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Reasonableness and Reaction Time

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Abstract

When the police use deadly force, their actions are judged by the reasonableness standard. This article seeks to inform the reasonableness standard by examining the ability of police officers to respond to armed suspects. The results of a reaction time experiment are presented. In this experiment, police officers encountered a suspect armed with a gun, pointing down and not at the police officer. The police officer had his gun aimed at the suspect and ordered the suspect to drop the gun. The suspect then either surrendered or attempted to shoot the officer. The speed with which the officer fired if the suspect chose to shoot was assessed. Results suggest that the officers were generally not able to fire before the suspect. Implications for the reasonableness standard and policy are discussed.

Keywords

use of force, shootings, reaction times, reasonableness standard

A police officer in uniform and on patrol encounters a man with a gun. They are facing each other at a distance of about 10 feet. The suspect has his gun pointed down at his side. The police officer draws her gun, aims at the suspect, and orders him to put his gun down. The suspect does not comply, but does not take any overtly hostile action. The police officer orders the suspect to drop the gun a second time. Again, the suspect does not comply. The police officer shoots and kills the suspect.

Was the shooting legally justified? Police officers occasionally deal with situations where they confront a suspect armed with a gun. If the suspect does not comply with

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an order to put the gun down, should the officer shoot? Consider a case that occurred in Conroe, Texas in April of 2011. Police officers responded to a call of a man with a shotgun at a strip mall. A sergeant arrived, took cover behind his car door, and ordered the suspect multiple times to put his gun down. The suspect did not comply and, after repeated commands to put the gun down, shot the officer.[1] The officer lost his eye but will live. If the officer had fired at this suspect, some would no doubt have criticized the action, arguing it was unreasonable given the fact that the man had not fired his weapon at the officer. What is a reasonable response to a suspect who will not put his gun down? Should the police officer choose to use deadly force, her or his actions will be judged using the legal standard of reasonableness. If the officer's actions are found to be unreasonable, he or she can face civil or criminal sanctions.

Because officers' actions are judged by the standard of reasonableness, it is important to identify factors that should inform such a judgment. This article examines the reasonableness standard by testing the ability of police officers to react to armed suspects. A study was conducted to determine whether or not a police officer with his gun out and pointed at a suspect, who does not have her gun pointed at the officer, can fire before the suspect. If the police officer can react faster than the person who initiates the shooting, then it would be unreasonable for the officer to fire on a suspect who has a weapon but does not begin to use it. However, if facts indicate that the "reactor" is at a disadvantage, even if his gun is drawn and aimed, then it would not be reasonable to expect the officer to wait and react to a suspect-initiated move because to do so may end in the officer's injury or death. First, the literature on use of force, reasonableness, and reaction time will be reviewed. Next, the methodology will be presented and the results will be appraised and discussed. Finally, policy implications will be discussed.

Use of Lethal Force

The use of force by police is rare; reports indicate that force is used in only 1.6% of all citizen–police interactions (Ducrose, Smith, & Langan, 2007, p. 1). Police shootings, in particular, are exceedingly rare, with some reports indicating that statistically, a police officer in New York City would have to work an average of 694 years to shoot and kill someone, and in other cities, the likelihood is so remote that the number of years would be much higher (Geller & Scott, 1992). Unfortunately, we have no national database to keep track of these numbers (Butterfield, 2001). The FBI does keep track of justifiable homicides by police officers, but this number does not include nonlethal shootings, or shootings that are ruled as other than justifiable homicide. For close to 40 years, the number of justifiable homicides by police has remained in the 300-450 range despite large increases in the national population and large increases in the number of police officers. In the 1970s, justifiable homicides ranged in the 400s, dropped to the 300s in the 1980s, and rose again to 450 in 1993. In the 2000s, justifiable homicides ranged from 347 to 398. In 2009, 406 individuals were justifiably killed by police (FBI, 2003-2010; Loftin, Wiersema, McDowall, & Dobrin, 2003).

Interestingly, there is not much research on firearms training in law enforcement. There are more than 14,000 law enforcement agencies and no standardization of firearms training, although CALEA offers model standards. State guidelines generally mandate a number of hours of instruction on a topic and give some limited curriculum, but the curriculum tends to be very general. Firearms training for recruits may still consist solely of traditional range-based marksmenship, although many departments now have adopted more sophisticated training curriculums including, video simulation and/or live scenario-based training. Generally, training that is simply range based is considered insufficient as it does not provide training in shooting while moving, identifying threats correctly, use of cover, distance, and other elements that accompany a real shooting incident with targets that shoot back. In fact, police departments and cities may even expose themselves to civil liability through failure to train by not providing more realistic training for officers (Ryan, 2008). After recruit training, officers may be simply expected to qualify each year with their firearms, firing at a stationary paper target at a set of fixed and known distances, although some suggest that in-service firearms training ranges from 4 to 16 hours per year (Aveni, 2008, p. 4).

A Rand (2008) study that reviewed the firearms training of the New York City police department found that firearms training included the basic message that shooting should be a last resort when there was no other available way to protect the officer or others. It included a use of force continuum that requires officers to meet resistance or aggression with proportional force. The training covered the relevant court cases including *Graham v. Connor* (490 U.S. 386, 1989) which will be discussed in a subsequent section. In New York City, shooting guidelines are more stringent than the Supreme Court test of reasonableness and follow the use of force continuum (Rand, 2008, p. xv). The conclusion of this review was that even though New York City did employ scenario-based training, more hours of such training and more feedback was needed (Rand, 2008).

Even though police shootings are a rare event, they are always traumatic and, at times, divisive, contributing to problematic relations with the community. Many cities, including San Francisco, Los Angeles, Atlanta, New York, Chicago, Detroit, Memphis, Newark, and Miami have experienced riots or other disturbances because of public reaction to a shooting. Furthermore, many millions of dollars have been paid in civil rights lawsuits when victims or their families sue the city and police department for wrongful death or injuries related to shootings that are ruled as an illegal use of force (Lacks, 2008). In fact, the use of lethal and less than lethal force lead the reasons for civil lawsuits against police departments (Ross, 2000). It is also true that cities spend large sums of money to defend themselves against such lawsuits when the officer is ultimately exonerated and the shooting is ruled justifiable. Often the perception of what is a lawful and reasonable use of lethal force differs depending on one's perspective. Although community members and the targets' families may believe that the shooting was unjustified, often objective review shows otherwise.

Research on police shootings can be found in the larger use-of-force literature. Some researchers have explored the prevalence of police shootings (Fyfe, 1986; Geller

& Scott, 1992). White (2006) reviewed some of the literature on police shootings and placed findings in the categories of situational, organizational, and environmental factors that affect police shootings. For instance, environmental factors that affect shootings may include violent crime arrest rates, homicide rates, and community-level violence. Organizational characteristics include administrative policies regarding shooting incidents and/or the continuum of force and other management controls over police use of force (Lee & Vaughn 2010). It has been found that restrictive and detailed policies are associated with reduced numbers of shootings (Terrill, Alpert, Dunham, & Smith, 2003; White, 2001, 2006). Finally, situational variables refer to such things as a citizens' demeanor, race, the age of the officer, and other factors relevant to the decision to shoot (Fyfe, 1981, 1986, 1988; White, 2002), including higher education (finding that those with higher education are less likely to be involved in uses of force, including lethal force) (Rydberg & Terrill, 2010). Several researchers have explored and identified racial bias in the decision to shoot, with African Americans more likely to be perceived as dangerous and requiring a shooting response (Correll et al., 2007; Correll, Park, Judd, & Wittenbrink, 2002; Payne, 2001), whereas others have measured the effect of negative emotionality and working memory on the likelihood of shooting (Kleider, Parrott, & King, 2010). A few researchers have examined liability issues (Novak, Smith, & Frank, 2003; Worrall, 2001). Finally, some researchers have defined the reasonableness standard (Alpert & Smith, 1994; Fyfe & Walker, 1990; Hontz, 1999), and explored perceptual distortions, and memory distortions with a discussion of how these elements are relevant to a finding of reasonableness (Engel & Smith, 2009; Honig & Lewinski, 2008; Klinger & Brunson, 2009). Because the latter studies are similar to the current study, we will review them in more detail next.

Although the above mentioned studies represent a body of literature on legal and environmental factors associated with police shootings, and the decision to shoot, there is very little research on the actual mechanics of the shooting itself, that is, accuracy and effectiveness. It is also true that recent technology (i.e., laser guns, sophisticated cameras) has greatly enhanced the ability of researchers to undertake such efforts (Barton, Vrij, & Bull, 2001). White (2006) explored accuracy in police shootings, using a data base of all 271 shooting incidents in Philadelphia between 1987 and 1992. He reviewed prior studies that indicated police miss their target, on average, more than half of the time, with hit rates in various cities ranging from 25% to 100%. In his analysis of the Philadelphia incidents, he found that in these 271 incidents, 51% missed the target, 35% hit and injured the target, and 14% of the shootings resulted in a fatality (White, 2006, p. 309). Situations where the officers missed the target were more likely to be when the suspect fired first, when the officer was more than 20 feet away, and when the officer was running. A few more interesting findings were that the officers' guns were drawn before the decision to shoot in 75% of the cases where they missed, as well as when they hit the target. Also, only about 18% to a quarter of officers in all cases used cover (White, 2006, p. 315). Some factors that might be hypothesized to affect accuracy were not statistically significant, such as lighting, location, cover, and whether the officer had his or her gun drawn (p. 322).

Also, it seems true that officers, on average, are almost as likely to miss their target as hit it. Finally, we know that a police shooting can be an extremely volatile and disruptive event in the community, thus, it is essential that we continue to try and understand what officers experience leading up to and during the shooting event. We turn now to the literature on the reasonableness standard.

Reasonableness

Police officers have a legal right to use force, including lethal force, when it is reasonable to do so. The Supreme Court detailed the standard to be used in determining whether or not a police officer's use of force is legal in *Graham v. Connor* (1989). The court had earlier held in *Tennessee v. Garner* (1985) that the Fourth Amendment was implicated in a police shooting. In effect, a shooting was a seizure and, therefore, must be "reasonable." In *Tennessee v. Garner*, the Court's holding invalidated police policies that allowed officers to shoot fleeing felons when there was no reason to believe that they would injure others because the use of lethal force in those situations was not reasonable. In *Graham*, the Court held that the force used by an officer must be "objectively reasonable" in light of the facts and circumstances confronting him. Furthermore, reasonableness should be judged "from the perspective of a reasonable officer on the scene, rather than with the 20/20 vision of hindsight," (*Graham v. Connor*, 1989, p. 396). An officer may shoot when there is an imminent risk of harm to self or others, or to stop someone who poses a danger to others if allowed to escape. If an officer's shooting is held to be unreasonable given the facts and circumstances, he or she faces federal and state criminal charges, as well as civil rights lawsuits and tort actions for wrongful death or injury.

The reasonable officer is somewhat of a chimera, with no one quite able to definitively describe such an officer, even though there have been attempts, such as the International Association Chiefs of Police with their model use of force policy:

> This . . . reasonable officer standard is an objective test. That is, it is not based on the intent or motivation of the officer or other subjective factors at the time of the incident. It is based solely on the objective circumstances of the event and the conclusion that would be drawn by any "reasonable officer at the scene." (IACP National Policy Center, 2005, p. 2)

A reasonable officer evidently is the officer who acts reasonably. Reasonableness is somewhat like obscenity, as Justice Stewart said in his concurring opinion in *Jacobellis v. Ohio* (1964, p. 184), ". . . perhaps I could never succeed in intelligibly [defining "hard core" pornography]. But I know it when I see it . . ."

Police shooting boards and courts apply the reasonable officer standard to police shootings. Shooting policies in police departments, for instance, are based on this reasonableness standard even while adding other factors such as a use of force continuum that requires the officer to meet resistance with proportional levels of force (Terrill, 2009). Under these policies, only proportional reactive force is considered reasonable, although it should be noted that the Supreme Court has never required that the officer use the least amount of force, only that the force used be considered reasonable. Although some argue that police officers who use their weapons and kill citizens are routinely protected and do not face the legal scrutiny that they should (Lacks, 2008); others argue that officers are unfairly held to a superhuman standard when making the decision to fire, and the "ideal" of reasonableness must include the objective realities facing officers who confront a suspect with a weapon.

In summary, the reasonable officer standard is seen as an objective standard used to determine whether or not the use of force by an officer is a "good shooting." The reasonable officer represents the average, prudent, well-trained officer. It is not a subjective test (which would take into account the specific characteristics, perceptions or abilities of the particular officer involved in the shooting); however, an objective standard would incorporate situational variables known to affect all or most officers in similar circumstances. This is why research that sheds light on the shooting incident can be helpful to the legal determination of reasonableness.

Researchers have examined factors such as perceptual distortions, memory distortions, and reaction time that are relevant to the reasonableness standard (Engel & Smith, 2009; Honig & Lewinski, 2008; Klinger & Brunson, 2009). These lines of research have revealed several perceptual and memory distortions that occur during traumatic events, such as tunnel vision, time dilation, and auditory blunting. For instance, Klinger and Brunson (2009) found in their study of 80 officers' detailed descriptions of 113 shooting incidents that the majority of officers experienced at least two perceptual distortions. Fully 82% of officers experienced auditory blunting, and 51% of the officers experienced tunnel vision (p. 126). These findings affect our understanding of what is reasonable in a shooting incident. For instance, if the majority of officers experience tunnel vision, then in situations where an officer is focused on a suspect with what they think is a gun, other visual cues may not be available to them; thus, in hindsight, it may appear that the shooting decision was unreasonable, even though the officer experiencing it believed that it was a necessary reaction to a threat. Similarly, if a majority of officers experience auditory blunting; this means that they may not hear someone shouting at them that the suspect is not a threat. Indeed, Klinger and Brunson's findings indicate that the "perspective" of a reasonable officer may be influenced by a range of perceptual distortions common to those in high stress situations. Thus, these realities must be taken into account when determining the reasonableness of the shooting. Another element to a determination of reasonableness lies in the reaction of officers to suspects who clearly have a weapon, but have not yet aimed or fired it.

Reaction Time Studies

The study in this article focuses on reaction time. There is a perception among some community members that officers are too quick to shoot those who only appear to pose a threat. Indeed the shootings that create the most public hostility and, in some cases, rioting and other disturbances are when it turns out that the suspect had no weapon. In the Amadou Diallo case in New York City in 1999, Diallo evidently resembled a rape suspect and was perceived to have a weapon, and as he turned to face police officers, was shot multiple times, but he was found to be unarmed. Yet, even in cases where the target was armed, community members sometimes criticize police shootings. For instance, Miami police, and the recently appointed police chief, are being criticized for the deaths of seven African Americans in 8 months, even though five of the men were armed. There are other elements to the Miami situation that have inflamed the minority community, including some ill-advised commentary from the chief and his officers. However, this type of public reaction may trigger the frustration that police feel when the community seems to believe that suspects with weapons should get a "free shot" before being fired at by police officers (van Natta, 2011). There are people who seem to believe that the "reasonable" officer should wait until a suspect with a gun begins to use the gun against the officer before the officer utilizes lethal force. The simple question is, would waiting be reasonable in situations where the suspect has his weapon in hand but not aimed? The answer to that question lies in reaction time research.

Generally, three types of reaction time experiment are recognized (Luce, 1986). Simple reaction time experiments feature only one stimulus and one response (i.e., press the button when you hear the tone). Recognition reaction time experiments feature a memory set, to which the participant should respond, and a distracter set, which should be ignored (i.e., press the button when you see a symbol that you have seen before). Choice reaction time experiments require the participant to give a specific response to a specific stimulus (i.e., press the right button when you see stimulus X and the left button when you see stimulus Y). It is generally accepted that reaction time increases with the complexity of the study (Brebner & Welford, 1980; Luce, 1986). That is reaction times are fastest in simple reaction time studies and slowest in choice reaction time experiments. Research has also revealed that the time for motor preparation and response (the time taken to prepare and execute the physical action) does not vary by type of study (Miller & Low, 2001). This suggests that the differences in reaction times for the different study types are the result of increases in processing time as the complexity of the task increases.

A variety of factors have been found to affect these basic reaction time findings. Reaction time improves until the late 20s, declines slowly from then until the 50s and declines more dramatically from then on (Der & Deary, 2006). Males have been found to have generally faster reaction times than females (Der & Deary, 2006). Distractions increase reaction time (Welford, 1980). Physically fit people have faster reaction times (Welford, 1980). Reaction time is also faster when participants are moderately aroused (Welford, 1980). Research has also generally found that practice reduces reaction time (Ando, Kida, & Oda, 2002, 2004; Fontani, Lodi, Felici, Migliorini, & Corradeschi, 2006; Rogers, Johnson, Martinez, Mille, & Hedman, 2003; Visser, Raijmakers, &

Molenaar, 2007). Simen et al. (2009) reported research which suggests that there is an accuracy/speed trade off. Faster reactions produce lower accuracies and vice versa.

Other recent research, suggests that separate systems may handle reactive and intentional movements. Welchman, Stanley, Schomers, Miall, and Bulthoff (2010), in a series of experiments used civilian volunteers, paired them, and then instructed them to react when the other began to push a row of three buttons on a machine in front of them. The speed in which both finished their sequence of buttons was recorded. These researchers found that the reactor executed the physical movements of the task 10% (21 ms) faster than the initiator. This difference in physical movements was, however, dwarfed by the more than 200 ms it took the reactor to initiate his or her physical movements. Thus, the existing research suggests that although the physical movement of reaction is faster than the physical movement of action, the actor usually wins. Next, reaction time studies which have explored the ability of police officers to respond are discussed.

In a series of experiments with officers from Tempe, Arizona, researchers discovered that the average reaction time for officers to shoot when cued with a light was .31 seconds. Three quarters of that time (.23 s) was taken up with processing and one fourth (.08 s) with the actual physical motion of moving the finger from the resting position and firing (Lewinski & Hudson, 2003a). This finding is consistent with other reaction time research which has found that reaction time to simple visual tasks is around .20 to .30 s (Eckner, 2010; Welchman et al., 2010). In a more complex scenario where officers had to process information from a number of lights in different rows in the decision to shoot, the reaction time almost doubled to .56 s (Lewinski & Hudson, 2003b). This is also consistent with the general reaction time research which indicates that complexity slows reaction time (Brebner & Welford, 1980; Luce, 1986). It is also important to note that an experiment which introduced relatively minor complexity in the decision to shoot produced a number of shooting errors—9% of officers shot when they should not have and 4% did not shoot when they should have per the instructions (Lewinski & Hudson, 2003b).

Although the existing literature provides some basic knowledge about reaction time and the ability of police officers to pull the trigger on a gun in response to a stimulus, it does not provide a clear picture of how reaction time plays out in a more dynamic policing scenario. This study seeks to examine this issue. The scenario that we have chosen to examine is one in which a police officer is confronting an armed suspect. The suspect does not have his or her gun pointed at the officer, but the officer has his or her weapon pointed at the suspect. The police officer issues commands to the suspect to put the gun down. The suspect either complies or attempts to shoot the police officer. The basic question is can the police officer shoot the suspect before the suspect shoots (assuming that the suspect attempts to fire)? In our discussions with police officers, they expressed interest in two different gun positions on the part of the suspect. The first was with the gun down to the side, and the second was with the gun pointed at the suspect's own head (as if threatening suicide). The officers were interested in knowing if a suspect who is pointing a gun at his or her head is as dangerous as a suspect pointing his or her gun at the ground. We incorporated these gun positions into our study as experimental conditions. Our second question, then, was whether reaction time on the part of the officer or firing time on the part of the suspect varied as a function of suspect gun position.

The answer to the first question may sound obvious. Of course, a police officer who has his or her gun out, pointed, and sighted at a suspect can fire before the suspect. The situation, however, is more complex than is often realized at first blush. The officer in the scenario must perceive and absorb the visual cues that the suspect is going to fire, process that information within the current context, decide on an appropriate course of action, and then signal the muscles to respond. In tactical policing circles, this is referred to as the OODA loop (see Howe, 2005). OODA stands for Observe, Orient, Decide, and Act. In the meantime, the suspect has already assessed the situation, decided on a course of action, and must only complete the act of firing. In OODA-loop terminology, the officer must negotiate the entire loop more quickly than the suspect executes the action portion of the loop if the officer is to win the encounter. This is why it is commonly argued that "action is always faster than reaction" (Honig & Lewinski, 2008, p. 141). The question is not can the officer squeeze the trigger faster than the suspect brings the gun into firing position and squeezes the trigger; rather, the question is can the officer observe the suspect's movements, interpret them, select an appropriate action, and then execute the action before the suspect brings the gun into firing position and shoots?

Method

General Strategy

An almost infinite number of variants on the basic scenario described above are possible. Additionally, it is not possible to capture all of the elements of a real-life use-of-force encounter in a laboratory experiment. For example, although there was some threat of harm from the wax bullets used in our scenario (they sting and can leave welts), there was no threat of death. Additionally, we chose to keep the scenario as simple as possible to test the police officers in a situation that would be as close to optimal as possible in terms of reaction time while still reflecting the basic decision making process of a shoot–don't shoot, deadly force encounter. We felt that the key components required to reflect this basic process were as follows: The officers interact with the suspects (i.e., issue commands); the officers have to make a shoot–don't shoot decisions (i.e., the officers don't shoot all of the suspects); and the scenario involves the exchange of simulated gunfire. The scenario described below meets these conditions without including extra factors (such as movement, poor lighting, or multiple suspects). We have good reason to believe that the reaction times of police officers in actual deadly force encounters would be slower than they were in the tested scenario. We detail these reasons in the discussion section.

Participants

Two groups of participants were used in this study. The 30 "suspects" were recruited from criminal justice classes at a large southwestern university by offering them course credit for participation. The mean age for the "suspects" was 21.88 years (*SD* = 2.42). The majority of the suspects were White (66.7%). Half were female. One of the suspects was a certified police officer with 7 years of tactical experience. The rest had no policing experience.

The second group of 24 participants played the role of police officers in the study. These were recruited from a regional tactical (SWAT) policing conference and were all participants in a 5-day active shooter training class. Our goal, again, was to present a best case scenario. To that end, tactical police officers have more policing experience in general than "normal" police officers and receive substantially more firearms and tactics training than "normal" police officers. SWAT officers can be considered to be elite in terms of the use of force, particularly when it comes to the use of deadly force. The mean age of these participants was 34.40 years (*SD* = 6.74). The majority of these participants were also White (52.2%). All of the police officer participants were male. Almost all (87%) were certified police officers at the time of the study. Those that were not currently certified as police officers were military personnel with policing experience. The participants' policing experience ranged between 1 and 29 years with a mean of 9.61 years (*SD* = 6.49). The tactical (SWAT) policing experience of this group ranged from 0 to 10 years with a mean of 4.74 years (*SD* = 3.32).

Procedure

The basic design of the study was that officers were responding to a generic "person with a gun" call. The suspect and officer started in the same room at a distance of 10 feet and were required to stay in boxes that were taped on the floor. The officer began each exchange facing away from the participant. The officer then turned, with his gun out and pointed at the suspect, and gave the suspect commands to put the gun down. Suspects in the surrender conditions were told to follow the officer's orders. Suspects in the shooting conditions were told to attempt to shoot the officer anytime after the initial command to put down the gun was given. We emphasized to the suspects that this was a reaction time study and that they should not shoot until after the first command was given. The suspects were also told that they could delay their response, but if they waited too long, the officer might shoot them. The officers were told that some of the suspects would comply and some would not, and that if the suspect attempted to shoot the officer, the officer should attempt to shoot first. All of the exchanges were recorded by a video camera filming at 30 frames per second. If the exchange involved shooting, the participants were told to face the camera after the shooting and indicate if they had been hit and where.

The guns utilized in this study were Glock 17T training weapons converted to fire Simunition® FX® Marking Cartridges. The FX® Marking Cartridges are wax-filled

Room 1 LS	Room 2 HS	Room 3 LN	Room 4 HS	Room 5 LS
Room 10 HS	Room 9 LS	Room 8 HS	Room 7 LS	Room 6 HN

Figure 1. Example of the study set up on Run 1
Note: H = Gun High Condition, L = Gun Low Condition, S = Shooting Condition, N = Non-shooting/Surrender condition

plastic projectiles, propelled by gun powder, which leave a mark when striking a surface. All participants wore safety equipment including head, eye, and throat protection to prevent injury. It should be noted that this equipment obscured the faces of the participants. No injuries occurred during the study.

Suspects were randomly assigned to be in either a gun high or gun low position with equal frequencies assigned to both conditions. In the gun low position, the suspects held a Glock training pistol down at their side and pointing at the ground. In the gun high position, the suspects held a Glock training pistol pointed at the side of their head in a manner consistent with threatening to shoot themselves. Suspects were also randomly assigned to either shoot or surrender. This was done at a 4 to 1 ratio, with four out of five participants being assigned to shoot. The surrender conditions were included to ensure that the police officers had to assess the actions of the suspect before shooting rather than just shooting as soon as the suspect moved.

Ten class rooms in an abandoned school were utilized. These rooms were very similar in dimension and contents. Three runs were completed. In each run, 10 suspects were randomly selected and placed in the rooms such that odd-numbered rooms contained suspects in the gun low conditions and even numbered rooms contained suspects in the gun high conditions. Within that constraint, the shoot and surrender conditions were randomly assigned in such a manner that four of the gun low and gun high rooms contained shooters and one gun high and one gun low room contained a person who would surrender.

Ten police officers were randomly selected for each of the first two runs and randomly assigned to a starting room. The remaining four officers were selected for the third run and were randomly assigned to start in one of the first four rooms. The officers rotated sequentially, in a clockwise manner through the rooms until they had completed an encounter in all ten rooms. The sequencing of the rooms was counterbalanced with regards to whether the officer began in a gun high or gun low condition and the positions in which the suspects surrendered (see Figure 1 for an example of the set up). Thus, each officer had 10 encounters; however, only 20 of the suspects had 10 encounters. The remaining 10 only had four encounters.

Coding

This procedure produced 240 exchanges. Of those, 192 involved shooting conditions. These 192 shooting conditions were subjected to coding.[2] An initial review of the exchanges eliminated another 33 exchanges for various issues. In seven of these excluded cases, the autofocus function on the camera malfunctioned producing a blurry image. One case involved a misfire of the marking cartridge such that no shot occurred. One involved an officer who did not shoot because he said that he could see that the suspect's gun was empty. One involved an officer who shot before the suspect moved, and the rest (23) involved suspects who did not wait for the officer to finish his first command before shooting. This left 159 cases that were coded.

The coded cases were loaded into a video editing program that allowed the video to be advanced frame by frame. The coders marked the frame in the video where the suspect began to move his or her gun hand as the start point and then advanced the video frame by frame until the suspect's gun fired to determine how long it took the suspect to fire. To determine how long it took the officer to react, the coders counted the number of frames from the start point (the initial movement of the suspect's gun hand) until the officer's gun fired. Each frame represented 1/30th of a second. One coder coded all 159 cases and a second coder independently coded 20% of the cases. The agreement between the coders was exceptionally high (Krippendorf's Alpha = .90 for the time of the suspect's fire and .93 for the time of the officer's fire). If the officer fired before the suspect, the exchange was coded as a win. If the officer fired at the same time as the suspect, the exchange was coded as a draw, and if the officer fired after the suspect, the exchange was coded as a loss. In no case did the coders disagree on who won the exchange. Shot hits were recorded based on the reports given by the participants to the camera. In three of the 159 coded trials, the suspect failed to indicate whether or not he or she had been hit. The same occurred in six of the 159 coded trials for the officers.

Results

Firing and Reaction Times

Because of the clustered nature of the data (each participant participated in multiple trials) and the uneven number of trials analyzed for each participant (due to the problems described in coding section), multilevel modeling was used to analyze the data (Raudenbush & Bryk, 2001). A series of models were developed for each group (officer or suspect). In each of these models, data from the individual trials was nested within the participants. The model examining the average firing times of the suspects revealed that an average of .38 s (SE = .02, 95% CI = [.34, .42]) elapsed from the initial movement until they fired.[3] The model examining the reaction times of the officers found that they responded in an average of .39 s (SE = .01, 95% CI = [.36, .42]) after the suspect's initial movement. As can be seen from the overlapping confidence intervals, the difference between the suspects' firing times and police officer reaction times was not significant. Officers and suspects appear to have fired at about the same time.

The next suspect model compared the differences in firing times for suspects assigned to the gun high condition with the suspects assigned to the gun low condition. Suspects in the gun low condition fired in an average of .36 s (*SE* = .03, 95% CI = [.30, .41]), and suspects in the gun high condition fired in an average of .40 s (*SE* = .04, 95% CI = [.32, .48]). This difference was not significant ($t_{(21.59)} = 1.07$, $p = .29$). Gun high or low position, then, did not appear to significantly affect the firing times of suspects.

The final model examined the within participants differences of the officers when they were in a gun low trial versus when they were in a gun high trial. Officers fired in an average of .38 s (*SE* = .02, 95% CI = [.34, .43]) after the initial movement of the suspect in the gun low trials. In the gun high trials, they fired in an average of .40 s (*SE* = .03, 95% CI = [.34, .46]) after the initial movement. This difference was also not significant at the .05 level ($t_{(20.01)} = .69$, $p = .50$). The gun position of the suspects did not appear to affect the speed with which the officers fired.

To examine who won each individual exchange, the suspect time was subtracted from the officer time on each trial. Positive numbers in this case indicated suspect wins and negative numbers officer wins. The results of this analysis are presented in Figure 2. The mean difference was +.01 seconds (*SD* = .11). This was not significantly different from 0 ($t_{(158)} = 1.11$, $p = .27$) suggesting again that officers and suspects fired almost simultaneously. An examination of each individual case revealed that officers shot faster than the suspects in 62 (39%) of the 159 trials. Suspects shot faster than the officers in 78 (49%) of the trials, and the suspects and officers fired simultaneously in 19 (12%) of the trials. This did not vary significantly by gun position ($\chi^2_{(2)} = 3.03$, $p = .22$).

Hits

Suspects successfully shot the officer in 77 (50.3%) of the 153 coded exchanges. The suspects' shots hit the officers in 34 of the 65 (52%) of the gun low scenarios and in 43 of the 88 (48.8%) gun high scenarios. This difference was not significant ($\chi^2_{(1)} = .177$, $p = .67$).

The police officers successfully shot the suspect in 138 (88.5%) of the 156 coded trials. The officers hit in 75 of the 88 (85.2%) gun high trials and 63 of the 68 (92.6%) gun low trials. This difference was not significant ($\chi^2_{(1)} = 2.07$, $p = .15$).

Discussion

When the average reaction times of the police officers and suspects in our study were compared, they showed that police officers and suspects were taking about the same amount of time to fire. When the individual exchanges were examined, police officers fired at the same time or later than the suspect 61% of the time. Additionally, even in the situations where the officer was faster, there was less than a .2 s difference, suggesting

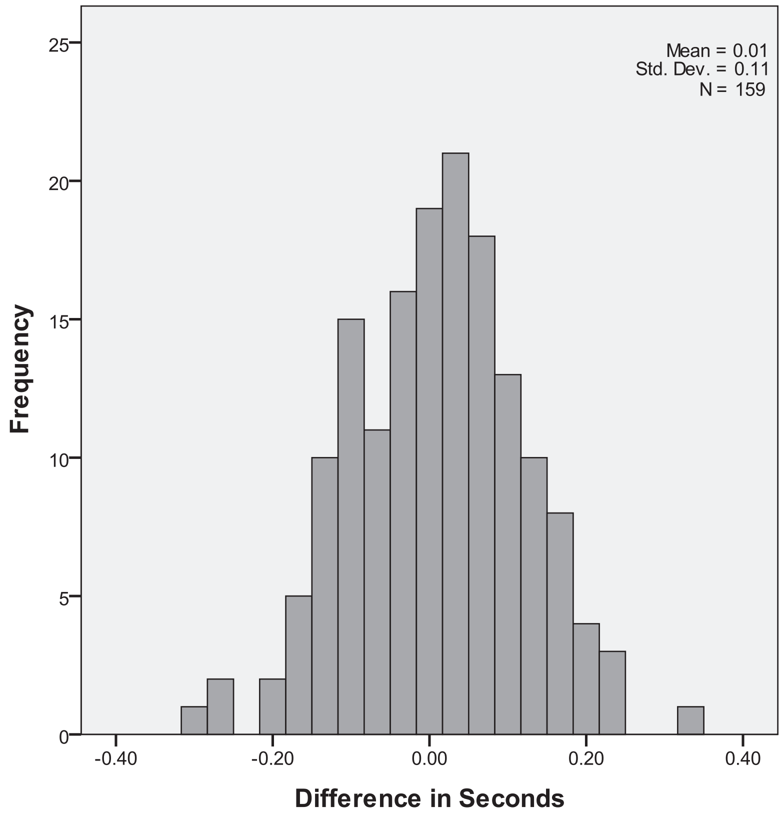

Figure 2. Difference in suspect and officer speeds

that the suspect would still get a shot off in most of these encounters. The process of perceiving the suspect's movement, interpreting the action, deciding on a response, and executing the response for the officer generally took longer than it took the suspect to execute the action of shooting, even though the officer already had his gun aimed at the suspect. Although our sample size is not large, our results are consistent with previous research and our general understanding of the reaction process (Brebner & Welford, 1980; Grossman & Christensen, 2004; Honig & Lewinski, 2008; Luce; 1986; Welchman et al., 2010). Completing all of the steps necessary to interpret a situation, select, and then execute a response simply tends to take longer than it takes to execute an already decided-upon action.

We did not find a significant difference in firing times or reaction times by gun position. Suspects with their guns down by their sides fired as quickly as suspects with their guns pointed at their heads, and officers reacted in the same amount of time in both situations. It would seem then, that from a mechanical point of view, both types of suspect are about equally dangerous.

Although we believe that our study is informative, it is not without limitations. It simply is not possible to make a laboratory experiment model all of the elements that might affect an officer in a real shooting. Perhaps one of the major limitations is that our scenario also did not approximate the level of arousal (stress) that an officer would experience during an actual life or death situation. Arousal has been shown to have an inverted u shaped relationship with reaction time (Wellford, 1980). Moderate arousal improves reaction time, but high levels of arousal degrade it. Although we did not attempt to measure arousal, the use of marking cartridges in training is generally considered to be moderately arousing (Grossman & Christianson, 2004; Murry, 2004). An actual life-or-death situation would obviously be highly arousing. Thus, reaction time in an actual deadly force encounter can be reasonably expected to be slower than in the current study.

A variety of other common features of police shootings that were not reflected in the current study would also serve to further increase reaction time. Because of this, we view our results as a best case scenario. For example, our officers were highly experienced and most were tactical (SWAT) officers, who knew that they would be encountering suspects with guns. Both practice (Ando et al., 2002, 2004; Fontani et al., 2006; Rogers et al., 2003; Visser et al., 2007) and warnings (Brebner & Welford, 1980) have been shown to decrease reaction times. The exchanges happened in well-lit rooms, with both parties remaining stationary and only a single suspect. Low light would make the actions of the suspect harder to detect (i.e., the stimulus weaker) and stimulus strength is inversely related to reaction time (Luce, 1986). Additional suspects in the room and movement would both create distractions, and distractions have been consistently shown to increase reaction times (Welford, 1980). The suspects never attempted to mislead the officers by pretending to comply and then shooting. This could be considered another form of distraction or a less intense stimulus. Additionally, the suspects extended their arms to bring the gun in line with their eyes before shooting in almost every exchange. Although this action might have improved accuracy, it was slower than simply rotating the gun and firing "from the hip." The suspects appear to have been willing to sacrifice speed for better accuracy (Simen et al., 2009). That is, the suspects could have shot faster if they were willing to sacrifice some accuracy.

The extremely high accuracy (88%) exhibited by our officers also suggests that our experiment may not have captured many of the elements that occur in real life shootings where accuracy is generally less than 50% (White, 2006). Although this high level of accuracy might be attributable to the training and skill of our participants, it is more likely the result of the simple nature of our study. Indeed, many of the factors that affect reaction time (such as distractions, movement, and higher stress) can be reasonably assumed to reduce accuracy. Again, our study appears to be a best case scenario and accuracy in the field could reasonably be expected to be lower than it was here.

It is also worth noting that even though we did not capture all the elements of a real shooting, it still appears that the experiment affected the ability of the officers to shoot.

Those familiar with firearms training would surely expect tactical officers to hit 100% of the time when firing at a stationary target from a stationary position at a distance of just more than three yards.

Our findings have two implications for the reasonableness standard. First, the reasonableness standard is based on what a well-trained, prudent officer would do in a given situation. The current study informs the reasonableness standard by providing parameters for police officer performance when responding to armed suspects. Our results show that even well-trained officers, who are operating in nearly ideal circumstances, with their guns aimed at a suspect, cannot reasonably be expected to shoot before the suspect raises his or her gun and fires.

Second, the reasonableness standard considers the danger perceived by the officer at the time of the use of force. The current findings serve to illustrate the extreme danger that armed suspects present to police officers. Our findings show that even when a police officer has his or her gun aimed at a suspect and the suspect is not aiming at the police officer, the police officer is still in extreme danger.

The results reported here have two primary policy/training implications. First, the results highlight the extreme danger that armed suspects pose to police officers. Because officer involved shootings can be traumatic to both the officer and the public, training should focus on helping officers avoid the type of situation presented here. Training should also teach officers how to mitigate the dangers posed by armed suspects. Distance and cover are generally considered to be an officer's friend when dealing with armed suspects. More distance and/or cover reduce the ability of the suspect to fire accurately at the officer and thus the danger to the officer is reduced. This gives the officer more flexibility in his or her response.

Second, several of the officers who participated in the study indicated their intent to have new recruits in their agencies participate in scenarios similar to the one presented here. These officers indicated that participation in this type of scenario would give the new recruits a better understanding of the dynamics involved in this type of situation and help correct inaccurate beliefs about shooting ability. The officer–participants indicated that this improved understanding of deadly-force encounter dynamics could help save officer lives. We, therefore, suggest that police departments consider implementing the type of scenario presented here in their training programs.

What then of the hypothetical and question posed at the outset of this article? Was the officer's shooting justified? In potentially deadly situations, the individual officer must consider the totality of the circumstances and choose a response that is reasonable. Given the close range of the encounter, the lack of available cover, the failure of the suspect to comply with multiple warnings, and the data presented here, we think that an officer who decided to shoot in the hypothetical situation meets the legal definition of reasonableness. We also believe that if the Conroe, Texas officer had chosen to fire his weapon before the suspect fired, the shooting would have been ruled justified.

We do not believe that the findings presented in this article support the position of: "shoot everyone with a gun" or "shoot everyone with a gun who does not comply."

The article's findings reinforce the need for improvements to firearms training. As stated above, decisions officers make in early stages of every encounter will be as important as the fateful shoot or don't shoot decision. To make those decisions, police officers should know that most officers don't shoot accurately in realistic encounters; that shooting may involve confusing sensory and perceptual distortions, and that (as our findings show) most officers can't fire faster than a suspect with a weapon in hand even if it is not aimed at the officer. This doesn't mean they should always shoot in these situations, it means they should, if at all possible, take the steps necessary to avoid the situations where they are without cover and distance when facing a suspect with a gun.

It is our hope that the current research will help officers, and those who judge the actions of officers, to make more informed decisions about the reasonableness of officers' actions. The current study is, of course limited in that the design did not represent many of the factors that officers face on the street and several of the trials had to be discarded due to participants failing to follow directions or other problems. Future research should, of course, attempt to replicate the current findings. Future research should also examine the impact of many commonly encountered environmental variables (such as lighting and multiple suspects) on reaction times. Research should also explore how to improve the reaction times of police officers and what actions (other than shooting) the officers could take to improve their survival chances.

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Notes

1. View the video of this event available at http://www.khou.com/news/local/Dash-cam-video-released-of-Conroe-officer-shooting-119419704.html
2. The officers did not shoot at any of the suspects in the surrender conditions.
3. The standard errors and confidence intervals are rounded. This may cause the reader's by-hand estimates to differ from the reported estimates.

References

Alpert, G., & Smith, W. (1994). How reasonable is the reasonable man? Police and excessive force. *Journal of Criminal Law and Criminology, 85*, 481-501.

Ando, S., Kida, N., & Oda, S. (2002). Practice effects on reaction time for peripheral and central visual fields. *Perceptual and Motor Skills, 95*, 747-752.

Ando, S, Kida, N., & Oda, S. (2004). Retention of practice effects on simple reaction time for peripheral and central visual fields. *Perceptual and Motor Skills, 98*, 897-900.

Aveni, T. (2008, Fall). Obsolescence: The police firearms training dilemma. *Answering the Call*, 1-7.

Barton, J., Vrij, A., & Bull, R. (2001). New paradigms in researching police use of firearms. *Journal of Police and Criminal Psychology, 13*, 36-41.

Brebner, J. T., & Welford, A. T. (1980). Introduction: A historical background sketch. In A. T. Welford (Ed.), *Reaction times* (pp.1-23). New York, NY: Academic Press.

Butterfield, F. (2001). When the police shoot, who's counting? *New York Times*, April 29, 2001. Retrieved from http://www.nytimes.com/2001/04/29/weekinreview/ideas-as-trends-bookkeeping-when-the-police-shoot-who-is-counting.html

Correll, J., Park, B., Judd, C., Wittenbrink, B., Sadler, M., & Keesee, T. (2007). Across the thin blue line: Police officers and racial bias in the decision to shoot. *Journal of Personality and Social Psychology, 92*, 1006-1023.

Correll, J., Park, B., Judd, C., & Wittenbrink, B., (2002). The police officer's dilemma: Using ethnicity to disambiguate potentially threatening individuals. *Journal of Personality and Social Psychology, 83*, 1314-1329.

Der, G., & Deary, I. J. (2006). Age and sex differences in reaction time in adulthood: Results from the United Kingdom health and lifestyle survey. *Psychology and Aging, 21*, 62-73.

Ducrose, M., Smith, E., & Langan, P. (2007). *Contacts between police and the public 2005.* Washington, DC: Bureau of Justice Statistics, DOJ.

Eckner, J. T., Kutcher J. S., & Richardson J. K. (2010). Pilot evaluation of a novel clinical test of reaction time in National Collegiate Athletic Association Division I football players. *Journal of Athletic Training 45*(4), 327-333.

Engel, R., & Smith, M. (2009). Perceptual distortion and reasonableness during police shootings: Law, legitimacy, and future research. *Criminology and Public Policy, 8*, 140-151.

F.B.I. (1999-2010). *Supplemental homicide reports*. Retrieved from FBI website at http://www.fbi.gov/about-us/cjis/ucr

Fontani, G., Lodi, L., Felici, A., Migliorini, S., & Corradeschi, F. (2006). Attention in athletes of high and low experience engaged in different open skill sports. *Perceptual and Motor Skills, 102*, 791-816.

Fyfe, J. (1981). Observations on police deadly force. *Crime and Delinquency, 27*, 376-389.

Fyfe, J. (1986). *The split-second syndrome and other determinants of police violence*. In A. Campbell and J. J. Gibbs (Eds.), *Violent transactions: The limits of personality* (pp. 207-223). Oxford, UK: Blackwell.

Fyfe, J. (1988). Police use of deadly force: Research and reform. *Justice Quarterly, 5*, 165-205.

Fyfe, J., & Walker, J. (1990). Garner plus five years: An examination of Supreme Court intervention and legislative prerogatives. *American Journal of Criminal Justice, 14*, 167-188.

Geller, W., & Scott, M. (1992). *Deadly force: What we know*. Washington, DC: Police Executive Research Forum.

Graham v. Connor (1989) 490 U.S. 386

Grossman, D., & Christensen, L. W. (2004). *On combat: The psychology and physiology of deadly conflict in war and peace*. Belleville, IL: PPCT Research Publications.

Honig, A., & Lewinski, W. (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*, 129-152.

Hontz, T. (1999). Justifying the deadly force response. *Police Quarterly, 2*, 462-476.

Howe, P. (2005). *Leadership and training for the fight: A few thoughts on leadership and training from a former special operations soldier.* Bloomington, IN: Authorhouse.

International Association of Chiefs of Police (IACP) National Policy Center. (2005). Use of force: Concepts and issues paper. Alexandria, VA: IACP. Reported in D. Klinger & R. Brunson (2009), Police officers' perceptual distortions during lethal force situations: Informing the reasonableness standard. *Criminology and Public Policy, 8*, 117-140.

Jacobellis v. Ohio (1964) 378 U.S. 184

Klinger, D., & Brunson, R. (2009). Police officers' perceptual distortions during lethal force situations: Informing the reasonableness standard. *Criminology and Public Policy, 8*, 117-140.

Kleider, H. M., Parrott, D. J., & King, T. Z. (2010). Shooting behavior: How working memory, arousal and affect influence police officer shoot decisions. *Applied Cognitive Psychology, 24*, 707-717.

Lacks, J. (2008). The lone American dictatorship: How court doctrine and police culture limit judicial oversight of the police use of deadly force. *New York University Annual Survey of American Law, 64*, 391-443.

Lee, H., & Vaughn, M. (2010). Organizational factors that contribute to police deadly force liability. *Journal of Criminal Justice, 38*, 193-206.

Lewinski, W., & Hudson, B. (2003a, September/October). Time to start shooting? Time to stop shooting?: The Tempe Study. *Police Marksmen, 7* 26-29.

Lewinski, W., & Hudson, B. (2003b, November/December). The impact of visual complexity, decision making and anticipation. *Police Marksmen, 28*, 24-27.

Loftin, C., Wiersema, B., McDowall, D., & Dobrin, A. (2003). Underreporting of justifiable homicides committed by police officers in the United States, 1976-1998. *American Journal of Public Health, 93*, 1117-1121.

Luce, R. D. (1986). *Response times: Their role in inferring elementary mental organization.* New York, NY: Oxford University Press.

Miller, J. O., & Low, K. (2001). Motor processes in simple, go/no-go, and choice reaction time tasks: A psychophysiological analysis. *Journal of Experimental Psychology: Human Perception and Performance, 27*, 266-289.

Murry K. R. (2004). *Training at the speed of life: The definitive textbook for military and law enforcement reality based training*. Gotha, FL: Armiger.

Novak, K., Smith, B., & Frank, J. (2003). Strange bedfellows: Civil liability and aggressive policing. *Policing: An International Journal of Police Strategies and Management*, *26*, 352-368.

Payne, B. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology, 81*, 181-192.

Rand Center on Quality Policing. (2008). *Evaluation of the New York City Police Department Firearm Training and firearm—Discharge Review Process*. Santa Monica, CA: RAND.

Rogers, M. W., Johnson, M. E., Martinez, K. M., Mille, M. L., & Hedman, L. D. (2003). Step training improves the speed of voluntary step initiation in aging. *Journals of Gerontology, Series A, 58*, 46-52.

Ross, D. L. (2000). Emerging trends in police failure to train liability. *Policing: An International Journal of Police Strategies and Management, 23*, 169-193.

Ryan, J. (2008). Training liability in the use of deadly force. Legal and Liability Risk Management Institute. Retrieved from www.llrmi.com

Rydberg, J., & Terrill, W. (2010). The effect of higher education on police behavior. *Police Quarterly, 13*, 92-120.

Simen, P. D., Contreras, D., Buck, C., Hu, P., Holmes, P., & Cohen, J. D. (2009). Reward rate optimization in two-alternative decision making: Empirical tests of theoretical predictions. *Journal of Experimental Psychology: Human Perception and Performance, 35*, 1865-1898.

Tennessee v. Garner (1985) 471 U.S. 1

Terrill, W. (2009). The elusive nature of reasonableness. *Criminology and Public Policy, 8*, 163-172.

Terrill, W., Alpert, G., Dunham, R., & Smith, M. (2003). A management tool for evaluating police use of force: An application on the force factor. *Police Quarterly, 6*, 150-171.

Van Natta, D. (2011, March 22). Race issues rise for Miami police. *New York Times Online*. Retrieved from http://www.nytimes.com/2011/03/23/us/23miami.html

Visser, I., Raijmakers, M. E. J., & Molenaar, P. C. M. (2007). Characterizing sequence knowledge using online measures and hidden Markov models. *Memory and Cognition, 35*, 1502-1518.

Welchman, A., Stanley, J., Schomers, M., Miall, C. & Bulthoff, H. (2010). The quick and the dead: when reaction beats intention. *Proceedings of the Royal Society of the Biological Sciences, 277*, 1667-1674.

Welford, A. T. (1980). Choice reaction time: Basic concepts. In A. T. Welford (Ed.), *Reaction Times* (pp. 73-128). New York, NY: Academic Press.

White, M. (2006). Hitting the target (or not): Comparing characteristics of fatal, injurious, and noninjurious police shootings. *Police Quarterly, 9,* 303-330.

White, M. (2001). Controlling police decisions to use deadly force: Reexamining the importance of administrative policy. *Crime and Delinquency, 47*, 131-151.

White, M. (2002). Identifying situational predictors of police shootings using multivariate analysis. *Policing, 25*(4), 726-752.

Worrall, J. (2001). Culpability standards in section 1983 litigation against criminal justice officials: When and why mental state matters. *Crime and Delinquency, 47*, 28-59.

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