm extended condition, produces a relative risk ratio of 1.5. Officers in the shoulder and chest conditions were 1.5 times more likely to be hit than officers who extended their arms.

Discussion

Officers who are operating in low light frequently use flashlights to help them see. A variety of techniques for holding the flashlight are taught, but little empirical research has been conducted on the effectiveness of these techniques. In this paper we provided a basic test to assess the effect of light position on the accuracy of suspects shooting at a "police officer" holding a light in one of three positions. We found that when the light was held away from the officer's body (e.g., dagger style), suspect accuracy was substantially reduced. Participants successfully shot the officer in 69% of scenarios when the light was held close to the body and 46% when the light was held away from the officer's body. Participants were 1.5 times more likely to hit the officer when the officer was holding the light closer to his body.

Interpreting our results from a resilience engineering point of view, we began by acknowledging that police officers will sometimes encounter armed suspects in low light environments and that these dangerous situations are (at least sometimes) unavoidable. We then sought ways to improve the ability of officers to respond to these situations. Two general approaches are possible: offensive and defensive.

The offensive approach involves improving the ability of officers to react to and deal with threats more quickly. Research on reaction time suggests that officers are at a reaction time disadvantage when encountering armed suspects (Blair et al., 2011; Blair & Martaindale, 2014). For example, Blair et al. (2011) conducted an experiment where experienced officers had their weapons drawn and sighted at a suspect who was armed and pointing his gun at the ground or at his own head. The officer would give commands to the suspect to put the gun down, in some conditions the suspects complied, in others they attempted to shoot the officers. In the conditions where the suspects attempted to shoot the officers, the officers attempted to fire before the suspect could. Blair et al. found that the officers fired at the same time or later than the suspect in 61% of the exchanges, and the differences in firing times were often less than .1 second. Even in this somewhat ideal test of police reaction time, the officers could not count on firing faster than the suspects. Additionally, recent resilience engineering-based research has suggested that keeping a firearm in a low muzzle position reduces police shooting errors, but this further slows the reaction time of the officers (Taylor, 2021). Given these findings, it appears that officers cannot expect to act first and make correct decisions.

The defensive approach appears more feasible. This approach involves reducing the effectiveness of those attacking the officers so that officers have more time to respond. The flashlight position findings presented here fall within this defensive area. It appears that holding the flashlight in a dagger position reduces suspect accuracy and thus increases the resiliency of the officers.

As with the research reported by Taylor (2021). Enhancing resiliency comes with tradeoffs. In the case of muzzle position, a low muzzle position allows more correct shooting decisions, but also slightly slows the reaction time of the officer. Holding a flashlight dagger style appears to reduce suspect accuracy, but it is also possible that it reduces the accuracy of that officer when returning fire. We did not attempt to address the effect of the flashlight tactics on the accuracy of officers' shooting, and the limited research on officer shooting accuracy (Copay & Charles, 2001; Donahue & Hovarth, 1991; Geller & Scott, 1992; White, 2006) has also not assessed the effects of different flashlight techniques on officers' ability to shoot accurately.

Although the available research has yet to consider accuracy using different flashlight techniques, those familiar with shooting pistols will know that firing a pistol with a single hand is more difficult than using two hands. We suspect that officer accuracy when shooting one handed (as in the neck index and dagger conditions) would be lower than officer accuracy in a more supported position (e.g., Harries). However, we believe that the defensive advantages of holding a flashlight dagger style outweigh the potential offensive disadvantages of firing one handed. If officers cannot expect to fire first, we believe the focus should be on surviving a suspect's first shot. Additionally, officers can transition to a more supported shooting position after the suspect engages.

Our results are also consistent with the practitioner theory that the flashlight represents the officer in lowlight conditions. Clearly, the suspects were firing at the light, and because the officer was offset from the light in the dagger conditions, suspect accuracy was reduced. Training manuals also suggest that the theory of flashlight as person extends to other areas of lowlight operations, such as the direction of the beam representing the gaze of the officer (ALERRT, 2013). Future research should explore whether these other practitioner beliefs are correct.

The test we presented here was a simple design. There are many permutations that can be done to more closely simulate the effect of light position on suspect accuracy under field conditions, but we chose to keep the design simple to avoid potentially confounding our results. This test presents clear evidence that suspects will shoot toward a flashlight in low light conditions, and that if the light is held away from their body, officers are less likely to be shot. Future research can utilize this knowledge to explore how flashlights can best be used in low light situations to improve police resiliency.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Emily D. Spivey is a Doctoral Research Assistant at the ALERRT Center. Through her work at the ALERRT Center, she has facilitated the collection and coding of data as part of largescale projects involving research into active shooters.

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