Hitting the Target (or Not): Comparing Characteristics of Fatal, Injurious, and Noninjurious Police Shootings

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HITTING THE TARGET (OR NOT): COMPARING CHARACTERISTICS OF FATAL, INJURIOUS, AND NONINJURIOUS POLICE SHOOTINGS

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*Despite the well-documented inaccuracy of police officers who use deadly force, research has generally given scant attention to factors that affect shooting accuracy. This article uses bivariate and multivariate analyses—logistic regression and chi-square automatic interaction detector (CHAID)—to examine characteristics among noninjurious, injurious, and fatal police shootings in Philadelphia from 1987 to 1992 (*N = *271). A number of factors emerge as predictors of shooting accuracy including distance, suspect actions, and officer approach and preparedness. Alternatively, a number of seemingly important factors appear unrelated to shooting accuracy including lighting conditions, use of cover, and gun type. The article concludes with a discussion of findings and their implications for police policy and training.*

Keywords: *deadly force; shooting accuracy; police shootings*

The power to deprive citizens of life and liberty through use of deadly force represents the most extreme exercise of police authority. Although police shootings are rare, they are controversial even under the best circumstances, and they can have potentially devastating consequences not only for the victim and the officer but also for the police department, the community, and their relationship (Fyfe, 1988; Geller & Scott, 1992). For example, in the past decade, police use of deadly force in Memphis and New York City has placed tremendous strain on police-community relations, and police shoot-

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ings in Cincinnati, Ohio, and St. Petersburg, Florida, led to civil disorder and riots.

Yet prior research consistently indicates that police officers who use deadly force *miss* their intended targets far more often than they hit them (Geller & Karales, 1981a, 1981b; Geller & Scott, 1992; Matulia, 1985). Hit rates vary notably across police agencies but rarely exceed 50% (Geller & Scott, 1992). Matulia (1985) stated that although Hollywood often portrays police officers as sharp shooters, "in reality many police officers have a difficult time meeting departmental qualification standards at the firing range, let alone during a combat situation" (p. 69). Despite the potentially destructive consequences of deadly-force incidents and the well-documented inaccuracy of police officers, research has generally given scant attention to factors that affect police shooting accuracy. As a result, very little is known about the characteristics of shootings where police kill, hit and injure, and miss their target; whether there are important differences between those incidents; and, if there are important differences, how that information can be used to improve officer shooting accuracy in such encounters.

This research examines these issues using police shooting data from Philadelphia from 1987 to 1992 ($N = 271$). The article employs a two-part analytic approach to study intentional shootings at suspects resulting in death, injury, and no injury (target missed). First, bivariate analysis including chi-square analysis, *t* tests, and one-way ANOVAs are employed to characterize fatal, injurious, and noninjurious shooting incidents and search for important differences among the different types of deadly-force encounters. Second, based on the bivariate analysis, logistic regression and chi-square automatic interaction detector (CHAID) tests are employed to identify predictors of fatal shootings and noninjurious shootings (misses). The article concludes with a discussion of the findings, their implications for police policy and training, and the need for additional research to more fully understand police shooting behavior and the factors that influence police shooting accuracy.

Prior Research on Deadly Force and Shooting Accuracy

The Prevalence of Deadly Force and Its Consequences

By all accounts, police use of deadly force is a rare event (Geller & Scott, 1992; Reiss, 1971). Geller and Scott (1992) noted that for the average

officer to be statistically expected to shoot and kill a suspect, he or she would have to work 193 years in Portland, Oregon; 198 years in Dallas; 594 years in Chicago; 694 years in New York City; 1,299 years in Milwaukee, Wisconsin; and 7,692 years in Honolulu. Although there were some indications that levels of deadly force increased during the late 1980s and early 1990s, the number of police shootings nationally has remained relatively stable over time (with variation in individual cities, of course; Geller & Scott, 1992).

Despite the rarity of the event, police use of deadly force can have devastating effects. Although the decision to shoot clearly poses great risk to the suspect, the potential consequences of a police shooting far exceed the physical injury of one person (Fyfe, 1988). According to Geller and Scott (1992),

> Any experienced police officer knows the potentially devastating effects of even justified shootings by police—loss of life and bereavement, risks to an officer's career, the government's liability to civil suits, strained police-community relations, rioting and all the economic and social crises that attend major civil disturbances. (p. 1)

The National Advisory Commission on Civil Disorders (1968) concluded that the police were an "activating cause" of many of the riots that occurred during the 1960s (see also Skolnick & Fyfe, 1993, p. 78). More recently, riot and disorder followed the shooting deaths of young Black men by police in St. Petersburg (in 1996) and Cincinnati (in 2001), and police-community relations in New York City were strained in 1999 when four police officers fired more than 40 shots at an unarmed man (Amadou Diallo).

Factors That Influence Police-Shooting Behavior

Although research has generally ignored factors affecting shooting accuracy, there is a substantial literature studying the factors that influence use of deadly force more generally. During the past 40 years, much research has focused on identifying the primary determinants of police shooting behavior, and three sets of potentially influential variables emerge from prior research: situational, organizational, and environmental.[1]

Environmental variables are outside the police organization and can be separated into two basic categories: community-level characteristics that indirectly affect police shooting behavior, such as the violent crime arrest rate, public homicide rate, and population level, and direct, external efforts to control deadly-force discretion (e.g., discretion control policies such as

court rulings and state laws). Numerous studies have linked levels of deadly force to the prevalence of community-level violence (Alpert, 1989; Fyfe, 1980; Geller & Karales, 1981b; Jacobs & Britt, 1979; Kania & Mackey, 1977; Liska & Yu, 1992; Matulia, 1985; Sherman & Langworthy, 1979; Sorenson, Marquart, & Brock, 1993; White, 2003). Direct, external efforts to control police shooting behavior include criminal law and judicial intervention (injunctive relief and rulings), although research has generally shown that these controls exert little influence on police shooting behavior if not accompanied by support within the police department (Skolnick & Fyfe, 1993; Tennenbaum, 1994; White, 2003).

Prior research demonstrates that formal and informal organizational characteristics, mostly notably administrative policy, significantly influence levels of deadly force (Blumberg, 1989; Fyfe, 1979, 1988; Geller & Scott, 1992; Reiss, 1968, 1980). The implementation of restrictive administrative policies has led to significant decreases in police shootings in New York City, Oakland, Omaha, Kansas City, Los Angeles, Dallas, Memphis, and Philadelphia (Fyfe, 1988; Gain, 1971; Geller & Scott, 1992; White, 2001, 2003). Research shows that other aspects of the internal environment, including informal policies and norms and administrative climate, can also significantly affect police officer decisions to use deadly force (Fyfe, 1988; Gain, 1971; Sherman, 1983; White, 2001).

Situational variables refer to factors specific to each police-citizen encounter, such as citizens' demeanor, the number of suspects present, and the presence of a weapon. The literature typically shows that characteristics of the officer, suspect, and incident can affect the likelihood of a violent outcome. The majority of suspects who are shot or are shot at present a real and imminent danger to the police (Binder & Fridell, 1984; Binder & Scharf, 1980; Fyfe, 1980, 1981a; Kobler, 1975a, 1975b; Margarita, 1980; Robin, 1963). The literature also consistently shows that shooting victims are disproportionately African American (Fyfe, 1981b; Geller & Karales, 1981a; Milton, Halleck, Lardner, & Albrecht, 1977; Robin, 1963; Takagi, 1974), although the causes of that overrepresentation are unclear and may vary by location.[2] Other situational factors shown to influence police shooting behavior include officer age (Blumberg, 1989), the visibility of the situation to peers and the public (Friedrich, 1980), and decisions made earlier in the police-citizen encounter (Binder & Scharf, 1980; Fyfe, 1986).

RESEARCH ON POLICE OFFICER ACCURACY

Hit Rates

There is a considerable amount of research examining the rates at which police officers shoot and hit—and shoot and kill—suspects. Research has consistently shown that although there is substantial variation across police departments, hit rates typically dip well below 50% (Copay & Charles, 2001). "The numbers of wounded and slain criminal suspects in the United States pale by comparison to the numbers shot at but missed by police" (Geller & Scott, 1992, p. 100). Horvath and Donahue (1982) reported that among 155 Michigan police departments, officers involved in deadly-force encounters hit suspects in approximately 27% of the incidents (from 1976 to 1981). Research in New York City showed consistently low rates from year to year for the New York Police Department (NYPD): 26% for 1987, 31% for 1988, and 23% for 1990 (Cerar, 1990; NYPD, 1988). Rates have been less stable in Los Angeles where during the 1970s officers in the Los Angeles Police Department (LAPD) hit their suspects in 56% of cases, but from 1980 to 1988, the rate dropped to 28% (Meyer, 1980; M. Scott, personal communication, February 17, 1989). Alpert (1989) reported that from January 1984 through June 1988, officers in the Metro-Dade, Florida, Police Department fired at 100 suspects, hitting their target in 31 cases. Pate and Hamilton (1991) reported similar hit rates for the six largest police agencies in 1986. The Dallas Police Department (1992) completed a survey of big-city police departments during 1991, and rates ranged from a low of 25% in Memphis to a high of 100% in San Antonio and San Francisco.[3]

Despite the abundance of research examining hit rates, it is difficult to make comparisons of officer shooting accuracy across agencies. Geller and Scott (1992) noted that these comparisons are complicated by problems in gaining access to "complete and accurate reports from officers about off-target shots" (p. 104) and by differences in how departments report their data. For example, hit rates for bullets fired are different from incident hit rates where officers may fire multiple shots with only one striking the suspect (Geller & Scott, 1992, p. 105). Incident hit rates are typically higher than bullet hit rates, which take into account the accuracy of each shot fired. Nevertheless, the research examining shooter accuracy overwhelmingly debunks the Hollywood myth of police officers as sharp shooters who can wing suspects in the shoulder or leg or shoot weapons out of suspects' hands (Geller & Karales, 1981b; Geller & Scott, 1992).

Factors Influencing Hit Rates

Little research has examined the factors that influence the accuracy of police officers in shooting incidents. Geller and Scott (1992) noted a significantly higher hit rate among officers in the New York City Transit Police Department (NYTPD) during the 1980s compared with officers in the NYPD, and they suggested that the difference in accuracy may be caused by the different work environments and the fact that transit officers were much less likely to receive adequate backup.[4] Schade and Bruns (1989) found that as the threat to the officer became more severe (gun assault vs. physical or other weapon assault), the officer's shooting accuracy decreased. Donahue and Horvath (1991) compared characteristics of fatal and noninjurious shootings (misses) and found that suspects who were killed were more likely to be armed and to have assaulted the officer, whereas suspects in off-target shootings were more likely to be fleeing. Also, suspects who were killed were much more likely to have serious criminal histories than those who were not injured, thereby suggesting that those who were killed may have acted differently (i.e., their more serious criminal records may have led them to act more desperately; Donahue & Horvath, 1991).

A number of researchers have examined the switch from revolvers to semiautomatic pistols in terms of impact on the number of shots fired and the accuracy of those shots, and the findings are mixed (Geller & Scott, 1992). Cerar (1990) and Brown (1992) found that the adoption of semiautomatic pistols did not lead to an increase in the number of rounds fired per incident, nor did it improve accuracy. Geller and Scott (1992) reported that the number of shots did increase considerably among officers using semiautomatics in the NYTPD and in Portland, Oregon. Matulia (1982) reported that agencies using semiautomatic pistols experienced a "significantly higher justifiable homicide rate" (p. 169; see also Matulia, 1985).[5]

Copay and Charles (2001) examined the impact of night sights in different lighting conditions on police officer shooting accuracy. Although the study was conducted as part of training and not in real-life shooting situations, the results indicated that the addition of night sights to firearms increased police officers' shooting accuracy in four different lighting conditions (Copay & Charles, 2001).[6] Couture et al. (1999) examined the impact of two mental training strategies separately and combined on police officer shooting accuracy. Again, in a training situation, officers receiving the combined mental training regimen were significantly more accurate in their shooting than officers getting the single training and no training (Couture et al., 1999).

Beyond this limited number of studies, research has not thoroughly considered the factors that influence police shooting accuracy. Given the well-documented problems with hit rates and the serious, long-term consequences of deadly-force incidents, it is important to study the circumstances, conditions, and factors that may affect police shooting accuracy in combat situations. This article examines these issues using shooting data from the Philadelphia Police Department.

METHOD

DATA

This article examines all intentional firearms discharges at citizens in the city of Philadelphia from 1987 to 1992 ($N = 271$).[7] The data are derived from Philadelphia Police Department Internal Affairs shooting investigations obtained through discovery in civil litigation against the department.[8] The internal affairs reports varied tremendously in their breadth and scope from several pages to several hundred depending on the nature of the shooting. The author employed a coding scheme that captured no fewer than 75 officer, suspect, and incident-related variables for each shooting.[9]

ANALYSIS

All data were entered into SPSS with the officer rather than the incident as the unit of analysis.[10] The author then created the dependent variable—that is, did the officer hit the intended target: no, missed suspect (0); yes, injured suspect (1); and yes, killed suspect (2). Of the 271 intentional shootings by police at suspects, 51% missed the suspect ($n = 139$), 35% hit and injured the suspect ($n = 94$), and 14% of the incidents were fatal ($n = 38$). The article relies on the outcome of the shooting—miss, hit and injure, and fatal—as a proxy for shooting accuracy.[11]

The article employs a two-pronged analysis to characterize and compare fatal, injurious, and noninjurious shootings in Philadelphia during the study period. First, the deadly-force encounters are examined using bivariate analysis including chi-square analysis, independent samples t tests, and one-way ANOVAs. The overall goal of this part of the analysis is to capture the basic characteristics of each type of shooting (i.e., factors associated with shooting accuracy) and identify important differences among them with regard to officer, suspect, and incident-related variables.

The second part of the approach employs multivariate analysis, including logistic regression and CHAID, to identify predictors of noninjurious shootings (misses) and fatal shootings.[12] Logistic regression functions much the same way as multivariate linear regression except that the outcome being predicted is a dichotomous, nominal-level variable (i.e., Did the officer miss the suspect? Did the officer kill the suspect?).

The CHAID method performs segmentation modeling by dividing the cases into groups that differ based on a specific variable (Magidson, 1993). The resulting segments are mutually exclusive and exhaustive, and cases can be classified by identifying the specific values of predictors that defined the splits (i.e., simply tracing the segment back up the CHAID tree). CHAID is especially useful for measuring interactions among predictors that highlight an increased association with values of the dependent variable.[13]

Both logistic regression and CHAID are employed to identify predictors of fatal and noninjurious shootings using the pool of potential predictors identified in the earlier bivariate analysis. The goal of this part of the analysis is to determine if differences between the types of shootings are strong enough to withstand multivariate regression testing and, if so, to consider the implications of the findings for police policy and training. Specifically, can the knowledge gained from the analysis shed light on the factors that lead to officers' missing the suspect or killing the suspect, and ultimately, can training and policy be modified to better prepare officers and improve their shooting accuracy?

LIMITATIONS

This article suffers from a number of limitations that must be acknowledged. First, the shootings examined here occurred more than a decade ago. The extent to which factors affecting police shooting accuracy have changed during the past 15 years is unknown. Second, the article only examines shooting data from one police department. Philadelphia is a large police department—more than 8,000 sworn personnel—with a unique history and culture. The generalizability of these findings to other police departments also remains unknown. Last, although a good portion of the article focuses on fatal shootings, the Philadelphia data include only 38 cases where a suspect was shot and killed. The small number of fatal shootings limits the conclusions that can be drawn from these analyses. Nevertheless, given that police are reluctant to voluntarily turn over internal

investigations of police shootings and given that little research has examined factors affecting shooting accuracy at this level of detail, the article still represents a valuable effort to increase the knowledge base in this underdeveloped area of the police literature.

RESULTS

BIVARIATE ANALYSIS

Table 1 shows basic officer, suspect, and incident-related characteristics among noninjurious, injurious, and fatal police shootings, and a number of differences emerge across shooting types (as illustrated by statistically significant chi-square values). Table 2 shows mean values for a variety of shooting-related characteristics as well as results from one-way ANOVA tests.

Incident-Related Characteristics

- Nonassaultive suspects:
  - — A greater percentage of noninjurious shootings involve nonassaultive suspects (10.1% vs. 2.1% for injurious and 2.6% for fatal).
- Time of day:
  - — A greater percentage of fatal shootings occur in the afternoon (34.2% vs. 12.9% for noninjurious and 19.1% for injurious).
- How officer became involved:
  - — A greater percentage of fatal shootings begin as a result of a radio call (55.3% vs. 30.2% for noninjurious and 37.2% for injurious).
- Burglary call:
  - — A smaller percentage of noninjurious shootings involve burglary calls (3.6% vs. 10.6% for injurious and 13.2% for fatal).
- Location—rear yard/alley:
  - — A greater percentage of fatal shootings occurred in an alley or rear yard (18.4% vs. 10.1% for noninjurious and 4.3% for injurious).
- Reason for shooting—defense of life:
  - — A greater percentage of fatal shootings involve the officer defending his or her life or someone else's (97.4% vs. 73.4% for noninjurious and 88.3% for injurious).
- Officer and suspect position—struggling:
  - — A greater percentage of noninjurious shootings occur during a struggle between the officer and suspect (18.7% vs. 4.3% for injurious and 2.6% for fatal).
- Suspect armed and fires first:
  - — A greater percentage of noninjurious shootings occur when the suspect fires a gun at the officer first (41.0% vs. 24.5% for injurious and 23.7% for fatal).
- Distance between officer and suspect:

  - — A greater percentage of noninjurious shootings occur when the suspect and officer are more than 20 ft apart (39.4% vs. 24.4% for injurious and 8.8% for fatal).
  - — The mean distance for noninjurious shootings is significantly greater than the distance for fatal shootings (3.92 ft and 3.0 ft, respectively).
- Justifiable shooting:
  - — A greater percentage of noninjurious shootings are found to be in violation of department policy (33.3% vs. 20.0% for injurious and 5.9% for fatal).

Officer-Related Characteristics

- Officer duty status:
  - — A smaller percentage of fatal shootings occur while the officer is off duty (7.9% vs. 27.3% for noninjurious and 26.6% for injurious).
- Officer position:
  - — A greater percentage of noninjurious shootings occur when the officer is running (13.7% vs. 6.4% for injurious and 7.9% for fatal).
  - — A greater percentage of fatal shootings occur when the officer is backing up (7.9% vs. 0.0% for noninjurious and 2.1% for injurious).
- Number of officers involved:
  - — The mean number of officers involved is greater for fatal shootings (2.97 vs. 2.14 for noninjurious and 2.20 for injurious).

Suspect-Related Characteristics

- Suspect weapon:
  - — A greater percentage of noninjurious shootings occur when the suspect is unarmed (10.1% vs. 2.1% for injurious and 2.6% for fatal).
- Suspect actions:
  - — A greater percentage of fatal shootings occur when the suspect is attacking/fighting/resisting (76.3% vs. 43.2% for noninjurious and 47.9% for injurious).
- Suspect age:
  - — A greater percentage of noninjurious shootings involve suspects aged 19 to 25 (52.6% vs. 37.0% for injurious and 35.1% for fatal).

Notable Nonsignificant Associations

Tables 1 and 2 also show a number of notable nonsignificant associations. That is, there is no significant bivariate association in these data when one might be expected either intuitively or because of prior research.

- Location—indoors or outdoors:
  - — Although noninjurious shootings were slightly more likely to occur outdoors (open, less confined spaces), the differences were not statistically significant (92.1% vs. 84.0% for injurious and 86.8% for fatal).
- Lighting conditions:
  - — Noninjurious shootings were no more likely to occur in dark or poor lighting conditions (i.e., poor light did not appear to influence accuracy; 25.4% vs. 21.1% for injurious and 28.9% for fatal).

TABLE 1. Bivariate Comparison of Characteristics Among Noninjurious, Injurious, and Fatal Police Shootings in Philadelphia, 1987 to 1992

	Noninjurious (n = *139*)	*Injurious* (n = *94*)	*Fatal* (n = *38*)	*Chi-Square Significance*
Incident-related characteristics				
Incident type (assault on officer)				.019*
Gun	65.5	62.8	63.2	
Knife	5.0	17.0	18.4	
Other weapon	10.8	12.8	13.2	
Physical	8.6	5.3	2.6	
Nonassault	10.1	2.1	2.6	
Time of day				.034*
Overnight (12:01-6:00 a.m.)	35.3	31.9	23.7	
Morning (6:01 a.m.-noon)	12.2	4.3	7.9	
Afternoon (12:01-6:00 p.m.)	12.9	19.1	34.2	
Night (6:01 p.m.-midnight)	39.6	44.7	34.2	
Location				.156
Indoors	7.9	16.0	13.2	
Outdoors	92.1	84.0	86.8	
How officer became involved				.017*
Radio call	30.2	37.2	55.3	
Observation/civilian advised	69.8	62.8	44.7	
Disturbance call				.600
No	97.1	94.7	94.7	
Yes	2.9	5.3	5.3	
Burglary call				.044*
No	96.4	89.4	86.8	
Yes	3.6	10.6	13.2	
Robbery call				.125
No	82.0	80.9	94.7	
Yes	18.0	19.1	5.3	
Suspicious person call				.373
No	87.1	90.4	81.6	
Yes	12.9	9.6	18.4	
Car stop				.089
No	84.2	88.3	97.4	
Yes	15.8	11.7	2.6	
Man with gun call				.321
No	73.4	80.9	86.1	
Yes	26.6	19.1	18.4	
Lighting conditions				.600
Dark/poor	25.4	21.1	28.9	
Good	74.6	78.9	71.1	
Location				.035*
Alley/rear yard	10.1	4.3	18.4	
Other	89.9	95.7	81.6	
Reason for shooting				.000*
Defend self/others	73.4	88.3	97.4	
Other	26.6	11.7	2.6	

(continued)

TABLE 1. (continued)

	Noninjurious (n = *139*)	*Injurious* (n = *94*)	*Fatal* (n = *38*)	*Chi-Square Significance*
Incident-related characteristics				
Shooting occurred during struggle				.001*
No	81.3	95.7	97.4	
Yes	18.7	4.3	2.6	
Who fired first shot				.013*
Officer	59.0	75.5	76.3	
Suspect/other	41.0	24.5	23.7	
Distance between officer and suspect				.006*
Point blank-3 ft	18.2	22.2	41.2	
4-10 ft	21.2	30.0	29.4	
11-20 ft	21.2	23.3	20.6	
21 ft or more	39.4	24.4	8.8	
Number of suspects				.297
1	57.6	62.8	71.1	
More than 1	42.4	37.2	28.9	
Number of officers				.161
1	41.0	35.1	24.3	
More than 1	59.0	64.9	75.7	
Number of shooters (police)				.079
1	87.1	76.6	76.3	
More than 1	12.9	23.4	23.7	
Internal affairs ruling				.002*
Shooting violated policy	33.3	20.0	5.9	
Shooting in accordance with policy	66.7	80.0	94.1	
Officer-related characteristics				
Rank				.479
Patrol officer	85.6	74.5	84.2	
Sergeant	7.2	13.8	10.5	
Other	7.2	11.7	5.3	
Officer gender				.987
Male	94.2	94.7	94.7	
Female	5.8	5.3	5.3	
Officer race				.297
White	53.2	60.6	65.8	
Black	37.4	37.2	31.6	
Hispanic	8.6	2.1	2.6	
Officer duty status				.038*
On duty	72.7	73.4	92.1	
Off duty	27.3	26.6	7.9	
Police officer actions prior to shooting				.074
Approaching vehicle	7.2	11.7	5.3	
Confronting suspect	31.7	35.1	26.3	
Subduing suspect	18.0	4.3	13.2	
Attempting to arrest suspect	30.9	28.7	39.5	
Other	12.2	20.2	15.8	
Officer's gun				.690
Semiautomatic	25.4	22.6	18.9	
Revolver	74.6	77.4	81.1	

(continued)

TABLE 1. (continued)

	Noninjurious (n = *139*)	*Injurious* (n = *94*)	*Fatal* (n = *38*)	*Chi-Square Significance*
Officer-related characteristics				
Police officer position during shooting				.001*
Standing	50.4	70.2	44.7	
Crouch/kneeling	4.3	4.3	0.0	
Running	13.7	6.4	7.9	
Struggling with suspect	16.5	6.4	13.2	
Backing up	0.0	2.1	7.9	
Other	15.1	6.4	26.3	
Shooter was the first officer on scene				.116
No	13.2	13.3	26.3	
Yes	86.8	86.7	73.7	
Other officers present during shooting				.127
No	53.2	43.6	36.8	
Yes	46.8	56.4	63.2	
Officer's gun drawn prior to shooting				.816
No	25.2	27.0	30.6	
Yes	74.8	73.0	69.4	
Officer used cover				.130
No	75.2	86.0	81.6	
Yes	24.8	14.0	18.4	
Officer called for backup prior to shooting				.076
No	73.5	64.9	55.3	
Yes	26.5	35.1	44.7	
Suspect-related characteristics				
Suspect weapon				.019*
None	10.1	2.1	2.6	
Gun	65.5	62.8	63.2	
Knife/cutting instrument	5.0	17.0	18.4	
Physical force/attack	8.6	5.3	2.6	
Other	10.8	12.8	13.2	
Suspect actions at time of shooting				.001*
Fighting/attacking	43.2	47.9	76.3	
Other	56.8	52.1	23.7	
Suspect age				.039*
19-25 years old	52.6	37.0	35.1	
18 or younger; 26 or older	47.4	63.0	64.9	
Number of suspects				.297
1	57.6	62.8	71.1	
More than 1	42.4	37.2	28.9	

*$p < .05$.

- Officer gun type—revolver or semiautomatic:
  - — Fatal shootings were no more likely when the officer used a semiautomatic pistol (18.9% vs. 25.4% for noninjurious and 22.6% for injurious).
- Officer use of cover and gun drawn prior to shooting:

TABLE 2. Selected Mean Differences and One-Way ANOVA Results Among Noninjurious, Injurious, and Fatal Police Shootings in Philadelphia, 1987 to 1992

	Noninjurious (n = *139)*	*Injurious* (n = *94)*	*Fatal* (n = *38)*	F *Value (ANOVA)*	F *Significance*
Mean officer age	35.17	34.33	33.87	0.667	.514
Mean number of suspects	1.65	1.58	1.44	0.773	.468
Mean number of shots fired by officer	2.37	2.83	2.79	1.140	.321
Mean total shots fired by police	3.06	3.86	4.61	2.358	.097
Mean number of shots fired at officer	0.61	0.89	0.92	0.409	.655
Mean number of officers involved	2.14	2.20	2.97	3.808	.023*
Mean number of shooters (police)	1.22	1.30	1.45	1.302	.274
Mean suspect age	27.04	26.34	28.03	0.455	.635
Mean distance between suspect and officer	3.92	3.63	3.0	4.094	.018*

*$p < .05$.

  - — There appears to be no relationship between the use of cover by the officer and shooting accuracy (24.8% for noninjurious, 14.0% for injurious, and 18.4% for fatal).
  - — The accuracy of the shooting was not affected by the officer having his or her gun drawn prior to the shooting (74.8% for noninjurious, 73.0% for injurious, and 69.4% for fatal).
- Number of officers using deadly force:
  - — Although the mean number of officers using deadly force is greatest in fatal shootings, the differences are not statistically significant (1.45 vs. 1.22 for noninjurious and 1.30 for injurious).
- Number of shots fired by officer and all police:
  - — Although the number of shots fired by the officer is greatest in fatal shootings, the differences are not statistically significant (2.79 vs. 2.37 for noninjurious and 2.83 for injurious).
  - — Although the total number of shots fired is greatest in fatal shootings, the differences are not statistically significant (4.61 vs. 3.06 for noninjurious and 3.86 for injurious).
- Number of suspects present:
  - — Although the mean number of suspects present is greatest in noninjurious shootings, the differences are not statistically significant (1.65 vs. 1.58 for injurious and 1.44 for fatal).

LOGISTIC REGRESSION

Clearly, the bivariate analysis provided a wealth of potential predictor variables for multivariate logistic regression. Logistic regression models were identified for both noninjurious and fatal shootings, and the results are shown in Table 3.

Noninjurious Shootings

Six factors were identified as predictors of off-target shootings:

- if the shooting occurred while the officer and suspect were struggling,
- if the distance between the officer and suspect was more than 20 ft,
- if the incident did not involve a burglary call,
- if the officer did not call for backup prior to the shooting,
- if there was only one officer who used deadly force, and
- if the shooting was later found to be in violation of departmental policy.

Fatal Shootings

Five factors were identified as predictors of fatal shootings:

- if the shooting occurred when the officer and suspect were 10 ft or less apart,
- if the shooting occurred during the afternoon hours,
- if the officer used deadly force to defend his or her life or someone else's,
- if the suspect was attacking/fighting/resisting the officer, and
- if the shooting occurred in an alley or rear yard.

CHAID

Noninjurious Shootings

CHAID considers the same independent variables used in the logistic regression analysis and selects (either automatically or manually) those most significant. By utilizing CHAID analysis, we are able to be more specific about the effects of particular independent variables on specific subgroups within the data. In Figure 1, the shooting outcome variable is at the top of the CHAID tree. Fifty-one percent of the shooting incidents involved an officer missing his or her target. The first split is made based on whether the officer and suspect were struggling: 84% of shootings that occurred while the officer and suspect were physically struggling were noninjurious (the highest miss rate) compared with 47% of those where the officer and suspect were not struggling. There is no subsequent split off of shootings occurring during a struggle.

Among those not occurring during a struggle, an additional split is made based on the distance between the officer and suspect at the time of the shooting: 9% of those occurring from point-blank range to 3 ft were noninjurious (the lowest miss rate) compared with 45% of those occurring from 4 to 20 ft and 67% of those occurring at more than 20 ft. Among those occurring when the officer and suspect are 4 to 20 ft apart, an additional split is

TABLE 3. Results From Logistic Regression With Noninjurious and Fatal Police Shootings in Philadelphia, 1987 to 1992

Predictors	*Noninjurious*	*Fatal*
Reason for shooting (occurred during struggle; other)	–1.973 (.001)	
Shooting distance (less than 20 ft; 20 ft or more)	1.277 (.000)	
Burglary call (no; yes)	–2.472 (.001)	
Called for backup prior to shooting (no; yes)	–0.725 (.021)	
Number of shooters—police (1; more than 1)	–0.771 (.047)	
Ruled a justifiable shooting (no; yes)	–1.091 (.003)	
Shooting distance (10 ft or less; 11 or more ft)		–1.214 (.006)
Time of day (other; afternoon)		1.180 (.009)
Reason for shooting (defending self/others; other)		–2.366 (.025)
Suspect actions (attacking/fighting; other)		–1.139 (.012)
Location type (other; alley/rear yard)		1.728 (.003)
Model characteristics		
Constant	2.843 (.029)	1.784 (.233)
Percentage correct	72.6	87.1
Chi-square and significance	54.167 (.000)	38.826 (.000)
–2 log likelihood	279.826	161.723
Cox and Snell r^2	.201	.141
n	241	256

made based on whether the shooting met department policy. Seventy-eight percent of shootings not occurring during a struggle, when the officer and suspect were 4 to 20 ft apart, and when the shooting violated department policy were noninjurious (target missed) compared with 35% of similar shootings that did not violate department standards. A final split is made off of shootings meeting department policy based on the time of day of the incident: 50% of those occurring overnight or during the morning hours involved a miss compared with 23% of those occurring during the afternoon or at night.

Table 4 shows the six termination cells for the CHAID analysis including their characteristics, size, and percentage of the dependent variable. Again, those occurring during a struggle frequently were noninjurious (84%) as were those that violated department policy where the officer and suspect were 4 to 20 ft apart (and not struggling; 78%). Shootings occurring when the distance between the officer and suspect is more than 20 ft (and they are not struggling) are also often off target (67%), as are those that meet department policy, occur overnight or in the morning, and occur when the officer and suspect are 4 to 20 ft apart (and are not struggling; 50%). The same types of shootings are much less likely to be off target if they occur during

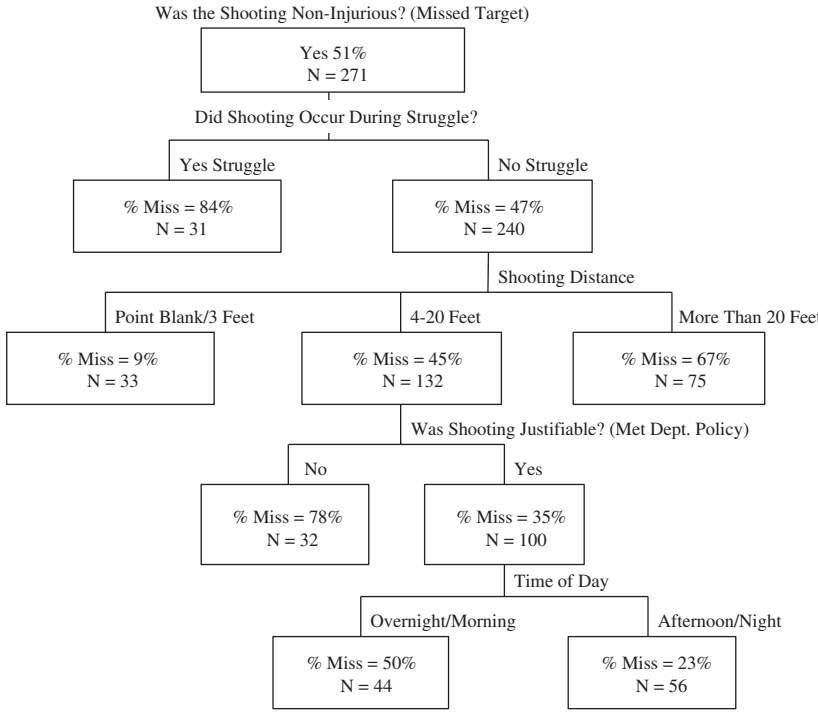

FIGURE 1: Chi-Square Automatic Interaction Detector Tree for Noninjurious Police Shootings in Philadelphia, 1987 to 1992

the afternoon or nighttime hours (23%). Last, shootings occurring at close distance—point blank to 3 ft—but not involving a struggle are almost always on target (9% are noninjurious).

Fatal Shootings

Figure 2 shows the CHAID tree for fatal shootings. Fourteen percent of the shootings during the study period were fatal (top of the tree). An initial split is made based on the suspect's actions. Incidents where the suspect was attacking or fighting the officer were more than 3 times as likely to be fatal than those where the suspect was not involved in those aggressive actions (fatality rates of 22% and 7%, respectively). Among incidents where the suspect was not attacking the officer, a split is made based on the shooting distance: 14% of those occurring at a range of 10 ft or less were fatal compared with 3% of those where the distance is greater than 10 ft.

TABLE 4. Summary of Chi-Square Automatic Interaction Detector End Groups for Noninjurious and Fatal Shootings

Description of End Group	n	*% of Total*	*% of Dependent Variable*
Noninjurious shootings			
Occurred during struggle	31	11.4	84.0
Did not occur during struggle, distance 4-20 ft, violated policy	32	11.8	78.0
Did not occur during struggle, distance is more than 20 ft	75	27.7	67.0
Did not occur during struggle, distance is 4-20 ft, shooting meets policy, occurred during overnight or morning	44	16.2	50.0
Did not occur during struggle, distance is 4-20 ft, shooting meets policy, occurred during afternoon or night	56	20.7	23.0
Did not occur during struggle, distance is point blank-3 ft	33	12.2	9.0
Total	$N = 271$	100.0	
Fatal shootings			
Suspect attacking/fighting, radio call (reactive)	57	21.0	32.0
Suspect attacking/fighting, officer-initiated (proactive), officer attempting arrest (other)	32	11.8	28.0
Suspect not attacking/fighting, distance is 10 ft or less	43	15.9	14.0
Suspect attacking/fighting, officer initiated (proactive), officer approaching vehicle/confronting suspect	45	16.6	4.0
Suspect not attacking/fighting, distance is more than 10 ft	94	34.7	3.0
Total	$N = 271$	100.0	

Among those incidents where the suspect is attacking or fighting, a split is made based on how the officer got involved in the incident. Thirty-two percent of those where the officer responded to a radio call (reactive) were fatal compared with just 14% of those where the officer proactively began the encounter. Last, a final split is made off of the officer-initiated incidents based on officer actions: Those that occur early during the encounter (officer approaching vehicle or confronting suspect) are much less likely to be fatal (4%) than shootings that occur later in the encounter (where the officer is attempting to make an arrest or other formal action; 28%). Table 4 shows the five final termination cells with fatality rates ranging from 32% to 3%.

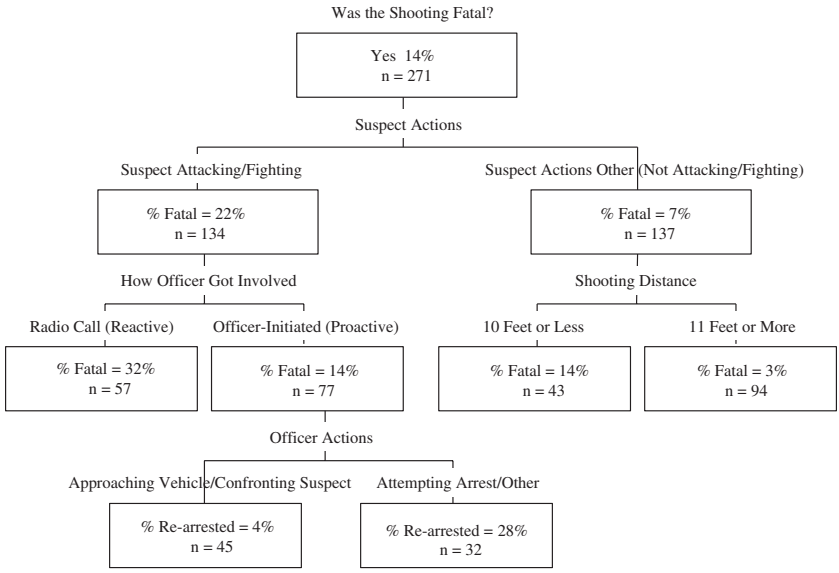

FIGURE 2: Chi-Square Automatic Interaction Detector Tree for Fatal Police Shootings in Philadelphia, 1987 to 1992

DISCUSSION

SUMMARY

Despite the well-documented, below-average hit rates among police officers, prior research has generally not examined factors that may influence police shooting accuracy. Using shooting data from Philadelphia during the late 1980s and early 1990s ($N = 271$), this article sought to identify suspect, officer, and incident-related factors that influence shooting accuracy. The article employed bivariate and multivariate analyses to examine fatal, injurious, and noninjurious deadly-force incidents and identify predictive models of specific types of shootings (i.e., as a proxy for accuracy). The logistic regression and CHAID analyses, as well as the bivariate analysis, produced a number of interesting findings involving the identification of specific factors that were either associated with or not associated with shooting accuracy.[14]

FACTORS UNRELATED TO SHOOTING ACCURACY

The bivariate analysis produced a long list of significant associations between officer, suspect, and incident-related variables and shooting accuracy, which served as the predictor pool for the multivariate analyses. As a byproduct of these analyses, the absence of a significant association also proved interesting in a number of areas (because one was expected). For example, whether the shooting occurred indoors or outdoors, the lighting conditions at the time of the incident, whether the officer used cover, and whether the officer had his or her gun drawn prior to the shooting all were unrelated to accuracy. Similarly, fatal shootings were no more likely when officers used semiautomatic pistols versus revolvers. Last, although there were differences between fatal, injurious, and noninjurious shootings with regard to the number of shots fired by police and the number of suspects present, the differences were not statistically significant.[15]

Intuitively, one might expect shootings occurring indoors to be more on target given the greater likelihood of a confined space. Similarly, it seems logical that shootings occurring in the dark or in poorly lit conditions, or where the officer does not have time to seek cover (and has to quickly draw the gun), would be linked to missed targets. Also, the increased firing capacity of semiautomatics (both in terms of the number of rounds and stopping power) and having multiple shots fired would seem to logically increase the likelihood of a fatal shooting. Yet, none of these intuitive relationships emerge.

Clearly, additional research is needed to consider these issues. Although the research on the adoption of semiautomatic pistols is mixed, prior research has not empirically examined these other factors in combat shooting situations. Quite simply, the anticipated relationships above may make intuitive sense, but there is no empirical support in the research literature to back up the logic. As a result (and given the limitations of this study), it is too early to dismiss them as unimportant. These nonsignificant findings may be an artifact of the data, they may be unique to Philadelphia during the study period, or perhaps these variables may be outweighed by more important predictors of shooting accuracy. For example, the lighting conditions or whether the officer uses cover may be irrelevant given the distance between the suspect and officer, whether they are struggling, and whether the suspect is fighting or attacking (all factors that emerge as significant). In sum, the nonsignificant findings described above are clearly of interest and warrant

further study before we can more definitively draw conclusions about their role and impact on officer shooting accuracy.

Factors Related to Shooting Accuracy

A number of interesting findings emerge from the multivariate analysis with fatal and noninjurious shootings. First, the predictors that emerge for noninjurious shootings in the logistic regression and CHAID analyses are remarkably similar, as are those for fatal shootings (i.e., same predictors emerge regardless of analytic technique). Given the variation in model assumptions and properties for logistic regression and CHAID, the consistency in identifying predictors speaks to the strength of the independent-dependent variable relationships.

Second, the predictors of fatal shootings are very clearly different from the predictors of noninjurious shootings with the exception of distance.[16] The differences in predictors highlight the fact that shooting accuracy is influenced by a host of variables and that different dynamics are in play during the encounter that affect whether an officer's shots are on target. The CHAID analysis in particular offers an interesting look at how variables can interact and, to a large extent, influence the outcome of the shooting (i.e., target hit or not). For example, in the CHAID analysis of fatal shootings (Figure 2), we see that shooting distance is not significant if the suspect is attacking or fighting, only if the suspect is engaged in other actions (in most cases, fleeing). On the other side of the CHAID tree, where the suspect is attacking or fighting, interesting findings emerge regarding how the officer gets involved and the stage of the encounter when the shooting occurs. Clearly, there are different patterns and relationships involving suspect, officer, and incident-related characteristics that influence officer shooting accuracy, and a number of those relationships warrant further discussion.

Implications of Findings From the Multivariate Analysis

The multivariate analysis described here represents a detailed, empirical examination of factors affecting police shooting accuracy. Bearing in mind the limitations described earlier, the results presented here may have a number of potential implications for police training and policy. First, the distance between the officer and suspect is clearly related to shooting accuracy. For fatal shootings, 10 ft or less appears to be the threshold distance; for

noninjurious shootings, accuracy drops off considerably beyond 20 ft. Interestingly, officers who are physically struggling with suspects—and are, by definition, very close to the suspect—often shoot and miss the target. Despite the close distance, the physical contact and probable struggling over the officer's gun likely reduces officer shooting accuracy. Two training-related issues emerge from this finding. First, given that more than half of the shootings in this study occurred when the officer and suspect were more than 10 ft apart and 30% occurred at a distance greater than 20 ft, there appears to be a need for additional firearms training at longer distances (in combat-like situations). Technological advances, such as computer-based simulation training (Firearms Training Systems, also known as FATS), night sights, and even laser sights may need to be considered to help improve officer shooting accuracy at greater distances. Alternatively, police training could emphasize restraint in using deadly force when the suspect is at greater distances (unless there is an immediate threat to life).

Second, although only 11% of the shootings in the study period occurred during a struggle, the likelihood of missing the target in those circumstances was extremely high. Training in this area could focus on methods to improve accuracy at close range during a struggle (i.e., close-quarters combat) or emphasize how to avoid getting into those types of situations (i.e., gun retention, holstering one's gun prior to a physical struggle, etc.). Given that officer injury seems more likely in these types of encounters than others, there appears be a need for training to both help officers avoid those situations and, if they do find themselves in such a struggle, to help them to resolve the incident with the least amount of risk to themselves.

The second group of findings with potential implications for policy and training involves officer approach and preparedness. The CHAID analysis indicated that shooting incidents beginning proactively (i.e., officer observes something and intervenes) were much less likely to be fatal than incidents beginning as a result of a radio call (reactive). Also, when the shooting occurred early on in the police-citizen encounter (i.e., officer approaching vehicle, confronting suspect), it was much less likely to be fatal than shootings that occurred at later stages of the encounter (i.e., officer attempting to make an arrest).[17] One interpretation of these findings suggests that if the shooting occurs when the officer has had less time to prepare himself or herself for the encounter, the likelihood of shooting accurately decreases. This may occur because situations that are initiated proactively by the officer are more likely to begin at a critical stage: The officer has witnessed suspicious and/or criminal behavior and has confronted the suspect

thereby limiting the suspect's options for escape. Alternatively, incidents that begin as a result of a radio call are more likely to progress to a later point so that when the officer reaches the scene, the suspect is more focused on escape than attacking the officer (i.e., the suspect has had more time to complete his or her criminal activity and shift focus toward escape). Regardless of the interpretation, the findings suggest that additional training may be needed with regard to officer approach and preparedness, especially in proactive encounters, so that if the incident quickly escalates to a deadly-force situation, the officer is better equipped to shoot accurately.

Third, the suspect's actions appear to play an important role in the shooting accuracy of the police officer. Clearly, noninjurious shootings were more likely to violate departmental policy. Although it did not emerge in the regression and CHAID analyses, the bivariate analysis indicated that noninjurious shootings were more likely to involve nonassaultive and, in most cases, fleeing suspects.[18] Importantly, nearly 70% of the suspects who were fleeing at the time of the shooting were armed with a gun (only 10% were unarmed). In those cases where the officer used deadly force against a nonassaultive suspect, the actions of the suspect—fleeing and armed with a gun—clearly made him or her a difficult target to hit. Given that a high percentage of these incidents violated departmental policy, additional training on when it is appropriate to fire at fleeing suspects—armed or not—may be warranted.

Alternatively, fatal shootings were more likely in defense of life (the officer's or someone else's) and when the suspect was attacking the officer. Geller and Scott (1992) noted that the increased shooting accuracy of NYTPD police (over NYPD officers) may be related to the fact the transit officers are much less likely to receive adequate backup, and perhaps the Philadelphia findings mirror those results: Officers who are acting to defend a life or who are under immediate attack shoot more accurately because, quite simply, their survival in the encounter hinges on their ability to shoot and hit the target. Regardless, the suspect's actions, whether fleeing or attacking, played a key role in the officer's shooting accuracy.

Last, this article represents an initial effort at examining the factors that may influence police officer shooting accuracy, and more research is needed. Additional work with more recent and a larger number of shootings will help place these findings in context and assess their external validity. Quite clearly, a number of important training and policy issues can emerge from work in this area. Ultimately, when officers use deadly force, their intent is to strike the target thereby ending the threat to their lives or the lives

of others (either at the present time or in the future). As research begins to identify the factors that can affect officer shooting accuracy both positively and negatively, police departments can begin to take the necessary steps to improve accuracy and reduce the prevalence of incidents where officers make the difficult decision to use deadly force but then miss their target.

NOTES

1. This discussion represents a brief overview of the 4 decades of research examining factors that influence police use of deadly force. See Fyfe (1988) and Geller and Scott (1992) for more complete coverage.

2. Goldkamp (1976) suggested that the disproportionality could result from either differential police practices (i.e., one trigger finger for White suspects and another for Black suspects; Takagi, 1974) or that Blacks may be disproportionately involved in violent crime and other activities that increase the likelihood of their being shot.

3. In both San Antonio and San Francisco, officers were involved in only six shootings, and in each city, officers hit their targets in all six cases.

4. Transit police work in more confined spaces such as subway cars and platforms, and the poor communications system means that their proficiency may be the only thing to keep them alive in a dangerous encounter.

5. Matulia (1985) later noted that the higher homicide rate may be a result of the increased stopping power of semiautomatics or the higher level of proficiency among officers using those firearms.

6. Night sights are rods of tritium attached to the rear and front gun sights. Tritium is a radioactive substance that emits a constant glow. The four lighting conditions were front-lighted target, back-lighted target, with a flashlight, and with intermittent lights.

7. Accidental discharges ($n = 55$), discharges at animals ($n = 1$), warning shots ($n = 1$), and cases where the officer's use of deadly force occurred as part of criminal conduct ($n = 10$) have been removed from the analysis.

8. The data examined here are part of a larger data set (1970 to 1992) obtained by Professor James J. Fyfe through his work as an expert witness in cases against the Philadelphia Police Department. The entire data set is thoroughly examined in White (1999, 2001, 2002, 2003). Data from 1987 to 1992 only include noninjurious shootings (misses).

9. Similar coding schemes have been employed elsewhere, including Fyfe's (1978, 1979) early work on deadly force.

10. That is, the data were officer based so that if multiple officers used deadly force in the same encounter, each officer would be captured as a separate shooter (rather than one incident).

11. There are limitations with this approach, particularly for injurious and fatal shootings. For example, the difference between an injurious shooting and a fatal shooting may have more to do with the amount of time before the person receives medical attention and the quality of that emergency care than with the officer's shooting accuracy. However, the approach serves as a reasonably rough measure of shooting accuracy when examining and comparing noninjurious and fatal shootings, which is the focus of this article.

12. These shootings have been selected for additional analysis because of their distinctiveness in terms of accuracy as well as the potential implications of the findings for police policy and training.

13. For other uses of chi-square automatic interaction detector (CHAID), see White (2002) and Jones, Harris, Fader, and Grubstein (2001).

14. Recall the earlier discussion of the article's limitations.

15. The number of officers using deadly force (i.e., number of shooters) appeared unrelated to the shooting types at the bivariate level (i.e., one-way ANOVA), but a dichotomous version of the variable (one shooter, more than one shooter) emerged as a predictor for noninjurious shootings in the logistic regression analyses.

16. Yet even with the distance between the suspect and officer, the cutoff for predicting shooting type is different: For noninjurious shootings, the breakpoint for accuracy occurs at 20 ft; for fatal shootings, the breakpoint is 10 ft.

17. Recall that these findings involve only those cases with a suspect who is attacking or fighting (see Figure 2).

18. In most circumstances, the shooting of a nonassaultive, fleeing suspect would violate the suspect's constitutional protection against unreasonable seizure unless he or she poses a threat to life in the event of escape (see *Tennessee v. Garner*, 1985).

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