Articles

Police Journal: Theory, Practice and Principles

How police officers are shot and killed during active shooter events: Implications for response and training

The Police Journal:
Theory, Practice and Principles
2022, Vol. 0(0) 1–19

DOI: 10.1177/0032258X221087827
journals.sagepub.com/home/pjx
SAGE

J Pete Blair and Aaron Duron
School of Criminal Justice and Criminology, Texas State University, San Marcos, TX, USA

Abstract
Active shooter events have driven police to change how they respond to events where an attacker is actively engaged in killing civilians. This paper examines these changes through the lenses of Normal Accident Theory (NAT) and Resilience Engineering (RE). Our results show a police officer is shot in one out of every six active shooter events in the United States. We then apply RE to better understand how these shootings occur so that police can improve their ability to anticipate, monitor, and respond during these attacks. Implications for police training are discussed.

Keywords
Resilience Engineering, normal accidents, assaults on police, active shooter events

Engineering resilience for police during active shooter events

Since the 1999 Columbine High School shooting in Littleton, Colorado, USA, American police response to active shooter events (referred to as marauding terrorist attacks in the United Kingdom) has changed dramatically (Martaindale and Blair, 2019). Before the Columbine High School shooting, police officers were expected to contain the shooter in the attack location, control access to the location, and call for the Special Weapons and Tactics (SWAT) team to deal with the problem. Now police officers are expected to enter the location quickly (even alone) and stop the attacker from killing more people.

Corresponding author:
J. Pete Blair, School of Criminal Justice, Texas State University, 601 University Drive, San Marcos, TX 78666, USA.
Email: pete.blair@txstate.edu

This shift from containment to engagement is undoubtedly dangerous, but to date, no research has attempted to assess how dangerous. This paper attempts to fill this void. We begin by discussing active shooter events in the United States and current response training. Next, we evaluate the current response in terms of Normal Accident Theory (Perrow, 1984). Finally, we utilize the tenets of Resilience Engineering (Hollnagel et al., 2006) as a framework to mitigate the danger inherent in current active shooter response.

Literature review

Active shooter events

The U.S. Department of Homeland Security defines an active shooter event as an individual killing or attempting to kill people in a confined and populated area (U.S. Department of Homeland Security, 2008). The Federal Bureau of Investigation (FBI) regularly publishes data that are considered the official United States data on these events (ALERRT and FBI, 2018a, 2018b; Blair and Schweit, 2014; Schweit, 2016). The rate of occurrence of these events appears to be increasing, but some have criticized the data set as missing cases, particularly cases that occurred in the early 2000s (see, for example, Blair and Martaindale, 2015; Fox and Levin, 2015; Lott, 2015).

While still a relatively new area of research, there is a growing body of literature dealing with various aspects of active shooter events and police response. Some research has explored the development and effectiveness of specific response tactics (Blair et al., 2011; Blair and Martaindale, 2013, 2014, 2017; Martaindale and Blair, 2019) and police perceptions of acceptable responses (Phillips, 2020). Qualitative research has examined how first responders can provide a more effective response to active shooter events (Duron, 2021). Researchers have published descriptive studies of active shooter events in schools and businesses (Blair et al., 2014; Martaindale et al., 2017; Majeed et al., 2019; Schildkraut et al., 2017; Schildkraut and Muschert, 2014). Other descriptive research has examined the correlates of the number of people shot and killed in these events (Blair et al., 2021b). Some research has examined media coverage of these events (Majeed et al., 2019; Schildkraut et al., 2017; Schildkraut and Muschert, 2014) and the possibility of contagion effects (Kissner, 2016; Lankford and Madfis, 2017; Meindl and Ivy, 2017; Towers et al., 2015). Researchers have additionally examined the impact of these shootings on survivors and communities (Jordan, 2003; Richardson et al., 1996; Shultz et al., 2014; Smith et al., 2019). The FBI Behavioral Analysis Unit has also examined the characteristics of the shooters (Silver et al., 2018).

Police response to active shooter events

Police response to these events has shifted dramatically since the Columbine High School shooting in 1999 with officers now expected to quickly engage the shooter to limit the number of casualties (Martaindale and Blair, 2019). In response to this expectation, most police officers in the United States now receive some form of active shooter training. In this paper, we will use the Active Shooter Response—Level I class developed by the

Advanced Law Enforcement Rapid Response Training (ALERRT) Center at Texas State University to discuss current training. While numerous other training programs exist, we use the ALERRT program as the model for two primary reasons. First, ALERRT was recognized as the national standard in active shooter training by the FBI in 2013. Second, ALERRT has provided training to more than 130,000 law enforcement officers from more than 9,000 law enforcement agencies in the United States (Martaindale and Blair, 2019).

ALERRT's basic active shooter response class is a 2-day (16 h) course. The class divides response into two phases: *Stop the Killing* and *Stop the Dying* (ALERRT and FBI, 2020). The morning of the first day consists of lecture material. In the afternoon, students participate in a variety of skills training blocks. During the second day, these skills blocks continue, but most of this day consists of participants completing a series of reality-based training scenarios designed to reinforce the core concepts and principles that were taught in the lectures and skills training blocks.

During the Stop the Killing phase, officers focus on preventing the attacker from creating more victims. Officers are taught to move quickly to the sounds of gunfire and bypass any innocent civilians they encounter in order to focus on distracting, isolating, and neutralizing the attacker (ALERRT and FBI, 2020). It is during this phase, when the attacker is still actively seeking victims, that police officers are shot.

The Stop the Killing phase further divides the response into two general areas: actions outside of structures and actions inside. The outside response is further broken down to enroute, arrival, moving to the structure, and breaching into the structure. Inside response training includes interior movements (e.g., moving through hallways) and entry into rooms. ALERRT teaches concepts, principles, and specific tactics for dealing with the risk of each specific area. We will use this general outside/inside and relevant sub area breakdown in our analysis.

The course material is more focused on interior response than exterior response both in terms of manual pages devoted to explaining relevant concerns and tactics (33 interior vs. 19 exterior) and in training time specifically dedicated to skills used in these areas (180 min interior vs. 60 min exterior; ALERRT and FBI, 2020). Additionally, in all eight of the reality-based scenarios that are used to reinforce the core concepts and principles of the training, the participant officers encounter the active shooter inside of a building.

After the shooter has been stopped, the Stop the Dying phase of response begins (ALERRT and FBI, 2020). This phase has two subcomponents. The first involves providing point of wounding care that is aimed at preventing the injured from dying on the scene. This primarily involves stopping heavy bleeding using tourniquets and wound packing, some airway management to prevent the wounded from suffocating or choking on aspirated material, preventing tension pneumothorax (caused by sucking chest wounds) using chest seals, and preventing hypothermia by using various warming methods. After police provide care to prevent immediate death at the scene, the focus is on rapidly transporting the injured to a location where they can receive definitive medical care (e.g., trauma center). This is because officers (or paramedics) cannot definitively treat most victim injuries (e.g., gunshots) in the field. We now turn to discussing officers being shot during response as normal accidents.

Normal Accident Theory

Perrow (1984) developed Normal Accident Theory (NAT) when seeking to understand how accidents happened in high-tech systems. The theory is simple in that it predicts accidents will occur when high-tech systems exhibit two traits: high complexity and tight coupling. As a system becomes more complex (e.g., has more interacting parts), there is an ever-increasing possibility something will go wrong in some part of the system. Coupling refers to how tightly connected the parts of the system are to each other. In a system that is tightly coupled, a problem in one part of the system passes into other parts of the system and can cascade through the entire system to create system-wide failure. This framework has been used to study diverse topics, such as petroleum refineries (Wolf, 2001; Wolf and Sampson, 2007), steel processing plants (Marley et al., 2014), and oncology (Chera et al., 2015a, 2015).

Klinger (2005) applied the NAT framework to explain force used by and against the police. He posited that many police shootings are normal accidents that occurred in highly complex situations where the officers and civilian had become tightly coupled. Because NAT assumes accidents will happen in complex situations with tight coupling, Klinger suggested that police shootings, and the shootings of police, could be reduced by using tactics that either reduce complexity and/or coupling. Klinger argued that while a barricaded suspect situation was highly complex, deploying a specialized team (e.g., SWAT) that had training and experience dealing with barricaded suspects would reduce complexity, and therefore, reduce the likelihood of a normal accident. In a similar way, Klinger argued that the police tactic of maintaining distance from potentially dangerous suspects reduced coupling and could therefore help avoid normal accidents. For example, staying away from a suspect armed with a knife decouples the officer from the suspect and gives the officer more options to deal with the situation. Klinger provided several other examples of how police tactics can reduce complexity and/or coupling and argued that these tactics can therefore reduce police shootings of civilians and shootings of police by civilians.

Klinger (2020) revisited NAT to clarify his original work and suggest ways in which NAT could be used to enhance our understanding of how violent interactions between police and civilians occur, how the number of police–civilian interactions where police use deadly force can be reduced, and how serious injuries and deaths of police officers can be reduced. In this work, Klinger emphasized that not all police shootings are normal accidents. Some police uses of deadly force are intentional and necessary. Klinger used police shootings of suspects actively engaged in deadly violence (e.g., active shooter events) as shootings that are *not* normal accidents; however, when police responding to an active shooter event are shot, this can be a normal accident. He also emphasized that in addition to reducing the number of encounters where police use deadly force against civilians, the NAT concepts of complexity and coupling can be used to reduce serious injuries and deaths of police officers.

NAT and active shooter response. From a NAT perspective, the police response to the Columbine High School shooting can be seen as an attempt to reduce complexity (by calling on a specialized unit) and coupling (by having patrol officers stay away from the attackers) in order to avoid a normal accident that results in police officers being injured or killed; however, this focus on officer safety left civilians exposed to attackers for a substantial period of time.

The current response intentionally inserts officers into a very complex situation and tightly couples the officers with the attacker to stop the attacker from injuring or killing more civilians. Given that violence is already occurring in these events and officers are entering a complex situation that tightly couples them with attackers, we predict police officers will frequently be shot during active shooter events. This leads to our first research question:

RQ1: how often are police officers shot during active shooter events?

Assuming police officers are frequently shot and the expectation for officers to quickly enter locations where an active shooting is occurring and stop the attacker is unlikely to change (i.e., officers will be expected to continue to enter complex situations and tightly couple with attackers), we use the Resilience Engineering (RE) framework to examine how officer resilience during these responses might be increased.

Resilience Engineering

Resilience Engineering was originally developed for the industrial safety setting but has since been applied to a variety of fields (Dekker, 2019). While definitions vary, Hollnagel (2011) defined resilience as, "the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions" (p. xxxvi). Resilience defined this way seeks to avoid accidents, when possible, but also acknowledges that accidents will occur, and seeks to limit the damage caused by these accidents. This is quite similar to the prevention of shootings and harm reduction suggestions made by researchers examining shootings by the police in the United States (see, for example, Sherman, 2018; Zimring, 2017).

Under the RE framework, people's ability to understand the situation and adjust becomes a critical element in maintaining resilient operations. Hollnagel (2011) suggests that people must have four key abilities to be resilient. The first ability is responding. The person must know what to do. This can be prepared responses for regular and irregular situations or adjusting as needed to deal with novel situations. The second ability is monitoring. Resilient people must know what is critical to maintaining operations. They must pay attention to both their own system and the environment for things that can become disturbances (i.e., threats) in the near term. Third, resilient people must anticipate. This is the ability to look further into the future than monitoring to see potential threats and opportunities before they materialize. Finally, resilient people must learn from experience. They must examine both mistakes and successes to improve on their ability to respond, monitor, and anticipate.

The RE framework has already been explicitly used to address police shootings by Taylor (2021). He found that when officers keep their firearms in a low ready position (as opposed to a high ready or aimed position), they made substantially fewer errors in a shoot/do not shoot simulator. Keeping the firearm in a low ready position also modestly slowed the speed with which the officers fired, but this slight slowing (i.e., decoupling) may have been what led to more accurate decisions. Teaching police officers to keep their guns in a low ready position when confronting potential threats to reduce the likelihood of an incorrect shoot/do not shoot decision is an example of improving the ability of a person to respond.

Additionally, Blair et al. (2021a) utilized RE to examine the impact of officer flashlight position on the accuracy of a suspect shooting at the officer. They found that when officers positioned their flashlights so that the flashlight was not aligned with the officers' bodies, the accuracy of the suspects was reduced. Something as simple as how officers hold their flashlights when searching for a suspect can impact their resilience.

RE and active shooter response. Assuming that responding to active shooter events is dangerous, we apply the RE framework to address two additional research questions:

RQ2: how can officers avoid being shot when responding to active shooter events?

RQ3: how can the survivability of officers who are shot be increased?

We believe that both questions can be addressed by examining the specific circumstances of officers being shot during active shooter events. Our analysis of these circumstances is an explicit attempt to learn from these events so that officers will be better able to anticipate, monitor, and respond during these events. We believe that this information may both reduce the frequency of police officers shot during active shooter events and increase the survivability of officers who are shot.

Methodology

Data

We identified cases where police officers were shot from the active shooter reports published by the FBI (ALERRT and FBI, 2018a, 2018b; Blair and Schweit, 2014; Schweit, 2016). As we mentioned before, they represent the U.S. government's official data on these events. After identifying the cases, we sought additional information on the circumstances of the shooting(s). This information came from news outlets, official police reports, and other official reports prepared following major incidents (e.g., Straub et al., 2017).

Coding

After identifying events with officers shot, we then coded several variables. These were:

Ambush. A dichotomous nominal variable coded one if the officer was shot in an ambush that was the beginning of the active shooter event. This included situations where the officer was responding to a non-active shooter call or standing a post to provide security. The event was coded zero if the officer was aware that an active shooter event was occurring at the time of the shooting.

Outside. A dichotomous variable coded one if the officer was outside at the time they were shot or zero if inside.

Details. A nominal variable providing more specific information about an officer's location when the shooting occurred. Levels were hallway, room, arrival (in or next to the officer's vehicle), moving outside (the officer was outside, but not next to or in their vehicle), and pursuit (the officer was shot while pursuing the suspect in a vehicle or immediately after the pursuit ended).

Shot multiple. A dichotomous variable indicating whether the officer was hit by gunfire once or multiple times. A one indicated that the officer was shot multiple times. A zero indicated that the officer was shot a single time. It was also not possible to code how many shotgun pellets struck an officer for officers hit by shotgun blasts. We coded all officers hit by shotgun blasts as being shot multiple times. The range of the number of times an officer was shot was between 1 and 15. As can be seen in Table 1, almost two-thirds (62.2%) of officers were shot a single time and about 1 in 3 (30.5%) were shot more than once.

Most severe hit location. An ordinal variable indicating the most dangerous area of the body where the officers were hit by gunfire. Levels were head, torso, extremities, or unknown.

Weapon. A nominal variable showing the type of weapon used to shoot the officer. Levels were pistol, rifle, shotgun, or unknown.

Killed. A dichotomous variable coded one if the officer died because of the gunshot wound(s) and zero if the officer survived.

A single coder coded each of the cases, and a second coder coded 20% of the cases to examine reliability. Agreement between the coders was acceptable (97%) (Hartmann, 1977; Stemler, 2004). Where disagreements occurred, the coders discussed the differences and came to a consensus about the coding. Descriptive statistics are presented in Table 1.

Analysis plan. Our analysis is largely descriptive and exploratory. We have structured it around the three research questions identified above. We first present relevant results for each question. Then, we discuss the results considering the relevant theories and current training.

Table 1. Descriptive statistics.

Variable	*n*	%
Ambush		
Yes	27	32.9
No	55	67.1
Outside		
Yes	53	64.6
No	29	35.4
Details		
Hallway	10	12.2
Room	15	18.3
Arrival	4	4.9
Next to Car	24	29.3
Moving	10	12.2
Pursuit	11	13.4
Unknown	8	9.8
Shot multiple		
Yes	25	30.5
No	51	62.2
Unknown	6	7.3
Most severe hit location		
Head	21	25.6
Torso	19	23.2
Extremities	32	39.0
Unknown	10	12.2
Weapon		
Handgun	28	34.1
Rifle	39	47.6
Shotgun	9	11.0
Unknown	6	7.3
Killed		
Yes	25	30.5
No	57	69.5

Results

How often are police officers shot during active shooter events?

We identified 43 events from 2000 to 2018 with at least one police officer shot. Eighty-two officers were shot in these 43 incidents. This distribution was positively skewed (mean = 1.9, SD = 1.8, median = 1, mode = 1) with a range of 1–10 officers shot during the events. Of the 82 officers that were shot, 25 (30%) died. During the 2000–2018 timeframe, there

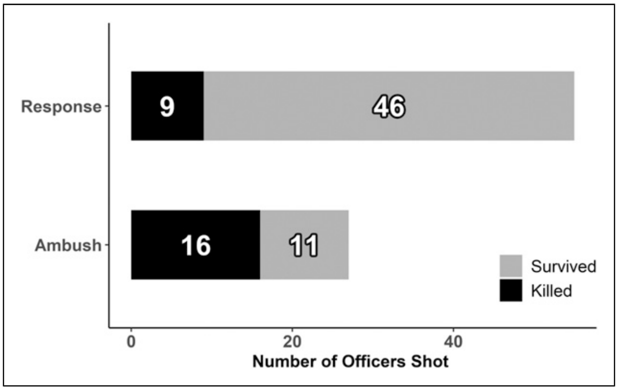

Figure 1. Lethality by response or ambush.

were 277 active shooter events. This means that an officer was shot in about one out of every six active shooter events.

When examining the events, we identified two distinct ways that officers were shot. In 15 events, the active shooter event began with the attacker shooting one or more police officers. These officers did not know that an active shooter event was occurring, and they were not responding. In 28 events, officers were shot when responding to the active shooter event. In five events, officers were shot both at the start of the event and when responding to the event.

Officers who were shot at the outset of an active shooter event were ambushed while performing their normal duties. Often, they were providing security at a fixed post. Research examining homicides of law enforcement officers in the United States has identified ambushes as being particularly deadly (Blair et al., 2016; Crifasi et al., 2016; The International Association of Chiefs of Police, 2020; White, 2020). The International Association of Chiefs of Police (IACP), for example, reported that officers were killed about 54% of the time when they were ambushed.

From the RE perspective, we predict ambushes to be deadly because they happen by surprise. In short, officers are not adjusting their behavior to deal with a potential threat. We expect the opposite to be true for officers who know they are responding to an active shooter event. They anticipate the situation is dangerous and are therefore adjusting their behaviors accordingly (e.g., monitoring and responding).

To test this supposition, we examined the deadliness of shootings in ambush situations versus response situations during active shooter events (see, Figure 1). Of the 55 officers that were shot when responding to an active shooter event, 9 (16%) died. Of the 27 officers shot in an ambush type situation at the outset of an active shooter event, 16 (60%) died. Officers were 7.4 times more likely to die when they were shot during an ambush type situation at the beginning of an active shooter event than when they were shot while responding to an event. This difference in fatality rates suggests that ambushes are distinct from response. Because of this, and because active shooter training is specifically

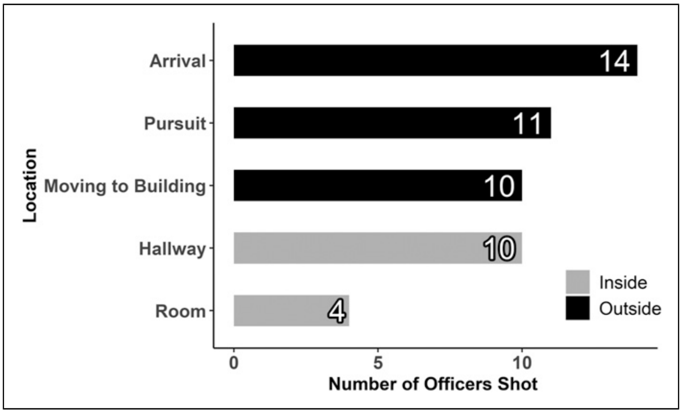

Figure 2. Location of shooting details.

designed to prepare officers to *respond* to an event, we will focus on officers who were shot when responding to an active shooter event for the rest of the analysis

Even when considering only those events where officers were shot responding to an active shooter event, there were 33 events where 55 officers were shot. An officer was shot responding to an active shooter in about 12% of the events (or about 1 out of every 8 events).

How can officers avoid being shot during active shooter response?

In the RE framework, avoiding an accident (i.e., being shot) requires an understanding of how accidents unfold. To provide this understanding, we considered the specifics of the shootings. Consistent with police training, we divided response into two primary areas: outside of buildings and inside of buildings (ALERRT and FBI, 2020; Blair et al., 2013). Thirty-seven (67%) officers were shot outside and 18 (33%) were shot inside buildings during response. Figure 2 provides details regarding the specifics of where officers were at the time of the shooting. Fourteen officers were shot on arrival at the scene of the attack (in or immediately next to their vehicle), 10 moving somewhere between their car and the building, 10 in hallways, and five in rooms. In examining situations of the shootings, we discovered that we needed to add a category reflecting officers shot during (or at the conclusion of) vehicular pursuits. These were generally cases where mobile active shooters began their attack at one location and then got in a vehicle to continue attacking other locations. At some point during this continued attack, the police began to pursue the attacker. Eleven officers were shot during or immediately following these pursuits.

The officers shot in rooms were already in the room at the time of the shooting. An attacker shot one officer in a large lobby-like area of a courthouse. Two officers were shot while searching a cubicle area, and one officer was shot inside a bar. None of the officers shot inside of rooms were performing a room entry when the attacker shot the officer. We note this because room entries are a focus of indoor training.

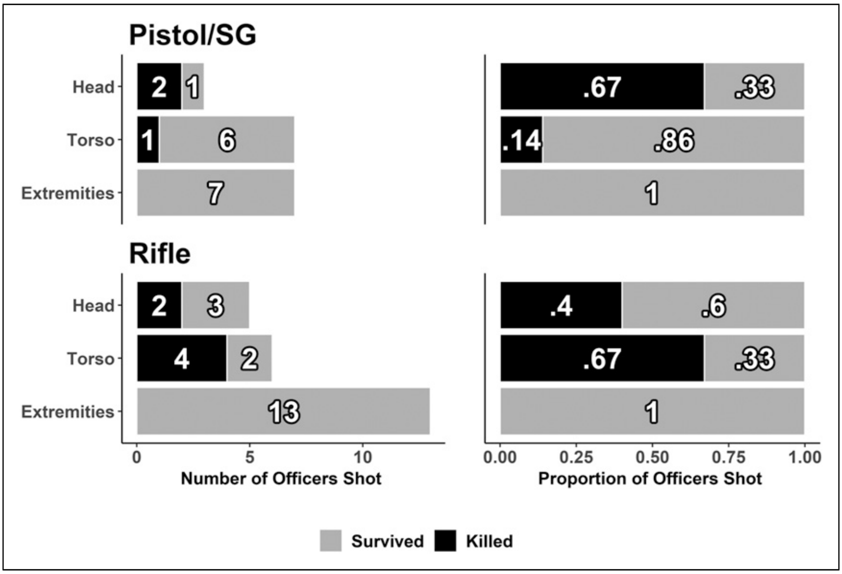

Figure 3. Lethality by most serious hit location and weapon.

How can the survivability of officers who are shot be increased?

We began by assessing if officers were killed while they were inside or outside when they were shot. Of the 37 officers shot outside of structures, 7 (19%) died. Of the 18 officers who were shot inside, 2 (11%) died. Officers who were shot outside of structures were about 1.9 times more likely to die.

Next, we explored where officers were hit, with what weapons, and their likelihood of death. These data are depicted in Figure 3. These data represent the most severe location where the officers were shot with head being considered the most severe, torso next, and extremities least. As shown by the data, eight of the most severe hit locations were in the head, 13 in the torso, and 20 in the extremities. We were missing hit location information for 14 officers.

Figure 3 also displays lethality by weapon used and most severe hit location. We draw the reader's attention to the difference in lethality when the officer's most severe hit location was in the torso. Eighty-six percent of the officers whose most severe hit was in the torso with a pistol or shotgun survived; whereas only 33% of those whose most severe injury was in the torso with a rifle survived. Officers who were shot in the torso with a rifle were 12 times more likely to die than those shot with a pistol or shotgun.

Another way to prevent death is to provide effective medical care to officers who are shot. Unfortunately, our data cannot directly assess the effectiveness of the medical interventions that are currently taught to police officers during active shooter training; however, we note that none of the 20 officers in our data whose most severe hit was in an extremity died.

Discussion

How often are police officers shot during active shooter events?

Consistent with the predictions of NAT, we found that responding to active shooter calls is dangerous for police officers. To place how dangerous active shooter events are in context, consider the rate of injury during domestic violence calls, which are widely considered to be dangerous (Buchanan and Perry, 1985; Buzawa and Buzawa, 2003; Ventura and Davis, 2005). Hirschel et al. (1994), for example, found that the Charlotte Police Department received 1,078,571 calls for service during a 3-year period. Approximately 84,250 (7.8%) of these calls were domestic disturbance calls. In 122 (0.1%) of these calls, an officer was assaulted. In 48 (0.05%) domestic disturbance calls, the officer was injured. In other words, domestic disturbance calls led to one assault per 690 calls and one officer injury per 1,754 calls. While domestic calls can be dangerous, officers are more likely to be injured when responding to an active shooter call (1 in 8 calls) than when responding to a domestic disturbance call (1 out of 1,754 calls).

The current response model tightly couples police with attackers in complex situations. We believe that the public and police leadership will continue to expect police officers to utilize this model; therefore, we expect that officers will continue to be shot during these events. We turn to the RE framework to assess how we can improve the ability of police to avoid being shot and their survivability when shot.

How can officers avoid being shot during active shooter response?

Under the RE framework, avoiding accidents requires that people be able to anticipate the problems that may occur, monitor the situation for signs that a problem is occurring, and utilize effective responses. Effective training should enhance these abilities.

Our data suggest that there is a mismatch between where most response training focuses and where the risk is highest during response to active shooter events. Responding officers are about twice as likely to be shot outside of a structure as inside, yet active shooter response training is more focused on interior operations than exterior (e.g., ALERRT and FBI, 2020). This lack of focus on exterior training may create a miscalibration in a responding officer's anticipation of where they are likely to encounter the attacker. As a result, the officer may not be carefully monitoring the exterior environment as they approach the scene. Increasing the amount of time spent on training in exterior environments and including scenarios where officers encounter the attacker outside may adjust a trainee's understanding of the situation. In turn, their anticipation and monitoring may more closely align with the threats that they are facing. Additionally, simply informing trainees that most officers are shot outside during active shooter events may help officers more accurately anticipate the dangers they face when responding.

Knowing how to effectively respond is also key in RE. In police training, this often means being taught specific tactics. Tactics that could improve response when outdoors can already be found in both military training manuals (Department of the Army, 2016) and specialized outdoor response to active shooter training manuals (ALERRT, 2017).

Among these responses are: donning any special active shooter gear (e.g., increased body armor, go-bags, and rifles) before responding, choosing an approach route that minimizes the opportunity of the attacker to engage the officer, parking in a location that shields the officer from potential gunfire, immediately exiting the vehicle and moving to cover, moving from the vehicle to the building using short rushes from cover to cover, and using bounding overwatch (i.e., one officer provides cover as another officer moves). While some current training and training manuals cover some of these exterior tactics, providing more focus and training time on these tactics may help better prepare officers to respond to exterior threats.

How can the survivability of officers who are shot be increased?

Our finding that responding officers who were shot outside were more likely to die was somewhat surprising. Engagement distances would generally be longer and accuracies lower when they happen outside as opposed to inside. Additionally, it should be easier for other officers to reach a fallen officer that is outside to provide both point of wounding care and rapid transport to definitive care. RE provides a potential explanation for this finding and support for our contention that current training miscalibrates officers to the danger they face. We noted in the results that 60% of officers who were shot at the outset of an active shooter event died and we used RE as an explanation. This RE explanation would also apply if current training miscalibrates the trainee's anticipation of danger. It is possible that officers are more likely to die when they are shot outside because the current focus on interior training causes officers to incorrectly anticipate the danger that is present during the exterior part of the response.

In RE, responding can also involve the use of equipment. Police officers in the United States commonly wear Level IIIa body armor to protect their chests and backs. This body armor is designed to stop most pistol bullets and shotgun blasts. Some researchers have suggested officers should wear ballistic plates capable of stopping rifle rounds (Level III or IV body armor) during active shooter events because about a quarter of all attackers use rifles (Blair et al., 2013, 2014). The data in Figure 3 support this contention. It appears that the standard Level IIIa body armor worn by police stops most torso hits with pistols or shotguns from being lethal but does not generally stop hits with rifle rounds from being lethal.

We also note that helmets rated at Level III and IIIa are available and issued by some police departments. While we cannot assess the overall effectiveness of these helmets for protecting officers during response, there were two officers in our data who were shot in the head while wearing ballistic helmets. Both officers survived. One of these was shot with a rifle and we were unable to determine the weapon used in the other case. Taken as a whole, wearing upgraded body armor when responding to active shooter events can increase the survivability of officers.

Responding under RE also involves responding to being shot. Medical training is now commonly included in active shooter training in the United States. Our data only allowed us to indirectly assess the impact of this training. The training focuses primarily on stopping serious extremity bleeding using tourniquets. None of the officers in our study whose most severe wounds were in the extremities died. Additionally, at least one officer had a tourniquet applied to his arm after being shot, and this tourniquet was attributed with saving the officer's life (Becker, 2019; Kennedy, 2018). It may be that the medical skills taught in active shooter training saved the lives of some of the other 19 officers with extremity wounds. Our data at least suggest that this medical training is useful.

Conclusion

As predicted by NAT, having police officers rapidly enter attack sites to engage shooters is extremely dangerous. Specifically, a responding police officer was shot in one out of every eight active shooter events that occurred in the United States from 2000 to 2018.

Using RE, we assessed how officers could avoid being shot when responding to these events. While the majority of active shooter response training focuses on operations inside of buildings, officers were more likely to be shot when outside. In RE, a key factor in avoiding accidents is the ability of people to understand situations and adjust. Key to these adjustments is the ability of people to anticipate where problems may occur, monitor the environment for indications that these problems are emerging, and respond appropriately. Current active shooter training may give officers an incorrect perception of the risk that they face when outside because substantially less training and scenario time is spent outside. As a result, the training may reduce the effectiveness of officers to anticipate, monitor, and respond. We identified a variety of tactics that could mitigate danger and suggested that spending more training time outside may produce not only better outside skills but also create a more accurate perception of the danger that officers face when they are outside.

We also utilized RE to assess how officers might improve their resilience when shot. RE acknowledges that adjusting can involve using specialized equipment in dangerous situations. Our analysis of the weapons used to shoot officers, hit locations, and survivability suggested that equipping officers with upgraded body armor could substantially increase the survivability of officers who are shot when responding to these events.

While we did not have data that spoke directly to the effectiveness of the medical procedures that are applied to injured officers, our observation that none of the officers whose most serious injury was in the extremities died and the case of one officer's survival being attributed to the application of a tourniquet at least suggest that the medical skills officers are being taught may have helped save lives. Future research should explore the effectiveness of the medical techniques that are now being taught to officers.

Our paper also demonstrated that the principles of NAT and RE can be applied successfully in yet another policing context (active shooter events). NAT had already been applied to understanding police shootings (Klinger, 2005, 2020). RE has been applied to assess the impact of weapon position on correct shoot/do not shoot decisions (Taylor, 2021), and flashlight positioning on hostile suspect accuracy (Blair et al., 2021). It is our belief that the NAT and RE principles can be used in a variety of policing contexts to both avoid errors and reduce the damage caused by errors when they occur. We hope that future research will explore this possibility.

Limitations

Like any study, our data had limitations. While we believe we identified all the cases where officers were shot during active shooter events because these cases receive more attention, we could not always get all the information regarding the shootings that we sought. As a result, we are missing information for some variables for some cases (for more information, see Table 1). Given the relatively small number of officers included in the study, this missing data could sway our results.

Additionally, the 7 July 2016, Dallas, TX, USA shooting, that occurred while police were providing security at a protest march, is the largest targeting of police officers during an active shooter event that has occurred in the United States; yet, no official report has been produced, the department will not share information on the shooting, and media accounts conflict (see for example Bruton et al., 2016; CBSDFW, 2021). Where there was conflict, we chose the more conservative estimates. We believe that we have accurate information on the officers killed in this case, but information on many of the officers who were wounded is missing. We do not believe that this substantially swayed our results because these cases simply drop out of our analysis. Despite these limitations, we believe that our analysis provides important insight into the risks that police officers face during these events, which can be used to improve officer safety and increase officer effectiveness when responding to these events.

Acknowledgments

Thanks to Jacob Fisher for sending us some of the training materials used in this study. Also thanks to Kim Rossmo and Thor Eells for their helpful comments on earlier drafts of this paper.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the Partial funding for this project was provided by COPS Office grant numbers 2019ASWXK001 & 2020ASWXK001. COPS does not endorse the views or opinions expressed by the authors.

ORCID iDs

J Pete Blair https://orcid.org/0000-0003-0905-2643
Aaron Duron https://orcid.org/0000-0002-8525-8056

References

Advanced Law Enforcement Rapid Response Training (ALERRT) (2018a) *Active Shooter Incidents in the United States in 2016 and 2017*. Washington, DC: Center at Texas State University and

Federal Bureau of Investigation. Available at: https://www.fbi.gov/file-repository/active-shooter-incidents-us-2016-2017.pdf/view

Advanced Law Enforcement Rapid Response Training (ALERRT) (2018b) *Active Shooter Incidents in the United States in 2018*. Washington, DC: Center at Texas State University and Federal Bureau of Investigation.

Advanced Law Enforcement Rapid Response Training Center at Texas State University (2017) ERASE: Exterior response to active shooter events.

Advanced Law Enforcement Rapid Response Training Center at Texas State University and Federal Bureau of Investigation (2020) *Active Shooter Response - Level 1*. version 7.2.

Becker A (2019) *Santa Fe Survivor: Inside the race to save Officer John Barnes*. Available at: https://www.tmc.edu/news/2019/02/santa-fe-survivor-inside-the-race-to-save-officer-john-barnes/(accessed 14 January 2022).

Blair JM, Fowler KA, Betz CJ, et al. (2016) Occupational homicides of law enforcement officers, 2003–2013. data from the National Violent Death Reporting System. *American Journal of Preventive Medicine* 51(5 Suppl 3): S188–S196. doi: 10.1016/J.AMEPRE.2016.08.019.

Blair JP and Martaindale MH (2013) *United States Active Shooter Events from 2000 to 2010: Training and Equipment Implications*.

Blair JP and Martaindale MH (2014) *Evaluating Police Tactics: An Empirical Assessment of Room Entry Techniques*. Oxfordshire, England: Routledge.

Blair JP and Martaindale MH (2017). Throwing a chair could save officers' lives during room entries. *International Journal of Police Science & Management* 19(2): 110–119. DOI: 10.1177/1461355717711452.

Blair JP, Sandel WL and Martaindale MH (2021b) Correlates of the number shot and killed in active shooter events. *Homicide Studies* 25(4): 335–360. doi: 10.1177/1088767920976727.

Blair JP and Schweit KW (2014) *A Study of Active Shooter Incidents in the United States between 2000 and 2013*. Washington, DC: FBI. Available at: https://www.fbi.gov/file-repository/active-shooter-study-2000-2013-1.pdf/view.

Blair JP, Pollock J, Montague D, et al. (2011). Reasonableness and Reaction Time. *Police Quarterly* 14(4): 323–343. DOI: 10.1177/1098611111423737.

Blair JP, Nichols T, Burns D, et al. (2013) *Active Shooter Events and Response*. Boca Raton, FL: CRC Press. DOI: 10.1201/b14996.

Blair JP, Martaindale MH and Nichols T (2014) *Active Shooter Events from 2000 to 2012*. Washington, DC: FBI Law Enforcement Bulletin, 7.

Blair JP, Martaindale MH and Spivey ED (2021a) An evaluation of light positioning on suspect accuracy in low light environments. *Justice Evaluation Journal* 1–11. DOI: 10.1080/24751979.2021.1970482.

Blair JP and Martaindale MH (2015) Misrepresenting the FBI active shooter report: a response to lott. *ACJS Today* 40(3): 32–35.

Bruton FB, Smith A, Chuck E, et al. (2016) Dallas police 'ambush': 12 officers shot, 5 killed during protest. Available at: https://www.nbcnews.com/storyline/dallas-police-ambush/protests-spawn-cities-across-u-s-over-police-shootings-black-n605686 (accessed 14 January 2022).

Buchanan DR and Perry PA (1985). Attitudes of police recruits towards domestic disturbances: an evaluation of family crisis intervention training. *Journal of Criminal Justice* 13(6): 561–572. DOI: 10.1016/0047-2352(85)90084-4.

Buzawa ES and Buzawa CG (2003) *Domestic Violence: The Criminal Justice Response*. (3rd ed.). Thousand Oaks: Sage.

CBSDFW com S (2021) Five years after deadly shootout, Dallas police July 7 ambush detailed. Available at: https://dfw.cbslocal.com/2021/07/07/five-years-deadly-shootout-dallas-police-july-7-ambush/.(accessed on 14 January 2022).

Chera BS, Mazur L, Buchanan I, et al. (2015b) Improving patient safety in clinical oncology. *JAMA Oncology* 1(7): 958–964. DOI: 10.1001/jamaoncol.2015.0891.

Chera BS, Mazur L and Marks LB (2015a) Applying Normal Accident Theory to radiation oncology: Failures are normal but patient harm can be prevented. *Practical Radiation Oncology* 5(5): 325–327. doi: 10.1016/J.PRRO.2015.07.005.

Crifasi CK, Pollack KM and Webster DW (2016) Assaults against U.S. law enforcement officers in the line-of-duty: situational context and predictors of lethality. *Injury Epidemiology* 3(1): 1–6. DOI: 10.1186/S40621-016-0094-3.

Dekker S (2019) *Foundations of safety science: a century of understanding accidents and disasters*. Boca Raton, FL: CRC Press.

Department of the Army (2016) *ATP 3-21.8*. Washington, DC: Infantry platoon and squad.

Duron A (2021) "Shots fired! we have many people down!": common recommendations for managing high-casualty active shooter events in the USA. *International Journal of Disaster Risk Reduction* 65: 102548. DOI: 10.1016/j.ijdrr.2021.102548.

Fox JA and Levin J (2015) Mass confusion concerning mass murder. *The Criminologist* 40(1): 8–11.

Hartmann DP (1977). Considerations in the choice of interobserver reliability estimates. *Journal of Applied Behavior Analysis* 10(1): 103–116. DOI: 10.1901/JABA.1977.10-103.

Hirschel JD, Dean CW and Lumb RC (1994). The relative contribution of domestic violence to assault and injury of police officers. *Justice Quarterly* 11(1): 99–117. DOI: 10.1080/07418829400092151.

Hollnagel E (2011) Prologue: the scope of resilience engineering. In: Hollnagel E, Paries J, Woods D, et al. (eds), *Resilience engineering in practice: a guidebook*. Boca Raton: CRC Press. xxix–xxxix.

Hollnagel E, Woods D and Leveson N (eds), (2006). *Resilience engineering: concepts and precepts* Boca Raton: CDC Press.

Jordan K (2003) A trauma and recovery model for victims and their families after a catastrophic school shooting: focusing on behavioral, cognitive, and psychological effects and needs. *Brief Treatment and Crisis Intervention* 3(4): 397–411. DOI: 10.1093/BRIEF-TREATMENT/MHG031.

Kennedy T (2018) *HPD retired officer john Barnes, shot in the elbow when he confronted the Santa Fe active shooter, believes medical trauma training and presence of a tourniquet enabled another officer to save his life*. Available at: https://hpou.org/hpd-retired-officer-john-barnes-shot-in-the-elbow-when-he-confronted-the-santa-fe-active-shooter-believes-medical-trauma-training-and-presence-of-a-tourniquet-enabled-another-officer-to-save-his-lif/(accessed on 14 January 2022).

Kissner J (2016) Are active shootings temporally contagious? An empirical assessment. *Journal of Police and Criminal Psychology* 31(1): 48–58. doi: 10.1007/S11896-015-9163-8.

Klinger D (2005) *Social theory and the street cop: the case of deadly force*. Police Foundation, 7.

Klinger D. (2020) Organizational accidents and deadly police-involved violence: Some thoughts on extending theory, expanding research, and improving police practice. *Annals of the Americal Academy of Political and Social Science* 687: 28–48.

Lankford A and Madfis E (2017). Don't name them, don't show them, but report everything else: a pragmatic proposal for denying mass killers the attention they seek and deterring future offenders. *American Behavioral Scientist* 62(2): 260–279. DOI: 10.1177/0002764217730854.

Lott JR (2015) The FBI's misinterpretation of the change in mass public shooting. *ACJS Today* 40(2): 18.

Majeed MH, Sudak DM and Beresin E (2019). Mass shootings and the news media: what can psychiatrists do? *Academic Psychiatry* 43(4): 442–446. DOI: 10.1007/S40596-019-01066-2.

Marley KA, Ward PT and Hill JA (2014) Mitigating supply chain disruptions - a normal accident perspective. *Supply Chain Management: An International Journal* 19(2): 142–152. DOI: 10.1108/SCM-03-2013-0083.

Martaindale MH and Blair JP (2019) The evolution of active shooter response training protocols since columbine: lessons from the advanced law enforcement rapid response training Center. *Journal of Contemporary Criminal Justice* 35(3): 342–356. DOI: 10.1177/1043986219840237.

Martaindale MH, Sandel WL and Blair JP (2017) Active-shooter events in the workplace: findings and policy implications. *Journal of Business Continuity & Emergency Planning* 11(1): 6–20.

Meindl JN and Ivy JW (2017). Mass Shootings: The Role of the Media in Promoting Generalized Imitation. *American Journal of Public Health* 107(3): 368–370. DOI: 10.2105/AJPH.2016.303611.

Perrow C (1984) *Normal accidents: living with high risk technologies*. New York: Basic Books.

Phillips SW (2020). Police response to active shooter events: how officers see their role. *Police Quarterly* 23(2): 262–279. DOI: 10.1177/1098611119896654.

Richardson JD, Davidson D and Miller FB (1996) After the shooting stops: follow-up on victims of an assault rifle attack. *Journal of Trauma and Acute Care Surgery* 41(5): 789–793.

Schildkraut J and Muschert GW (2014). Media salience and the framing of mass murder in schools. *Homicide Studies* 18(1): 23–43. DOI: 10.1177/1088767913511458.

Schildkraut J, Elsass HJ and Meredith K (2017) Mass shootings and the media: why all events are not created equal. *Journal of Crime and Justice* 41(3): 223–243. DOI: 10.1080/0735648X.2017.1284689.

Schweit KW (2016) *Active Shooter Incidents in the United States in 2014 and 2015*. Washington, DC.

Sherman LW (2018) Reducing fatal police shootings as system crashes: research, theory, and practice. *Annual Reviews* 1: 421–449. DOI: 10.1146/ANNUREV-CRIMINOL-032317-092409.

Shultz JM, Thoresen S, Flynn BW, et al. (2014). Multiple vantage points on the mental health effects of mass shootings. *Current Psychiatry Reports* 16: 1–17. DOI: 10.1007/S11920-014-0469-5.

Silver J, Simons A and Craun S (2018) *A Study of the Pre-attack Behaviors of Active Shooters in the United States between 2000 and 2013*.

Smith ER, Sarani B, Shapiro G, et al. (2019). Incidence and cause of potentially preventable death after civilian public mass shooting in the US. *Journal of the American College of Surgeons* 229(3): 244–251. DOI: 10.1016/J.JAMCOLLSURG.2019.04.016.

Stemler SE (2004) A comparison of consensus, consistency, and measurement a comparison of consensus, consistency, and measurement approaches to estimating interrater reliability approaches to estimating interrater reliability. *Practical Assessment, Research, and Evaluation* 9(4): 1–11. DOI: 10.7275/96jp-xz07.

Straub F, Cambria J, Castor J, et al. (2017) *Rescue, response and resilience: a critical incident review of the orlando public safety response to the attack on the pulse nightclub*. Washington, DC. DOI: 10.1348/000711008X374126.

Taylor PL (2021). "Engineering resilience" into split-second shoot/no shoot decisions: the effect of muzzle-positionPolice quarterly. *Police Quarterly* 24(2): 185–204. DOI: 10.1177/1098611120960688.

The International Association of Chiefs of Police (2020). *Ambush fact sheet*. Available at: https://www.theiacp.org/sites/default/files/2018-08/IACP_Ambush_Fact_Sheet.pdf (accessed 2 September 2021).

Towers S, Gomez-Lievano A, Khan M, et al. (2015). Contagion in mass killings and school shootings. *Plos One* 10(7): e0117259. DOI: 10.1371/JOURNAL.PONE.0117259.

U.S. Department of Homeland Security (2008) *Active Shooter: How to Respond*. Washington, DC.

Ventura LA and Davis G (2005). Domestic violence. *Violence Against Women* 11(2): 255–277. DOI: 10.1177/1077801204271722.

White MD (2020). Ambush killings of the police, 1970-2018: a longitudinal examination of the "war on cops" debate. *Police Quarterly* 23(4): 451–471. DOI: 10.1177/1098611120919441.

Wolf F and Sampson P (2007). Evidence of an interaction involving complexity and coupling as predicted by normal accident theory. *Journal of Contingencies and Crisis Management* 15(3): 123–133. DOI: 10.1111/J.1468-5973.2007.00514.X.

Wolf FG (2001). Operationalizing and testing normal accident theory in petrochemical plants and refineries. *Production and Operations Management* 10(3): 292–305. DOI: 10.1111/J.1937-5956.2001.TB00376.X.

Zimring FE (2017) *When Police Kill*. Cambridge: Harvard University Press.