Ambushes Leading Cause of Officer Fatalities – When Every Second Counts: Analysis of Officer Movement from Trained Ready Tactical Positions

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Abstract

*Recently, the threat of ambush assaults to police officers has dangerously increased. These assaults can occur very rapidly, and to be better prepared to respond, it is important to understand the speed of officer responses and any advantages officers may gain from various tactical techniques. Therefore, the purpose of this study was to understand and examine officer movement times from various finger-indexing positions as well as the speed at which officers can fire their weapons from various starting positions. In the first experiment, officers (*n *= 52) fired their weapons from four trained finger-index positions to measure their time to fire. In the second experiment, officers (*n *= 68) fired their weapons from various starting, or tactically ready, positions to measure the speed of movement to weapon discharge. Results of Part One showed that contrary to training, all indexing positions were similar in time to contact the trigger, except indexing high on the slide. Part Two revealed that point shooting was significantly faster than aimed shooting as well as that the Low-Ready position was the fastest from which to fire, and the High-Guard ready position was the slowest. These results may provide analytical and training implications to improve the safety of officers.*

Introduction

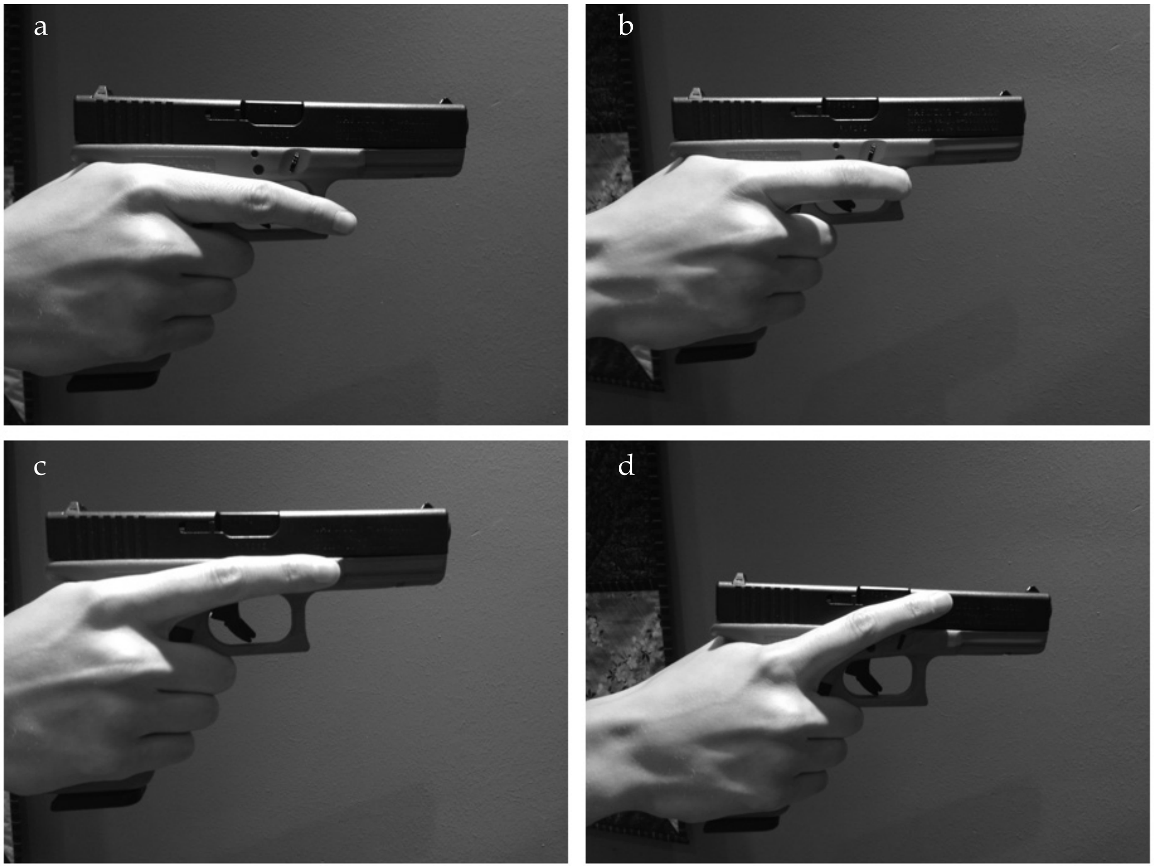
Law enforcement officers are continuously reminded of the risks and dangers they face while working on patrol; however, just recently, the International Association of Chiefs of Police (IACP) (2014) has brought attention to the threat of ambush assaults. An ambush assault is considered to be an attack on an officer that contains the element of surprise, concealment of the assailant, suddenness to the attack, and lack of provocation. From 2003 through 2012, 115 officers were killed and 267 officers were injured as a result of these types of attacks (Federal Bureau of Investigation [FBI], 2014). While ambush assaults may be premeditated, according to Law Enforcement Officers Killed and Assaulted (LEOKA) reports, over 68% of the ambushes that have occurred since 1990 have been spontaneous and unprovoked (FBI, 2014). Additionally, a vast majority (82%) of officers caught in ambush situations were alone at the time. Although in 35% of cases, officers were attacked with an assailant's hands, in over 36% of ambush assaults, officers were attacked with a firearm, greatly increasing their risk of injury or death and rapidly increasing the speed at which the attack occurs (IACP, 2014). Alarmingly, the survival rate for officers caught in an ambush situation is only 46% (IACP, 2014). With such a low survival rate, the threat of officers being hunted and attacked without notice gives one more, of many, reasons to emphasize the need for officers to be tactically ready, aware at all times, and able to effectively respond.

To ensure tactical awareness, officers and law enforcement trainers should understand the rapid speed at which these ambush assaults can occur to be better prepared to respond. Analysis of deadly traffic stops has demonstrated that a suspect in the driver's seat can draw a weapon and fire at an officer in as little as 0.23 seconds (s), with an average time of 0.53 s (Lewinski, Dysterheft, Seefeldt, & Pettitt, 2013). Research examining sprinting mechanics has shown that the average individual, in their early 20s, is able to cover a distance of greater than 15 feet in just over 1 s and slash or stab an officer with an edged weapon (Dysterheft, Lewinski, Seefeldt, & Pettitt, 2013; Lewinski, Hudson, & Dysterheft, 2014). If an individual attacking an officer had their finger on the trigger of a handgun and the handgun aimed, he or she would be able to fire once in 0.06 s (the actual travel time of the trigger to break point) and then fire an additional round in just another approximate quarter of a second (0.28 s) (Lewinski et al., 2014). All the while, an officer faced with a complex decision-making process, comprised of movement pattern recognition and a choice response task, will take an average of anywhere from 0.46 to 0.70 s to begin their response (Lewinski et al., 2014; Ripoll et al., 1995; Vickers, 2007). With the addition of movement time to bring the weapon on target and then time to return fire, unprepared officers are immediately placed at a tactical disadvantage during an assault. As officer survival rates during ambush situations nearly double when officers take cover and are able to return fire (IACP, 2014), it is pertinent that officers be tactically and mentally prepared to respond at the earliest possible moment. Along with tactical movement training, early threat detection and pattern recognition can help to ensure officers stay ahead of the reaction curve.

As previously mentioned, it is known how quickly an officer can fire a handgun once his or her finger is on the trigger and even when he or she is faced with a complex decision from that position (see Lewinski et al., 2014). Unfortunately, one key piece of information that is missing in the analysis of an officer-involved shooting is the amount of time it takes officers to move their weapon from whichever location it may be in to a firing position. While officers are taught numerous ready positions and finger-indexing positions, little to no research has examined the amount of time it takes officers to react and move from them. Therefore, it is unknown what positions may most benefit officers with the quickest responses during deadly use-of-force situations.

The first and seemingly most basic position officers learn during their firearms training is where to index, or place, their finger outside of the trigger well when handling their gun to minimize the risk of unintentional finger movement and accidental discharge. It is theorized by law enforcement officers that placement of the index finger on the handgun has a direct influence on finger movement time and then the speed of trigger pull completion or weapon discharge time (DT). The DT of a trigger pull is considered to be the time from the initial movement of the index finger, from its safe position outside of the trigger well, to the time when the trigger is pulled completely, resulting in weapon discharge (Lewinski, 2003). Based off of author experience and observation of law enforcement firearms training, there are four finger indexing positions that are predominantly taught and practiced by officers: (1) the index finger is placed straight ahead, resting on the trigger guard; (2) the index finger is placed straight ahead, the same as position a, however, the finger has a slight bend, resembling a c-curve; (3) the trigger finger is placed with the tip of the finger on the frame of the weapon; and (4) the trigger finger is placed resting with the tip of the finger on the slide of the weapon (see Figures 1a-d). While it is argued by some law enforcement professionals that positions a and b are considerably faster for shooting, it is speculated that the risk of unintentional discharge may be greatly increased (Enoka, 2003; Heim et al., 2006). However, it

Figure 1. Commonly Trained Finger Indexing Positions

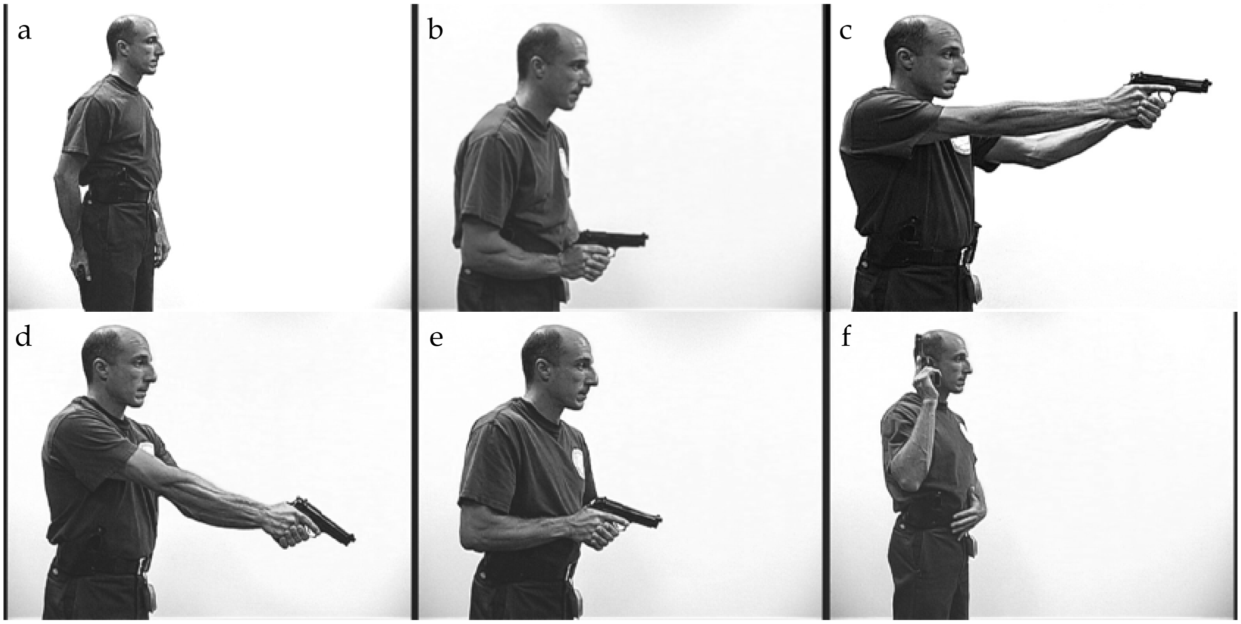


From upper left to lower right: (a) finger-indexed straight ahead, (b) finger-indexed straight ahead with c-curve, (c) finger-indexed on frame, and (d) finger-indexed on slide

is still unknown whether any difference exists between each position and if positions a or b have any significant benefit of speed.

The position officers take when approaching a potentially threatening situation is one of the most arguably influential aspects to the speed of their reaction and their ability to defend themselves. According to Adams, McTernan, and Remsberg (2009), officers should draw their weapon if they have reason to believe a deadly force situation may occur as it is implied that drawing from a holster is likely to take the longest time of any of the reactions officers could have. Once their weapon is drawn out of the holster, officers are trained to take any one of numerous ready positions to tactically prepare for a possible deadly threat. Some positions, such as the Bootleg position (Figure 2a), slightly conceal the weapon from the suspect; while others, such as the Belt Tuck position (Figure 2b), allow officers to have their weapons directly in front of them and ready for a possible deadly encounter (Remsberg, 2001). Additional positions in which officers hold their firearms in front of them at the ready are the High-Ready, Low-Ready, and Sul (Figures 2c-e) positions (Taubert, 2012). Officers are most commonly trained to use these positions as they are considered to be some of the safest and tactically ready positions to take when entering a threatening situation (Remsberg, 2001). It should be noted that not all departments train or endorse the use of all of the positions studied.

Figure 2. Handgun Tactical Ready Positions



From upper left to lower right: (a) Bootleg, (b) Belt Tuck, (c) High-Ready, (d) Low-Ready, (e) Close-Ready/Sul, and (f) High-Guard

While not widely practiced in the U.S., but frequently seen, the High-Guard position (Figure 2f), commonly used by Hollywood to depict officers approaching threatening situations or doing building searches, is trained and used in the United Kingdom. The High-Guard position is generally used as a safer position than High- or Low-Ready when officers are surrounded by others, such as in a crowd situation, in order to prevent unintentional or accidental discharges and ricochets. It can be a very fast and accurate position from which to shoot. However, as it is unpracticed in North America, it is believed that an officer's movement from this position is very awkward, relatively slow, and likely inaccurate. In North America, there is also a stated concern that a High-Guard position may result in unintended discharges upward into multi-story buildings.

While handguns are the most commonly used firearms by officers, a growing number of departments have considered increasing the use of rifles by their patrol officers (IACP National Law Enforcement Policy Center Board, 2007). The primary reason for this shift is that officers are being outgunned by deadly assailants, and the officer's traditional sidearm does not match the firepower of a rifle or the myriad of other more powerful weapons with which officers are confronted. With the increasing use of rifles and shotguns by officers, along with the growing number of long barrel firearm assaults on officers, it is important to start investigating the movement and timing differences while using these weapons (for more information on rifle use in law enforcement, see IACP National Law Enforcement Policy Center Board, 2007; see Figures 3a-c for shotgun positions).

In addition to ready positions, to improve officer response time even more, some law enforcement training experts also suggest that when in deadly, close quarters combat, officers should use a variation of instinct, or point, shooting relying on a visual fixation if possible and then kinesthetic alignment or pointing (Adams et al., 2009; Applegate & Janich, 1998; Conti, 2006, Vickers & Lewinski, 2012). When using instinct shooting, officers align their

Figure 3. Shotgun Tactical Ready Positions

From upper left to lower right: (a) Port, (b) High-Ready/Modified Port, and (c) Low-Ready

gaze and often their body to point the muzzle of their gun in the direction of the target and fire without using traditional aiming or reference to the sights of the weapon. Although some may argue against this technique, previous literature on officer shooting ability and gaze patterns have observed that average officers may spend too much time focusing on their sights rather than their target, particularly in close and fast-moving encounters, thus compromising speed and even shooting accuracy (for more information, see Lewinski et al., in review; Vickers & Lewinski, 2012).

While all of the aforementioned positions offer an advantage in various situations, it is still unknown whether some might allow officers to move and respond faster during a deadly force situation. It is generally hypothesized that positions in which an officer's gun is held closer to the final firing position will result in much quicker responses; however, the degree to which these positions are faster is still unknown. In general, understanding all of the motor components of an officer's response, including the finger-indexing and ready positions that offer officers the quickest reactions and best responses, are necessary to help better train and prepare officers for unanticipated attacks. Therefore, the purpose of this study was twofold: (1) to examine the average amount of time it takes officers to fire their weapons, beginning from various finger-indexing positions; and (2) the speed of movement from commonly trained starting positions to weapon discharge. These two types of movement times were examined to determine and better understand officer movement during high-risk situations. Additionally, in order to address the growth of long barrel firearms use in officers, a small pilot sample investigating shotgun movement times was also examined.

Methods: Part One

Participants

An original sample of 52 participants (94% male) from a participating national government law enforcement agency volunteered for the study. Participants were recruited through information distributed by their supervisors, and they responded anonymously to the testing site during their arranged firearms training session, as well as individually on personal time. All participants were told that the purpose of the study was to "better understand trigger finger placement and the influence of that on time to fire a weapon." All participants completed informed consent waivers and demographic data information forms before beginning any trials.

Equipment

All data collection took place at the participating government law enforcement agency's firing range. The participants used their own service pistols; therefore, no practice for acclimation to the testing weapon used was needed. The following weapon models were used during testing: 9 mm Beretta (n = 1), .45 caliber Colt (n = 1), .40 and .45 caliber Glock (n = 40), .40 and .45 caliber SIG Sauer (n = 11), and .45 caliber Springfield 1911 (n = 1). For digital movement analysis, the trials were video-recorded using high-speed digital cameras (Cannon Powershot s120, Cannon U.S.A., Melville, NY, USA), filmed at a rate of 120 Hz. The cameras were positioned on a tripod at weapon height and located on the participant's dominant hand side to record all trigger finger movement. Participant videos were digitized on a frame-by-frame basis using commercial digital analysis software (*Dartfish Prosuite 6.0*, Dartfish, Alpharetta, GA, USA). For data analysis, the time for the initial movement of the trigger finger to the time of contact with the trigger, as well as the time the weapon was fired, was recorded.

Procedures

To examine movement action time, the four previously discussed finger-indexed positions were chosen for testing: (1) straight ahead on trigger guard, (2) straight ahead on trigger guard but with a c-curve, (3) at a slight 15° angle on the frame, and (4) at about a 30° angle placed on the slide (see Figures 1a-d). These finger-indexing positions were chosen based on the current methods used for training purposes by law enforcement and military firearms instructors.

Prior to arriving at the range facility, all officers were instructed to bring their service weapons. A participating researcher instructed all officers on the procedure prior to testing. Participants were told they would be completing a total of four trials, each beginning from a different finger-indexing position, and they would fire their weapon three times from each position for a total of 12 rounds fired overall. Prior to testing, all finger-indexing positions were described and demonstrated for the participant. Once participants were cleared to enter the range, following their regulation range protocol, they were instructed to approach the firing line with their service weapons and four magazines.

After the range supervisor declared the range hot, as instructed, participants drew their weapons, inserted a magazine, and charged the weapons while in their natural firing stance. With the weapon pointed downrange, participants were asked to take the first of the randomized physical finger-indexed positions as demonstrated by the researcher. Participants were then instructed that they would fire a total of three rounds beginning from this indexing position, pausing at least 5 s between each round to ensure proper indexing. The researcher gave participants a signal when they were allowed to fire the next round. Therefore, all of the movements studied in Part One of this study were self-initiated, and the time recorded reflects only movement time and not reaction and motor movement time.

Although officers were not required to respond immediately after the signal, they were instructed by the researcher that they were required to complete the trigger pull as quickly as possible, without focusing on weapon aim or accuracy. After completing the first trial, the researcher instructed and demonstrated the remaining three finger-indexed positions for participants to complete in a randomized order. Upon completion of all four finger-indexing trials, participants were asked to clear their weapons and were taken off the range by the range supervisor. Once off the range, participants were allowed to ask questions pertaining to the study and given researcher contact information.

Data Analysis

Due to the observational nature of the study, only descriptive and comparative statistical analyses were performed on the variables. The dependent variables measured for analysis were the movement action times for participants both (1) making contact with the trigger (Contact Time) and (2) DT for each of the defined finger-indexed positions. Both variables were measured from the first initiation of movement observed in the trigger finger. During video analysis, a fifth position was added for analysis, based on officer positioning during testing (position e). This position includes the index finger held low on the trigger guard at a downward angle. Data (25%) was analyzed for inter-rater reliability for DT time using intraclass correlation coefficient (ICC) and coefficient of variations (CV) (Hopkins, 2000). Additionally, all variances in Contact Time and Fire Time between finger safety positions were analyzed using an ANOVA with repeated measures and Bonferroni-adjusted post-hoc testing.

During data analysis, a discrepancy in performance effort and techniques was observed. Although researchers emphasized that participants should fire as quickly as possible and shoot without aiming, some participants, likely due to habit, moved cautiously and took the time to aim their weapons or keep their weapons aligned downrange. Therefore, officers were divided into two groups: (1) No Aim and (2) Aim. Participants in the No Aim group had no pause in their movement and moved as quickly as possible; whereas participants in the Aim group distinctively aimed, paused, or chose to perform movements very slowly for precision. An independent samples *t*-test was used to compare the results of these groups for both Contact Time and Fire Time. As a result of the number of participants who aimed, Contact Time was used for primary analysis for the various finger-indexing positions. The criterion to reject the null hypothesis was $p < 0.05$. All descriptive statistics for both study parts are reported as mean (M) ± standard deviation (SD), and change is reported as Δ.

Methods: Part Two

Participants

An original sample of 68 participants (95% male) from a large metropolitan police department participated in the study. Participants were recruited through information provided to their department and supervisors and responded randomly to researchers to schedule testing times either while on duty, with permission from supervisors, or when off-duty. Upon arrival, participants were informed that the purpose of the study was to "better understand and examine the speed of movement and how quickly officers can fire their weapon from various starting positions." All participants completed informed consent waivers and were informed of all details of the study prior to testing.

Equipment

All data collection took place at the department's training facility. Targets used for testing were provided by the facility. Participants used their own service pistol (9 mm Beretta [n = 30] and .45 caliber Smith and Wesson [n = 38]); therefore, no practice was needed for acclimation to a testing weapon. Of the 68 officers tested, nine also had Remington 870 shotguns and, therefore, were measured for movement times from the various shotgun ready positions. Participants were asked to use their own weapon holster for testing to prevent the need to practice. This also ensured participants could move as quickly as possible without needing to adjust to an unfamiliar new holster type or fit, which may have had slower movement times and biased the data.

A PACT shot timer was used to signal participants to begin movement, as well as to record time to fire (Club Timer, PACT Inc., Grand Prairie, TX, USA). A PACT shot timer creates an auditory stimulus, most often a loud beep or buzz sound, which signals the shooter to fire. As the shooter fires his or her weapon, the vibration caused by the weapon discharge triggers an internal diaphragm, which then timestamps the discharge time accurately to within 0.01 s. The PACT shot timer is able to record the times for three rounds fired after the auditory stimulus. These times were recorded by researchers in a separate format immediately following each trial.

Because the officers were reacting to the simple auditory stimulus of the PACT timer, all of the times recorded for Part Two of this study are inclusive of both a motor movement time and an auditory reaction time. For reference purposes only, an average reaction time to an auditory cue is just under 0.20 s (Vickers, 2007).

Procedures

All officers reported to the designated testing site at the training facility for their scheduled testing time. One researcher greeted and took all officers through the study procedure, allowing them to use their own guns and holsters for testing. Officers were informed they would be performing a number of trials, discharging their weapon at a target, beginning from various positions, in reaction to a PACT shot timer.

Once participants were cleared to enter the range, a researcher instructed them to stand at a line 4.5 meters from a target placed directly ahead of them. Officers were randomly assigned to randomly complete 10 of the 20 shooting tasks below. A researcher guided officers through each position and demonstrated the movement (if necessary). These tasks included the following:

1. Point shooting, from Weapon on Target, Finger Indexed on Frame position
2. Point shooting, from Weapon on Target, Finger on Trigger position
3. Firing a three round burst, sighted, from Weapon on Target, Finger Indexed on Frame position
4. Firing a three round burst, sighted, from Weapon on Target, Finger on Trigger position
5. Drawing weapon from holster snapped (if applicable), raising weapon, sighting, and firing
6. Drawing weapon from holster unsnapped (if applicable), raising weapon, sighting, and firing
7. Drawing weapon from holster snapped (if applicable), raising weapon into Close-Contact/Combat Tuck position, and firing
8. Beginning in Low-Ready position with finger on frame, raising weapon, sighting, and firing
9. Beginning in Low-Ready position with finger on frame, raising weapon, and point shooting
10. Beginning in High-Ready position with finger on frame, raising weapon, sighting, and firing
11. Beginning in Close-Ready position with finger on frame, raising weapon, sighting, and firing
12. Beginning in Close-Ready position with finger on frame, raising weapon, and point shooting
13. Beginning in Belt-Tuck position with finger on frame, raising weapon, sighting, and firing
14. Beginning in High-Guard position with finger on frame, lowering weapon, sighting, and firing
15. Beginning in High-Guard position with finger on frame, lowering weapon, and point shooting
16. Beginning in Bootleg position with finger on frame, raising weapon, sighting, and firing
17. Beginning in Bootleg position with finger on frame, raising weapon into Close-Contact/Combat Tuck position, and firing

(Shotgun Pilot Research)

18. Beginning in Port position, bringing shotgun down, sighting, and firing (if applicable)

19. Beginning in Low-Ready position, bringing shotgun up, sighting, and firing (if applicable)
20. Beginning in High-Ready position, bringing shotgun down, sighting, and firing (if applicable)

Participants were instructed to complete each task as quickly as possible in reaction to the PACT timer's signal. Researchers reminded participants they should not take the time to focus on aiming or accuracy but should generally get a glimpse of their front sight on the target and fire as rapidly as possible. Only participants who had an on-duty shotgun were tested for the Port, Low-Ready, and High-Ready shotgun tasks. Once participants had completed each task, they were asked to reload their weapons, if necessary, and given instructions on the next task. After all of the tasks were completed, the participants were asked to clear their weapons and were escorted from the firing range.

Data Analysis

The primary values measured in Part Two of the study were times to react and complete all of the aforementioned movement tasks (1 to 17 in "Procedures" in the "Methods: Part Two" section). Comparative analysis was performed on similar movement tasks to examine whether significant variance occurred. A one-way ANOVA with Bonferroni adjusted post-hoc testing was used to compare movement times for the Weapon on Target positions (Indexed Finger vs. Finger on Trigger, both for the single and three shots fired). To examine the effects of aim vs. point shooting from the weapon in High-Guard, Close-Ready, and Low-Ready positions on shooting time, a two-way ANOVA was used with Bonferroni adjusted post-hoc testing. Finally, a paired *t*-test was used to compare movement times from the Bootleg position, into sighted firing, and into firing from the Combat Tuck position. Due to the small number of officers who were tested using shotguns, no comparative analysis was performed between the positions. The criterion to reject the null hypothesis was $p < 0.05$. All descriptive statistics for both study parts are reported as mean (M) ± standard deviation (SD) and change is reported as Δ.

Results

Part One

Inter-rater reliability for the analysis of DT for 25% of each indexing position was extremely high (ICC = 0.96 and coefficient of variation = 2.05%). All descriptive statistics are reported in Table 1. For Trigger Contact Time, participants in the Aim group (0.22 ± 0.12 s) were significantly slower than those in the No Aim group (0.11 ± 0.06 s) ($p < 0.01$). Likewise, participants in the Aim group (0.55 ± 0.23 s) were significantly slower to weapon discharge than those in the No Aim group (0.20 ± 0.08 s) ($p < 0.01$). Results from the one-way ANOVA demonstrated there was heterogeneity of variances as assessed by Levene's test ($p = 0.01$). There was a significant effect of finger position on Fire Time, Welch's $F(4, 82.12) = 7.92$, $p < 0.01$, and Contact Time, Welch's $F(4, 47.94) = 7.83$. Results of the Games-Howell post-hoc analysis indicated position d, or high on the slide, was significantly slower for Contact Time than positions a ($p < 0.01$), b ($p < 0.05$), and c ($p < 0.05$). No other significant main effects for finger-indexing positions were found.

Part Two

All descriptive statistics are reported in Table 2. In the repeated measures ANOVA, Mauchly's test of sphericity indicated that the assumption of sphericity had been violated, $X^2(2) = 65.43$, $p < 0.01$. Epsilon (ε) was used ($\varepsilon = 0.74$), as calculated according to Greenhouse and Geisser (1959), to correct the repeated measures ANOVA. Results of the repeated measures ANOVA demonstrated significant changes in movement time from position, $F(2.22, 150.67) = 42.43$, $p < 0.01$. From the Weapon on Target position, indexing on the frame was significantly slower ($p < 0.01$) than indexing on the trigger. Starting

Table 1. Finger-Index Position Results for Contact and Fire Time

Group	Position	Contact Time	Fire Time
No Aim			
	A	0.10 (0.06)	0.18 (0.07)
	B	0.08 (0.05)	0.17 (0.08)
	C	0.12 (0.05)	0.19 (0.07)
	D	0.15 (0.05)*	0.25 (0.09)
	E	0.12 (0.09)	0.25 (0.11)
	Average	0.11 (0.06)	0.20 (0.08)
Aim			
	A	0.20 (0.08)	0.50 (0.17)
	B	0.18 (0.06)	0.47 (0.14)
	C	0.27 (0.12)	0.61 (0.27)
	D	0.23 (0.09)*	0.57 (0.26)
	E	0.10 (0.01)	0.60 (0.27)
	Average	0.22 (0.12)	0.55 (0.23)
Overall			
	A	0.13 (0.08)	0.30 (0.19)
	B	0.11 (0.07)	0.26 (0.17)
	C	0.16 (0.10)	0.32 (0.25)
	D	0.19 (0.09)*	0.42 (0.25)
	E	0.12 (0.08)	0.39 (0.25)
	Average	0.15 (0.09)	0.33 (0.23)

* $p < 0.05$

Table 2. Movement Time Results for Tactical Ready Positions

Handgun Position	Mean (SD)	Max	Min
(1) Weapon on Target, Indexed Finger	0.51 (0.15)	1.36	0.25
(2) Weapon on Target, Finger on Trigger	0.37 (0.09)**	0.96	0.20
(3) Weapon on Target, Indexed Finger, 3 Round Burst	0.44 (0.15)	1.43	0.15
(4) Weapon on Target, Finger on Trigger, 3 Round Burst	0.38 (0.13)*	1.24	0.10
(5) Weapon in Holster, Snapped	1.82 (0.31)	2.93	1.29
(6) Weapon in Holster, Unsnapped	1.68 (0.27)**	2.61	1.17
(7) Weapon in Holster into Combat Tuck	1.44 (0.31)**	2.77	0.73
(8) Low-Ready, Indexed Finger, Aim	0.97 (0.19)	1.71	0.50
(9) Low-Ready, Indexed Finger, Point	0.64 (0.10)**	1.02	0.42
(10) High Ready, Aim	0.83 (0.20)	1.46	0.44
(11) Close Ready, Aim	1.03 (0.20)	1.72	0.64
(12) Close Ready, Point	0.74 (0.11)**	0.87	0.52
(13) Belt Tuck, Aim	1.02 (0.21)	1.75	0.68
(14) Weapon in High-Guard, Aim	1.13 (0.23)	2.22	0.62
(15) Weapon in High-Guard, Point	0.73 (0.12)**	1.07	0.49
(16) Weapon in Bootleg, Aim	1.32 (0.20)	1.88	0.87
(17) Weapon in Bootleg, Combat Tuck	0.93 (0.19)**	1.54	0.55
Shotgun Position	**Mean (SD)**	**Max**	**Min**
(18) Port	1.28 (0.48)	2.88	0.79
(19) Low-Ready	0.99 (0.20)	1.35	0.63
(20) High-Ready/Modified Port	0.84 (0.17)	1.15	0.65

*$p < 0.05$
**$p < 0.01$

from the Weapon in Holster position and drawing into a Combat Tuck position was significantly faster ($p < 0.01$) than aiming after drawing from both a snapped and unsnapped holster. Drawing from an unsnapped holster was also significantly faster than drawing from a snapped holster ($p < 0.01$).

Results from the two-way ANOVA demonstrated there was a significant effect of position, $F(2, 247) = 20.48$, $p < 0.01$, and aiming, $F(1, 247) = 46.58$, $p < 0.01$. For the Weapon on Target (both single and three shots fired), Low-Ready, Close-Ready, and Weapon in High-Guard starting positions, point shooting was significantly faster ($p < 0.01$) than aiming down the sights. The High-Guard position was the slowest to fire from ($p < 0.01$), and the Low-Ready position was the fastest ($p < 0.01$). When participants began in the Bootleg position, firing from the Combat Tuck position was significantly faster ($p < 0.01$) than raising the weapon to eye level and firing after acquiring a sight alignment.

Discussion

The primary purpose of this study was to understand and examine movement speed from various holster types and finger-indexing positions, as well as how quickly an officer can fire his or her weapon from various starting positions. By better understanding the influence of these factors on the speed at which officers can fire their weapons, officers and law enforcement trainers may be able to improve rapid response techniques to deadly force situations.

The results from Part One of the study demonstrated two important concepts. The first is that, contrary to what many officers are commonly taught, there is no significant difference in contact time found between the finger-indexing positions, except for position d. When indexing their finger high on the slide, officers were roughly 0.08 s slower to making contact with the trigger and over 0.10 s slower to fire than all other positions, except position e, low on the trigger guard. While many law enforcement officers argue that indexing the finger on the trigger guard, curved or straight, is faster than on the frame, the difference in mean time to trigger contact in comparison to the other positions (a, b, c, and e) is less than 0.04 s. Therefore, when training officers in which finger-indexing positions to use, it might be more important to consider implications of grasping reflexes, unintentional discharges, and effects of maintaining weapon alignment. It is highly suggested that further investigation into finger-indexing placement and possible risk of unintentional discharge take place.

The second important concept demonstrated by these results is the average time experts might expect officers to take to make contact with the trigger and fire. Because positions a, b, c, and e were all very similar in contact and fire time, it should be generally accepted during analysis that movement time to contact with the trigger, from any of the faster positions (a, b, c, and e) will be an overall average of 0.13 s. Additionally, an overall average for officers with their finger indexed from any of the faster positions and who quickly aim or not are likely to fire their weapon in 0.32 s. If officers move as quickly as possible, this average time is decreased to 0.11 s to contact time and 0.20 s to DT, respectively. These values are supported by previous literature examining the time to trigger pull completion from trigger contact to weapon fire (Lewinski et al., 2014).

One of the primary findings of Part Two was the average amount of time it takes officers to move from various ready positions using both a handgun and a shotgun. With the use of previously measured data, the movement times collected in this study can help to create a timeline of events from the time a stimulus is presented, such as a suspect drawing a weapon, to the anticipated time of response based on an officer's positioning. As demonstrated in Table 2, officers beginning from some of the most recommended ready positions of Low-Ready, Close-Ready, and High-Ready, may take anywhere from less than 0.50 s to over 1.70 s to fire their weapon. Without aiming, officers moving from the Low-Ready position were fastest overall, firing in an average time of 0.64 s. For tactical positions involving aiming, the High-Ready position was the quickest to fire from at 0.83 s. Other, less recommended and perhaps not endorsed by departments, but still highly used, positions, such as the Bootleg (aim: 1.32 ± 0.20 s) and the High-Guard positions (aim: 1.13 ± 0.23 s), were similar in firing speed. While the High-Guard position is very similar to High-Ready, the large movement speed difference is likely due to the lack of practice of the position in the U.S. Further research examining this position movement time in officers from the UK may shed more light on this variance and the effects of practice on position speed.

Similarly, results of the pilot data from the shotgun trial demonstrate that officers were fastest when firing from the High-Ready or Modified Port position. Contrary to what researchers had expected, the fire time from each of the shotgun positions was very close to handgun times. Some of the fastest officers firing with a shotgun were able to fire in just over 0.60 s from the Low-Ready and High-Ready positions (averages of 0.99 ± 0.20 s and 0.84 ± 0.17 s, respectively), and as quickly as 0.79 s from the Port position (1.28 ± 0.48 s). Unfortunately, some officers took well over 1.0 s to fire from each of the shotgun positions, leaving far too much opportunity for an assailant to attack. As with any skill, regular, high amounts of repetition in practice at high speeds will greatly benefit officers in reaction and moving as quickly as possible. With the rise of assailant use of long barrel weapons, it is highly recommended that officers who intend to use rifles or shotguns while on patrol regularly practice each ready position and how they would move with speed to an accurately aimed discharge. With the immense threat posed by assault rifles used against officers, minimal practice and slower response times are likely to only result in severe injury or death to the officer. Further research is necessary to better understand and improve officer training with long barrel firearms, particularly their use in tactical situations such as an active assailant situation.

Not surprisingly, officers using point or instinct shooting were significantly faster in firing from each position ($p < 0.01$ for all positions). As supported by the results of Part One of the study, point shooting was observed to save officers over 0.30 s from each position used in the comparison. This type of shooting can be effective at distances of 6.5 meters or less and, with regular practice, up to 20 meters or more (Applegate & Janich, 1998). In a close-range confrontation, an officer taking the time to align and acquire their sights will only delay their response time, lessening their ability to neutralize a threat and increasing their risk of injury or death. Similar research supports this, finding that law enforcement officers who use a point shooting technique of driving their weapon through their line of gaze instead of fixing their focus on their sights have increased levels of speed and accuracy when shooting (Vickers & Lewinski, 2012), particularly at an intermediate distance of conflict.

Another outcome anticipated by researchers was that individuals drawing from an unsnapped holster were significantly faster than those drawing from a snapped holster (1.68 ± 0.27 s vs. 1.82 ± 0.31 s). Although these data demonstrate a benefit of officers unsnapping their holster while approaching a threatening situation, researchers observed that many officers who had frequently practiced drawing quickly from their holsters were actually slower and less accurate in their movements when grasping their weapon from an unsnapped holster. When the holster was unsnapped, each officer's weapon became slightly unstable within the holster, and thus, as officers went in to grasp their weapon, they needed to adjust their grip in order to comfortably and automatically draw. This was noted as a large disadvantage as officers often rely on a familiar hand position and automatic motor programs to quickly and effectively draw and fire their weapons.

Additionally, the adjustment that took place for this instability and the conscious attentional focus on the draw lengthened the time it took officers to fire their weapons.

It is recommended that future research examine drawing times from unsnapped and snapped holsters while officers maintain a hold on their weapon while it is in the holster in addition to the influence of other forms of weapon retention and levels of retention in police holsters. In this study, all holsters used by officers had one or more forms of active restraints, resulting in discharge times, in reaction to simple stimuli with no additional movements, of well over 1.5 s. However, the holster type and the frequency with which an officer practices drawing rapidly may play a large role in the time it takes officers to return fire. In a recent study of officer responses to threatening traffic stop situations, officers were required to respond to complex stimuli, retreat from a deadly threat, and, either simultaneously to or after retreat, draw their weapons and return fire (Lewinski et al., 2013). It was observed by researchers that some officers (n = 10) who were using more modern, level two thermoplastic holsters were able to perform all of the aforementioned movements and return fire in an average of 1.21 s (Lewinski et al., 2013). Some officers were able to go from grasping the weapon in the holster to discharging in a time of 0.75 s. As officers using the modern holsters were able to fire their weapon during a high stress situation in over 0.30 s less time than traditional holsters using active restraints, further investigation into training and holster type is highly recommended to determine possible speed and retention benefits of thermoplastic holsters.

Limitations

As the current study was one of the first investigative studies of its kind, there are limitations that exist in the research. The largest limitation was that not all tests were performed in Part Two due to time constraints within the participating officers' schedules. Additionally, only one police department was tested for this research in Part Two. While the experience and specific training offered by that department may have influenced the abilities of officers, follow-up investigation with multiple departments may be used to aid in the verification of the results of this study. The lack of information on shooting accuracy in correlation to movement times and information on draw times from specific holsters are also limitations; further research and investigation can be done to examine these components. Future studies could also expand upon the long barrel firearm data by investigating differences in weapon type, training, and officer performance.

Implications

Overall, the values observed in this study are key components in better understanding the total response time of officers during a highly stressful, and possibly life threatening, situation such as an ambush. These times not only help to break down and analyze officer response times, but also demonstrate how quickly a deadly situation can unfold. Most significantly, this research emphasizes the drastic need for officers to be prepared to respond as quickly as possible to potentially deadly situations such as ambush assaults. Some tactical ready positions allow on average for faster response times for officers; however, it is highly recommended that officers train from the positions that are most comfortable and quickest for them. Additionally, it is recognized that the positions which are most practiced by officers will result in the quickest reaction time; therefore, the positions found to be the most tactically advantageous in this study should be practiced and trained with as often as possible to give officers the ability to rapidly respond and to increase their chances of safety and survival.

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