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The Influence of Agency Policies on Conducted Energy Device Use and Police Use of Lethal Force

Frank V. Ferdik[1], Robert J. Kaminski[2], Mikaela D. Cooney[2], and Eric L. Sevigny[2]

Abstract

Law enforcement agencies across the United States, partly in response to public outcries over fatalities associated with police use of lethal force, have adopted numerous less lethal technologies, including conducted energy devices (CEDs). Although the device was intended to reduce citizen deaths resulting from police use of force, various human rights groups have linked its usage to increased fatalities. The present study adds to the literature on CEDs by examining (a) the relationship between the restrictiveness of CED-related policies and CED deployments and (b) the relationship between these policies and fatal police shootings. Using data from a nationally representative sample of American law enforcement agencies, this study estimates a series of count regression models to examine the influence of departmental policies on CED usage and fatal shootings by police. Findings illustrate that less restrictive CED policies are associated with increased CED usage and fewer fatal shootings by police. Although design limitations preclude causal arguments, these results suggest that police departments should at least consider adopting more liberal policies regarding the application of this less lethal technology. Future studies on this issue using more rigorous designs are warranted.

[1]Department of Criminal Justice, University of West Florida, Pensacola, FL, USA
[2]Department of Criminology and Criminal Justice, University of South Carolina, Columbia, SC, USA

Corresponding author:
Frank V. Ferdik, Department of Criminal Justice, University of West Florida, Pensacola, FL 32514, USA.
Email: Ferdik@email.sc.edu

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Introduction

Law enforcement's primary responsibility is that of ensuring the safety and protection of the public, which sometimes necessitates the use or threat of the use of force (Bittner, 1970; Black, 1976; Skolnick & Fyfe, 1993). Firearms, batons, and other forms of force (e.g., impact munitions) likely to cause serious bodily injury or death have long been the traditional weapons of choice by police officers to accomplish their objectives; however, concerns over the sometimes serious injuries and fatalities resulting from their use have been raised by police practitioners, researchers, policy makers, and various human rights groups (Amnesty International, 2004; Thomas, Collins, & Lovrich, 2010). To reduce the risk of injurious and fatal outcomes to suspects and officers, as well as to allay general concerns associated with police use of force, law enforcement administrators across the country adopted new and improved less lethal weapons, primarily oleoresin capsicum (OC) or pepper spray and conducted energy devices (CEDs; Alpert & Dunham, 2010; Kaminski, Edwards, & Johnson, 1999; Smith, Kaminski, Rojek, Alpert, & Mathis, 2007).[1]

Although heralded by some for their ability to minimize harm (MacDonald, Kaminski, & Smith, 2009; Smith et al., 2007), the adoption and use of these technologies have not been without controversy. Concerns have been raised across a broad range of issues: low placement on use-of-force continua leading to overuse, adverse health effects, disproportionate use on minorities, multiple or sustained applications, intentional misuse, exaggeration of incapacitative effects, whether adoption reduces or increases injuries to suspects, their use on passive resisters, their use on vulnerable groups (e.g., children, the mentally ill), and their contribution to sudden in-custody death (American Civil Liberties Union of Northern California, 2005a, 2005b; Amnesty International, 2004; Kaminski et al., 1999; Kaminski, Engel, Rojek, Smith, & Alpert, 2013; Lin & Jones, 2010; Terrill & Paoline, 2012a; Thomas et al., 2010; White & Ready, 2009, 2010). The recent controversies surrounding the adoption, placement, and use of CEDs, coupled with the relatively few large-scale (e.g., national) studies on this topic, indicate a need for continued research on these devices.

Smith et al. (2009) administered surveys to a nationally representative sample of law enforcement agencies across the United States to inquire more about police use-of-force policies and their impact on various outcomes. Cross-sectional data collected by these authors are used in the current study to investigate whether law enforcement use-of-force policies influence CED use, and further, whether policies governing CED use are associated with fatal police shootings of citizens. As such, the present analysis represents one of a handful of studies and

reports to explore the above issues on a national scale. This study is also the first to use vignettes (in a prediction model) describing scenarios consisting of increasing levels of suspect resistance and law enforcement officials' responses indicating whether the use of a CED would be appropriate. The scenarios represent proxy measures of police department use-of-force policies or protocols and are unique in that they present contextual information surrounding such events. Findings from our analysis contribute to the literature on police use of force and offer some insight into the circumstances under which officers are authorized to deploy CEDs and whether more or less restrictive CED policies are associated with fatal police shootings.

CED Policy and Placement on Use-of-Force Continua

As noted by Thomas et al. (2010), prior to the publication of their research, there were no large-scale, national-level studies on the relationship between differences in agency CED polices, such as where CEDs are placed on use-of-force continua and various use-of-force outcomes. Analysis of CED placement is important because if the location of CEDs is too low on use-of-force continua, higher rates of use and too frequent use on subjects who only mildly or passively resist may result (Alpert & Dunham, 2010; Terrill & Paoline, 2012b; Thomas et al., 2010). One 2005 national survey using different scenarios with varying levels of suspect resistance found, in fact, that 20% of law enforcement agencies authorized the use of CEDs in dart/probe mode on subjects who did not resist police physically and 59% authorized their use on subjects who resisted by only tensing or pulling away (Alpert & Dunham, 2010; Smith et al., 2009).

Given the potential for CED overuse and safety concerns (e.g., CED-proximate deaths), some law enforcement agencies have placed CEDs higher on force continua or, if continua are not used, they have placed greater restrictions on the types of circumstances under which officers are authorized to use them (Terrill & Paoline, 2012b; Thomas et al., 2010). However, because there is no standard national use-of-force continuum, agencies use a wide variety of ranking systems regarding the placement of CEDs and other types of force (Smith et al., 2009; Terrill & Paoline, 2012b; Thomas et al., 2010; White & Ready, 2007, 2010). For example, some agencies rank sequentially specific intermediate weapons, such as batons, pepper spray, and CEDs, whereas others may place one or more on the same level (Smith et al., 2009). This makes it difficult to create a standardized measure of CED placement relative to other types of force to precisely gauge trends in the restrictiveness of policies either across agencies or over time.

On the basis of survey data from Smith et al. (2009), Alpert and Dunham (2010) found that in 2005, 26% of law enforcement agencies placed CEDs relatively low on use-of-force continua, 64% placed them at a midlevel, and 10% placed them at a high level. Thomas et al. (2010) surveyed agencies and asked them to rank the placement of CEDs on a scale of 1 to 10, and these agencies

also tended to place them at a midlevel range. Alpert and Dunham's use of broad placement categories (low level, midlevel, and high level) undoubtedly reflects the wide variability of use-of-force continua used by law enforcement agencies. Further, although useful, Thomas et al.'s 1 to 10 ranking system is somewhat limited in that the scale is unlikely to reflect actual use-of-force continua or protocols used by agencies for guiding officers' actions during use-of-force encounters. In addition, the 1 to 10 rankings of various force types may simply reflect the opinions of the individuals who happened to fill out the surveys on behalf of the agency executive, which again may not reflect actual agency policy or practice.

An alternative scale-free method of assessing the placement of CEDs that permits a comparison over time and reflects actual continua in use is to examine their placement relative to firearms, the highest level of force possible. Thus, we would know that agencies that place CEDs one or two steps below firearms are more conservative in their policies regarding the use of CEDs compared with agencies that place them three or four steps below firearms on their use-of-force continua or other force ranking systems. Analyses of data from two national surveys administered in 2005 and 2009 (Smith et al., 2009) using the same CED-related questions suggest that among agencies serving populations of 50,000 or more, CED policies have, in fact, become more restrictive on average. For example, in 2005, 19% of agencies placed CEDs one step below firearms and 21% placed them two steps below, whereas in 2009, the percentages were 22% and 36%, respectively.

Given the potential impacts of variation in CED placement policies on the incidence of CED deployments and associated force outcomes (injuries, use of deadly force, fatalities, and so forth) plus the fact that only one large-scale national study using multiple regression has been conducted on this issue (Thomas et al., 2010), additional research on the effects of variation of such policies is important. For example, if less restrictive policies are associated with increased CED use, which in turn are associated with reductions in fatal shootings, then less restrictive policies may be preferred, other factors being equal. If, however, CED use is unrelated to fatal shootings, then more restrictive policies may be in order given concerns regarding CED overuse, associated injuries, and CED-proximate fatalities. Using data from a nationally representative sample of law enforcement agencies, this study investigated two primary research questions: First, are less restrictive CED policies associated with increases in CED deployments? Second, are less restrictive CED policies associated with decreases in fatal shootings?

Previous Literature on CEDs

Researchers have investigated a variety of issues related to CEDs, including their overall effectiveness relative to other forms of force (Lin & Jones, 2009; Ready,

White, & Fisher, 2008; White & Ready, 2007), ethical considerations regarding their use (Kleinig, 2007), their use on the mentally ill (Ho, Dawes, Johnson, Lundin, & Miner, 2007), their influence on other types of force (Smith et al., 2007; Sousa, Ready, & Ault, 2010; Terrill & Paoline, 2012a), their portrayal in the media (Ready et al., 2008; White & Ready, 2009), and policy, procedure, and training issues (Alpert & Dunham, 2010, Bunker, 2009; Police Executive Research Forum, 2005; Smith et al., 2007). Due to space limitations, however, we restrict our review to the literature most relevant to the current study, namely, the relationship among CEDs and suspect injuries, CED-related fatalities, and reductions in police use of deadly force.

CEDs and Injuries

In an analysis of 708 use-of-force incidents from the Washington State Patrol, Lin and Jones (2010) found that the impact of CEDs on suspect injury was mixed. Specifically, the authors found that in one year of evaluations of CED deployments, CED use was inversely related to suspect injuries, whereas in the following year, they were positively related. Smith et al. (2007) examined 1,080 use-of-force incidents in the Miami-Dade (FL) Police Department (MDPD) and Richland County (SC) Sheriff's Department (RCSD). Findings revealed that CEDs were associated with reductions in injury and the severity of injury to suspects in the MDPD, but they had no statistically significant effects in the RCSD; thus, the adoption of CEDs neither increased nor decreased injuries among officers and suspects. The authors speculated that the differences in findings may in part be due to policy differences in the departments (e.g., the RCSD had only recently adopted CEDs and that the MDPD did not authorize the use of OC for its officers). MacDonald et al. (2009) obtained data on more than 24,000 use-of-force incidents from 12 law enforcement agencies. In cross-section multilevel regression models, the researchers found that CEDs were associated with statistically significant and substantial decreases in the odds of suspect injury. In a separate model, the authors included an agency-level policy variable as an indicator of agencies with a more restrictive versus a less restrictive policy, given a certain level of suspect resistance. The effect of this variable was statistically insignificant, however, and may have been due to the small Level 2 sample size for this model ($n = 10$).

The researchers also used a quasi-experimental design (interrupted time series) and found substantive and statistically significant reductions in injuries to both officers and suspects following the adoption of CEDs by two agencies. Other researchers conducted a quasi-experiment by comparing 4 years of data from seven law enforcement agencies that deployed CEDs with six matched agencies that did not (Taylor & Woods, 2010). Examining a variety of injury outcomes, they found that CED adoption was significantly associated with lower rates of officer injuries, the severity of suspect injuries, and injuries to suspects

and officers requiring medical attention. Terrill and Paoline (2012a) analyzed nearly 14,000 use-of-force incidents from seven agencies to assess the influence of CEDs on suspect injuries. Estimating a variety of cross-section regression models, they generally found an increased risk between suspect injury and CED use, a finding contrary to the majority of prior studies on this issue (Kaminski et al., 2013). The authors speculated their findings may have differed from previous research in that routine dart punctures (i.e., minor wounds to approved target areas) typically were not counted as injuries in prior studies.[2] Arguing that routine dart punctures should not be counted as injuries, Kaminski et al. (2013) conducted an analysis using data from an agency that allowed for the inclusion and exclusion of routine dart punctures as injuries. Based on a series of regression models, the researchers were able to demonstrate empirically that CEDs were associated with reductions in injuries to suspects when routine punctures were excluded and that they were associated with increases in suspect injuries when they were included.

CED-Proximate Deaths

The occurrence of approximately 500 suspect deaths following exposure to a CED since 2001 has raised substantial concern regarding their contributory or causative role in these fatal outcomes. The rarity of deaths following CED exposure, however, makes analyses of these events difficult and expensive (Kaminski, 2009)[3] and, consequently, there have been few related studies.

Bozeman et al. (2009) conducted medical screenings and record reviews of 1,201 exposed suspects. Two CED-proximate fatalities were reported, but on autopsy, it was concluded that the deaths were unrelated to CED exposure. In a similar study, Eastman, Dawes, and Ho (2007) examined 426 exposed subjects and reported one death. This subject, however, had a core body temperature of 107.4°F and was intoxicated on cocaine. The remaining subjects in the above studies suffered no or only superficial injuries.

Other medical researchers conducted retrospective mortality reviews, examining hundreds of autopsy and toxicology reports of suspects who died following exposure to a CED. Many subjects were intoxicated on drugs, suffered from cardiovascular disease, or were in a highly agitated state at the time of exposure (excited delirium). In general, these investigators concluded that CEDs are not a common cause or contributor to sudden in-custody death (Kornblum & Reddy, 1991; Strote & Hutson, 2006; Swerdlow, Fishbein, Chaman, Lakkireddy, & Tchou, 2009). Zipes (2012), however, reviewed eight cases of CED-proximate deaths and concluded that CEDs can cause cardiac dysrhythmias and sudden death, although this study was critiqued on a number of methodological grounds (Vilke, Chan, & Karch, 2013).[4]

In a study designed to test the effect of CED deployments on rates of sudden in-custody death in the absence of lethal force, Lee et al. (2009) obtained data

spanning 5 years both before and after CED adoption from 50 (40%) of 126 agencies surveyed. Controlling for arrest rates, they found that the rate of sudden in-custody death increased more than sixfold in the first full year after deployment compared with the 5-year predeployment average. The authors speculated that high initial rates of CED use contributed to the increase in sudden deaths by escalating some confrontations to the point that officers needed to resort to the use of deadly force. O'Riordan (2009), however, highlighted several design concerns associated with this study, casting some doubt on the findings.

Using a different methodology, White and Ready (2009) conducted a national search of media reports of fatal and nonfatal CED incidents to identify potential correlates of CED-proximate deaths. Using regression and other statistical techniques, their analysis revealed that the number of CED discharges was unrelated to death, alcohol intoxication was negatively related, and both drug impairment and mental illness were positively related to fatal outcomes.

CEDs and Reductions in Lethal Force

Although the focus of research on CEDs has been on their contribution or potential contribution to in-custody deaths (Kaminski, 2009), few studies examined the potential of CEDs to reduce citizen fatalities and the use of lethal force by police (Thomas et al., 2010). Given the deterrent and incapacitative effects of CEDs and other less lethal weapons such as OC, however, it is likely that their early use during some resistive and violent encounters prevents further escalation and the need for the use of deadly force (Mesloh, Henych, Thompson, & Wolf, 2008; Thomas et al., 2010; White & Ready, 2007, 2010) . For example, TASER International® reports that as of October 2012, police use of CEDs saved more than 97,000 people from potential death or serious bodily injury (see http://www.taser.com/taser-products-save-lives). In addition, several law enforcement agencies reported reductions in the use of lethal force by its officers following the introduction of CEDs (Smith et al., 2009), although there have been some exceptions (Amnesty International, 2004; Thomas et al., 2010). However, simple before-and-after comparisons suffer from a number of threats to internal validity and often are not the product of independent research (Alpert & Dunham, 2010; Smith et al., 2009; Taylor & Woods, 2010) . Findings, therefore, must be viewed cautiously.

In a more rigorous study of CED use on mentally ill subjects, Ho et al. (2007) used data on CED deployments self-reported by law enforcement agencies to TASER International® and estimated that CEDs were deployed in nearly 50% of encounters in which deadly force would have been justified and that 1,100 lives were potentially saved over a 6-year period because of the availability of the device. A prospective study of 426 CED field uses in a large U.S. city concluded that the availability of CEDs prevented police use of lethal force in 5.4% or 23 encounters (Eastman et al., 2008). Support for these findings was provided by

Sousa et al. (2010), who conducted a randomized field experiment to examine differences in responses to lethal encounters between officers equipped and not equipped with CEDs. The results showed that CED-equipped officers were significantly less likely than their non-CED-equipped counterparts to use lethal force. Although this finding does not specifically address the relationship between CEDs and fatalities, it nevertheless illustrates the potential value of CEDs for reducing officer shootings. Contrary to these results, Lee et al.'s (2009) examination of CED use within 50 of 123 California police agencies found that CEDs were not associated with a decrease in firearm-related deaths. Thus, both the relative paucity of research on this topic and the equivocal findings produced to date warrant additional investigation.

The Thomas et al. (2010) Study

Given the dearth of research on the effects of CED-related policies on force outcomes and because we build on the work of Thomas et al. (2010), we review their study in some detail. Using the 2003 Law Enforcement Management and Statistics (LEMAS) survey as their sampling frame, Thomas et al. mailed surveys to 484 U.S. municipal police departments in 2008 that employed 100 or more full-time sworn officers. They obtained a 54% response rate ($n = 261$) and ultimately 210 usable surveys for analysis (e.g., some agencies did not deploy CEDs). The authors investigated two main research questions: (a) Is the placement of CEDs along the use of force continuum[5] associated with the number of CED deployments? and (b) Are the number of CED deployments associated with respondent perceptions that CEDs reduce police use of lethal force?

On the first question, their findings indicated that higher placement of CEDs on their use-of-force scale was inversely associated with CED deployments, whereas the number of lethal force applications, the number of CED training hours, and population size were positively associated with CED deployments. On the second question, two key predictors—the number of CED deployments and CED placement on the use of force scale—were not statistically related to perceptions of whether CEDs reduce police use of lethal force. Of the other control variables, only the number of CED training hours and population size were significantly related to the outcome (both estimates were positive).

The key findings suggest that CED placement higher on use-of-force continua is associated with fewer CED deployments but that the incidence of police use of lethal force is positively correlated with the number of CED deployments, probably because agencies characterized by higher rates of the use of deadly force tend to use other types of force at higher rates as well, including CEDs (Thomas et al., 2010). Unfortunately, given the cross-section analysis, it is not possible to test whether either the adoption or frequency of use of CEDs is associated with reductions in police use of deadly force. Their findings also suggest that the incidence of CED deployments and the relative placement of CEDs on

use-of-force continua are not associated with perceptions of whether CEDs reduce police use of deadly force.

Although Thomas et al. (2010) provided a new and important analysis of the effects of CED policy on police use of deadly force, additional research is necessary before law enforcement administrators develop or modify existing policies based on their findings. There are several limitations of their study that warrant this reservation. First, the small number of statistical controls used in their study raises concerns about omitted variable bias. Second, it is unclear why the authors modeled respondent perceptions of CEDs rather than actual reported numbers of deadly force incidents. Third, the authors included the population at risk on the right-hand side of their models, whereas it is typical to include this population as an offset or exposure variable to adjust for unequal exposure across jurisdictions (Cameron & Trivedi, 1998; Long & Freese, 2006).

To address some of these limitations, we conduct a similar investigation using a different and larger sample of law enforcement agencies. In addition, we (a) control for a larger number of potentially confounding variables, (b) examine the effects of policy-related factors on the actual numbers of reported CED deployments and fatal police shootings, and (c) adjust for unequal exposure by including population size as an offset variable. However, our study is not without its own limitations, which we detail later.

Data and Methods

The research questions outlined earlier are addressed using data from a National Institute of Justice-funded use-of-force study conducted by Smith et al. (2009). Administered in 2006 by the Police Executive Research Forum in collaboration with researchers from the University of South Carolina, that study mailed surveys to a nationally representative sample of law enforcement agencies. The intent of the survey was to provide a comprehensive national assessment of less lethal weapon deployments, force-related policies, training, and other topics (Smith et al., 2009). Data were collected using a stratified random sample of 950 municipal, county, and state law enforcement agencies drawn from a population of 16,072 agencies identified in the 2005 National Directory of Law Enforcement Administrators (Smith et al. 2009). Of the 950 selected agencies, 518 successfully completed the survey for a 55% response rate. The subsample of interest for the present study includes 259 municipal police departments and full-service county sheriffs' offices that had deployed CED technology to sworn officers and deputies as of year-end 2005.

Dependent Variables

Our first dependent variable of interest (*CED Uses*) is the number of reported CED deployments in 2005 (descriptive statistics for all variables are provided

in Table 1). Unfortunately, about 63% of respondents reported the number of incidents in which a CED was used. Thus, in any given incident involving multiple officers or multiple suspects, one or more officers may have deployed one or more CEDs one or more times. Although many, if not most, such incidents likely involved a lone officer and suspect (Smith et al., 2009), this measure undercounts the actual number of deployments to some unknown degree. Another 30% of respondents reported CED deployments at the officer level as opposed to the incident level, and another 7% reported the numbers in some *other* way (e.g., a combination of incident and officer levels). As explained later, we adjust for this limitation as best as possible by including dummy indicators for the different reporting methods.

The second dependent variable (*Fatalities*) is the number of citizens fatally shot by police in 2005. One issue was that this information was missing for 26 agencies. Thus, we went to great lengths to determine whether police fatally shot one or more persons in these jurisdictions. Specifically, the research team contacted relevant governmental agencies (e.g., law enforcement departments, coroner and district attorney offices), searched local newspaper reports, and conducted thorough online media searches using both Google and Lexis Nexus for incidents of suspects being shot and killed by police. If these efforts failed to uncover a fatality, we replaced the missing value with a zero count.[6] As fatal police shootings are rare and high-profile events, we are confident that this process produced reliable and valid figures.

Primary Independent Variables

We use two variables to assess the impact of CED-related policies and practices on CED deployments and police use of lethal force. The first is based on a standard vignette or scenario in which the only variation is increases in a hypothetical male suspect's level of resistance during an arrest situation (for details, see Smith et al., 2009). The levels of resistance are as follows:

- Level 1: The suspect sits on the ground with hands in clear sight and fails to comply with the officer's verbal demands.
- Level 2: Refusing to comply with the officer's orders to stop resisting, the suspect tenses his arms and pulls away from the officer's grip when the officer attempts to guide the suspect's hands behind his back.[7]
- Level 3: When told by the officer that he is under arrest, the suspect states, "I'm not going to jail" and faces off against the officer with his hands raised in a "boxer's stance."
- Level 4: When told that he is under arrest, the suspect swings at the officer's head with a closed fist. The officer dodges the blow and backs away, but the suspect continues to advance toward the officer with his fist raised.

Table 1. Descriptive Statistics for Variables Used in the Analysis.

Variable	Description	Code or Min–Max	*N* or Mean	% or *SD*
CED Uses	Count of CED uses, 2005	0–540	46.76	92.50
Fatalities	Count of subjects shot and killed by police, 2005	0–12	0.73	2.00
Resistance	Departmental authorized CED use in:			
Probe passive	Probe mode—subject passively resists	0 No	211	82.10
		1 Yes	46	17.90
Probe tensing	Probe mode—subject tenses/pulls away	0 No	152	59.61
		1 Yes	103	40.39
Probe combative	Probe mode—subject threatens or assaults officer (REF)	0 No	149	58.20
		1 Yes	107	41.80
Drive passive	Drive mode—subject passively resists	0 No	190	74.22
		1 Yes	66	25.78
Drive tensing	Probe mode—subject tenses/pulls away	0 No	149	58.20
		1 Yes	107	41.80
Drive combative	Probe mode—subject threatens or assaults officer (REF)	0 No	177	69.14
		1 Yes	79	30.86
Either passive	Either mode—subject passively resists	0 No	192	74.42
		1 Yes	66	25.58
Either tensing	Probe mode—subject tenses/pulls away	0 No	150	58.14
		1 Yes	108	41.86
Either combative	Probe mode—subject threatens or assaults officer (REF)	0 No	174	67.44
		1 Yes	84	32.56
CED Rank	CED placement relative to firearms	0–8	2.42	01.30
CED50	>50% of officers carry CEDs	0 <50%	85	32.69
		1 >50%	175	67.31
Continuum	Departments uses a use of force continuum	0 No	23	08.88
		1 Yes	236	91.12
Effects	Officers required to experience CED effects	0 No	145	55.77
		1 Yes	115	44.23

(continued)

Table 1. Continued.

Variable	Description	Code or Min–Max	*N* or Mean	% or *SD*
CED Review	Level of supervisory review for CED use	0 None or first line supervisor	68	26.25
		1 Command staff	191	73.75
Force Training	Sum of 9 types of required force related training / 9	0–1	0.64	0.30
CED Training	Required number of CED training hours	0 2–6	118	45.74
		1 8–40	140	54.26
CED Retrain	Departments requires annual CED training	0 No	82	32.41
		1 Yes	171	67.59
CED Restrictions	Number of agency policies restricting CED use	0 None	210	83.33
		1 1–3	42	16.67
CED Reporting	Agency reported CED counts as:			
Incidents	Incident based (REF)	0 No	91	35.13
		1 Yes	168	64.86
Officer based	Per officer/deputy use	0 No	189	72.97
		1 Yes	70	27.02
Other based	Either	0 No	240	92.66
		1 Yes	19	00.07
Sworn	(Number of sworn/population)* 10,000	1.06–199.69	21.06	18.31
Female	Percentage of sworn female officers	0–24.92	09.56	05.83
Crime	Number of Part I crimes per 10,000 population	0–20.38	01.10	02.64
Region	Bureau of the Census classification:			
Northeast	Northeastern region	1 Northeast	24	00.09
Midwest	Midwestern region	2 Midwest	65	25.00
South	Southern region (REF)	3 South	70	27.00
West	Western region	4 West	100	38.61
Agency Type	Municipal/county police departments vs. sheriffs	0 Sheriff	110	42.47
		1 Municipal	149	57.52
Population	Self reported residential population (offset)	1,345–10,000,000	339,981.33	778,474.79

Note. Total observations = 259. REF = reference category.

Respondents were then asked to indicate whether a CED in dart mode and a CED in touch-stun mode would be authorized, given the specific level of resistance. Note that Levels 3 and 4 had to be combined due to sparse sizes. For example, only 10 respondents indicated their department would not authorize the use of a CED in dart mode on suspects who took a boxer's stance, and only six indicated it would not authorize its use on suspects who took a swing at an officer. We conceptualize the combined measure as indicating a *combative* suspect. In all cases, the combative level serves as the reference category.

Responses to these scenarios are assumed to reflect departmental policies or practices (because not all agencies use a force continuum) regarding the circumstances under which CEDs are authorized to be deployed. As these measures are not based on use-of-force continua, they are scale free and, in this regard, represent a unique method for assessing the impact of agency policy and practice on CED deployments and police use of deadly force. Further, it is important to differentiate between dart mode and touch-stun mode, as policies governing when each is authorized for a given level of resistance may vary. We also generate a third related variable, which is simply a combination of dart mode and drive-stun mode. In other words, for a given level of resistance, this variable indicates that both touch-stun and dart modes would be authorized. Thus, we have a total of nine CED-related indicator variables. Specifically, for each level of resistance (passive, resistive, and combative), we have indicators of whether dart mode, drive-stun mode, or either mode was authorized. These indicators are tested across a series of multiple regression models.

The second measure (*CED Rank*) is based on a question that asked respondents to rank order types of departmental-authorized force, using 1 to represent the lowest ranking, and the highest number to represent the maximum level of force (highest was used so as to not artificially truncate upper level rankings). Respondents could indicate the same number for several types of force if, in fact, those types of force were ranked at the same level per agency policy (see Smith et al., 2009). The types of force ranked were as follows:

1. Voice controls/commands
2. Chemical agents (e.g., OC)
3. CED (e.g., TASER)
4. Control holds (e.g., escort, pain-compliance holds)
5. Strikes/punches
6. Baton/impact weapons
7. Chemical/kinetic hybrids (e.g., pepper-filled projectiles)
8. Kinetic weapons or munitions (e.g., beanbag projectile)
9. Incapacitation holds (e.g., neck restraints)
10. Firearms

There was a substantial variation in the agency rankings of the different types of force, with some agencies, for example, grouping at the same level strikes/punches, baton/impact weapons, and chemical/kinetic hybrids, whereas other agencies ranked them hierarchically using unique numerical scores. The fact that there is no standard use-of-force continuum used by law enforcement agencies (not to mention that many do not use a continuum; Terrill & Paoline, 2012b) presented problems in trying to develop a standard measure of the placement of CEDs relative to other types of force. Therefore, we calculated a new measure that subtracted the numerical value assigned to a CED from the numerical value assigned to the highest level of force (firearms). This provides a measure of the relative restrictiveness of CED-based policies across agencies. For example, a hypothetical value of 1 would indicate a more restrictive CED policy than a value of 3, as in the first instance, CEDs are placed just one step below firearms, whereas in the second case, CEDs (perhaps along with other less lethal weapons) are placed three steps below firearms. We would expect, then, that a score of 3 would be associated with higher rates of CED use than a score of 1, and that a score of 3 would also be associated with lower rates of police use of deadly force.[8]

Control Variables

Several control variables were included in the analyses to minimize potentially confounding influences on our main variables of interest. *CED50* indicates whether agencies issued CEDs to more than 50% of its officers. Other factors being equal, we expect to observe higher rates of CED use in agencies issuing CEDs to more than half their officers versus those issuing them to less than half, as there should be more opportunities for their use during resistive encounters with suspects, other factors being equal.

Researchers have noted that police departments adopt use-of-force continua to regulate how and under what conditions law enforcement officers are permitted to use various types and levels of force (e.g., Connor, 1991; Terrill & Paoline, 2012b). As we have already outlined the variability in departmental policies concerning use of force and how they may influence force outcomes (Thomas et al., 2010), we included the variable *Continuum* in our analyses to control for the effects of the presence of a use-of-force continuum on both CED deployments and fatal police shootings.

The variable *Effects* indicates whether agencies mandate that their officers experience the effects of the CED prior to its being issued. This is typically advocated for two reasons: First, it is important for officers to experience its effects in case an assailant uses the officer's own CED against him or her, and second, it is presumed that officers who experience the painful effects of a CED will be more judicious in its use. Regarding other control variables, CED training has been found to be associated with both CED deployments and citizen

deaths (Thomas et al., 2010). We, therefore, include three CED training-related variables in the analysis. One (*Force Training*) is a general indicator of mandatory in-service force-related training. This measure consists of the average of nine dummy-coded force-related indicators.[9] The resulting scale ranged from 0 (no mandatory training on any topic) to 1 (mandatory training on all topics). The second measure is *CED Training*, which indicates the number of required training hours dedicated to CEDs. Given the unusual distribution of reported hours, this variable was dichotomized (i.e., 2–6 hr = 0 and 8–40 hr = 1).[10] The third measure is an indicator of whether agencies required annual CED retraining (*CED Retrain*).

Law enforcement agencies often require supervisory review of each force incident in which a CED is deployed (Smith et al., 2009), and it is reasonable to expect lower rates of CED usage in agencies requiring greater oversight, such as when reviews are conducted (vs. not) and conducted by higher ranking administrators (e.g., command staff vs. first-line supervisors). The variable *CED Review* is included to control for this possible effect and is coded 1 if command staff or chief/sheriff review is required and 0 if no review is required or it is required only by a first-line supervisor (e.g., sergeant). Another measure that likely influences the rate of CED deployments across agencies is the number of restrictions placed on their use (use on vulnerable groups, persons fleeing in a motor vehicle, on foot, etc.). Specifically, respondents were asked to indicate whether their department enforced any type of restriction on CED use in any of the following circumstances: (a) against persons of a certain age, (b) against persons in stated of excited delirium, (c) while operating a motor vehicle, and (d) against persons around water. The variable was coded 1 if there were one or more restrictions and 0 if there were none.

As discussed earlier regarding the dependent variable *CED Uses*, most respondents reported the number of CED deployments based on force incidents, followed by the number of officers who deployed a CED, and a combination of the two (*CED Reporting*). To adjust for this reporting artifact, we include dummy variables indicating agencies that reported CED uses based on incidents (*Incidents*), officer uses (*Officer-based*), or both (*Other-based*). This will allow us to determine whether reporting method influences the results.

The remaining controls come from Uniform Crime Report (Federal Bureau of Investigation, 2005) and Law Enforcement Officers Killed and Assaulted (Federal Bureau of Investigation, 2005) data compiled by the Federal Bureau of Investigation. From LEOKA, we code the number of sworn officers per 10,000 residents (*Sworn*) to control for differences in the ratio of officers to civilians across jurisdictions. We also control for the percentage of female officers (*Female*), as there is some evidence suggesting that female officers handle use-of-force encounters differently than male officers (e.g., Klahm & Tillyer, 2010). Population size is included as an offset or exposure variable to normalize for varying population sizes across jurisdictions (Cameron & Trivedi, 1998;

Long & Freese, 2006). Because varying crime rates across jurisdictions can be expected to influence rates of police use of force, including the use of CEDs and firearms, we also include the total number of UCR Part I Index crimes known to the police per 10,000 population (*Crime*).[11] We also control for agency type (municipal vs. sheriff) using a dummy indicator coded 1 for municipal agencies and 0 for sheriffs' departments (*Agency Type*). Finally, we control for potential regional effects by including separate indicators of agency location by Census region (*Region*).

Analytic Strategy

There are two major considerations for the analysis. One concerns adjustments to the regression models to take into account the stratified random sampling design and survey nonresponse, and the second is the rare-event count nature of the outcome variables. Each issue is addressed in turn.

Sampling Adjustments

Survey methodologists caution that failure to account for a survey's design elements can produce biased and misleading results (Chambers & Skinner, 2003; Kreuter & Valliant, 2007; Lee & Forthofer, 2006). Therefore, design-based analytic methods were employed using Stata 12.1 to account for the sampling design. Specifically, design parameters were set to account for 68 strata defined by the type of law enforcement agency (state police, municipal police departments, or county sheriff's offices), four Census regions, and size of the population served (seven categories ranging from under 10,000 to 1,000,000 or more and including a missing population designation). Certain law enforcement agencies were also selected with certainty (e.g., all state police agencies, law enforcement agencies serving 500,000 or more people), so these certainty units were included as their own strata per standard practice (Chambers & Skinner, 2003). Also, a finite population correction (FPC) was applied to account for the reduction in variance when sampling without replacement. Final sample weights account for unequal probability of selection and agency nonresponse across strata (see Smith et al., 2009). Finally, design-based subgroup estimation procedures were used to compute appropriate variance estimates using the full design-based sample of law enforcement agencies (Lee & Forthofer, 2006).

Distributions of the Dependent Variables

A common starting point for any regression-based analysis is an examination of the distribution of the dependent variable. As shown in Figure 1(a) and (b), both dependent variables exhibit extreme positive skew, and given that both represent rare-event counts, the Poisson regression model is a reasonable starting point for

the analysis. An assumption of the Poisson model, however, is that the conditional mean equals the conditional variance, and, when violated, it typically indicates overdispersion (and more rarely, underdispersion). Under these conditions, standard errors, confidence intervals, and tests of significance will be incorrect.

Unfortunately, the adjustments for the survey design elements preclude the use of standard tests for overdispersion as well as, for example, pseudo-R^2, Bayesian information criterion (BIC) and Akaike information criterion (AIC) statistics for model fit comparisons (Hardin & Hilbe, 2012). As shown in Figure 1(a), however, the unconditional variance for the number of CED deployments is 1,556 times larger than the unconditional mean, whereas for the number of fatal shootings (Figure 1(b)), the unconditional variance is over 5 times that of the unconditional mean. These values indicate that the Poisson model will almost certainly remain overdispersed following the introduction of regressors (Cameron & Trivedi, 1998). As an additional check (not shown), however, we compared the coefficients, standard errors, and so forth, from both Poisson and negative binomial regression models, and substantive differences were observed, also suggesting an overdispersion problem.

The recommend procedure under these conditions is to try to determine the source of the overdispersion (e.g., excess zeros, omitted variables, failure to include interaction terms, etc.), make the necessary adjustments, and, if successful, proceed with the Poisson or an appropriate alternative model (Hardin & Hilbe, 2012). Unfortunately, it is virtually impossible to determine the source of overdispersion in cross-sectional models (Cameron & Trivedi, 1998). Given that the Poisson model is likely to remain overdispersed once regressors are included, plus the fact that the Poisson and negative binomial results were vastly different, we opted to use negative binomial regression[12] for all models (but see Berk & MacDonald, 2008, for caveats regarding substituting the negative binomial for the Poisson in the presence of overdispersion). We also note that given the relatively small sample size and the complexity of the analytic method (i.e., nonlinear model) and the fairly large number of regressors, we consider variables as potentially important when statistically significant at the .10 level, designated with a † symbol.

Findings

Table 2 presents findings pertaining to our first research question—whether departmental policies governing the use of CEDs have an influence on the number of reported deployments. To address this question, we included both operational modes of the CED device (dart/probe and drive/touch-stun) and a combined indicator in which either mode was authorized for a given level of suspect resistance. Model 1 assesses the impact of authorization of probe mode for different levels of resistance on CED deployments, controlling for other

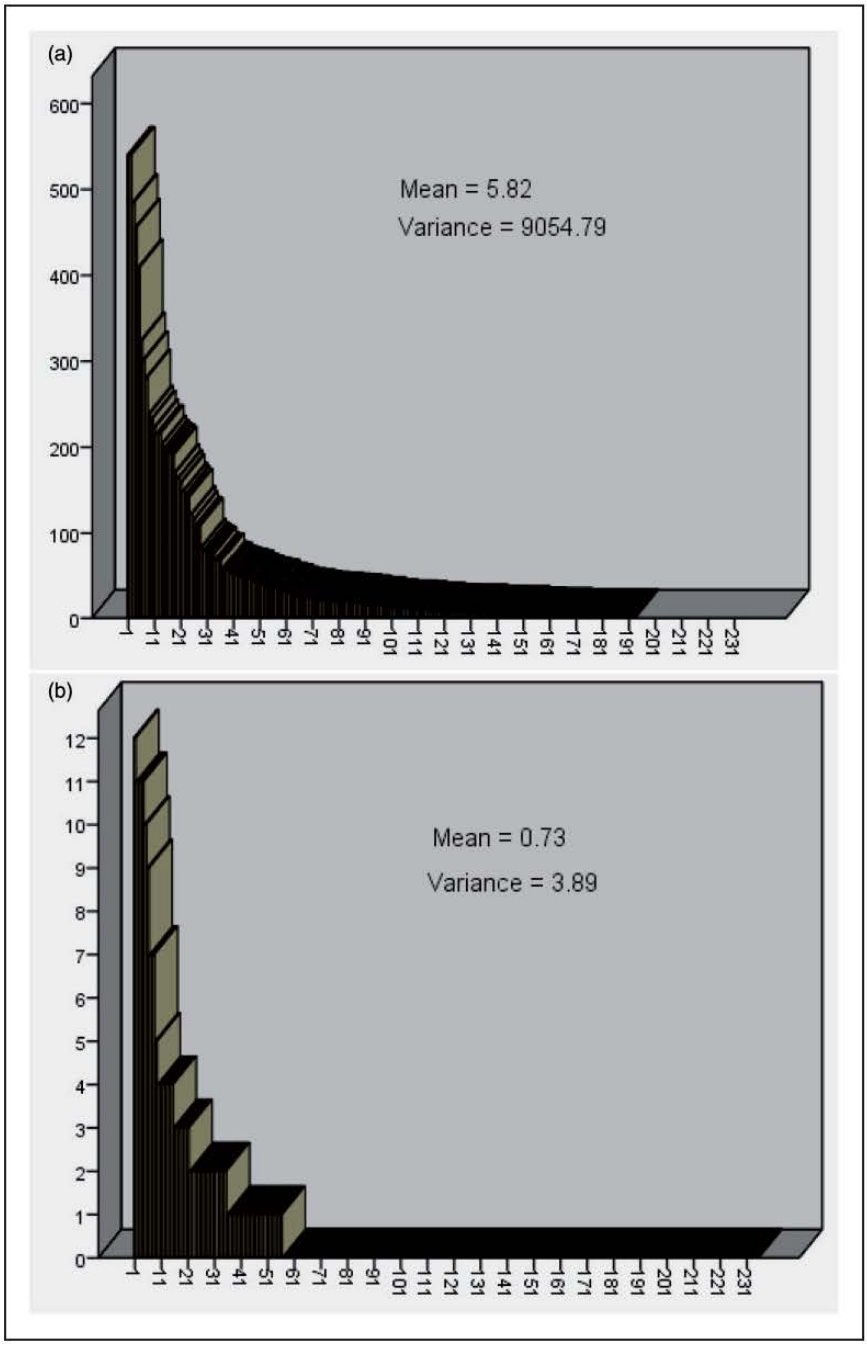

Figure 1. Distributions of dependent variables: (a) number of CED deployments, 2005 and (b) number of fatal shooting, 2005.

Table 2. Negative Binomial Regression Models of the Number of Police CED Deployments, 2005.

	Model 1			Model 2			Model 3		
Variable	IRR	*SE*	CI	IRR	*SE*	CI	IRR	*SE*	CI
Resistance									
Probe-passive	2.49***	.52	1.65 3.76						
Probe-tensing	1.03	.26	0.63 1.67						
Drive-passive				2.49**	.75	1.38 4.49			
Drive-tensing				1.61	.48	0.89 2.90			
Either-passive							2.60***	.77	1.44 4.66
Either-tensing							1.70†	.49	0.96 3.01
CED Rank	0.82**	.05	0.72 0.93	0.86*	.07	0.73 0.99	0.85*	.07	0.73 0.99
CED50	0.84	.27	0.45 1.56	0.98	.35	0.48 1.98	1.01	.36	0.50 2.03
CED Reporting									
Officer-based	1.01	.26	0.59 1.68	1.05	.32	0.57 1.90	1.08	.33	0.59 1.96
Other-based	0.20***	.08	0.09 0.42	0.25*	.14	0.08 0.73	0.25*	.14	0.09 0.76
Continuum	1.79†	.58	0.94 3.40	2.17*	.68	1.16 4.03	2.15*	.68	1.16 4.00
Effects	1.33	.24	0.93 1.91	1.05	.23	0.68 1.61	1.01	.23	0.65 1.57
CED Review	1.01	.33	0.53 1.94	0.94	.33	0.48 1.88	0.97	.34	0.49 1.93
Force Training	0.86	.21	0.53 1.40	0.79	.21	0.46 1.34	0.74	.19	0.45 1.23
CED Training	0.63*	.14	0.40 0.97	0.61†	.16	0.37 1.01	0.64†	.16	0.39 1.04
CED Retrain	0.91	.17	0.63 1.32	0.99	.20	0.67 1.46	0.95	.19	0.64 1.40
CED Restrictions	1.20	.34	0.69 2.08	1.23	.37	0.68 2.21	1.27	.38	0.69 2.30
Sworn	1.01	.01	0.98 1.02	1.01	.01	0.99 1.03	1.01	.00	0.99 1.03
Female	0.99	.02	0.94 1.03	0.99	.02	0.95 1.04	1.00	.02	0.95 1.04
Crime	1.42***	.05	1.32 1.53	1.45***	.07	1.32 1.59	1.45***	.06	1.32 1.58
Region									
Northeast	0.20***	.07	0.09 0.41	0.25***	.09	0.12 0.50	0.25***	.08	0.12 0.50
Midwest	0.97	.30	0.53 1.77	0.95	.34	0.47 1.93	0.98	.35	0.48 1.99
West	0.84	.28	0.44 1.61	0.93	.33	0.47 1.86	0.93	.33	0.46 1.86
Municipal	2.29***	.49	1.50 3.49	2.04**	.52	1.22 3.38	2.02**	.53	1.21 3.38
Population (offset)									
F test	$F(20, 294) = 99.97$; $p \leq .0000$			$F(20, 294) = 35.87$; $p \leq .0000$			$F(20, 296) = 33.21$; $p \leq .0000$		
N	182			182			184		

Note. IRR = incidence rate ratio; *SE* = linearized standard error, CI = 95% confidence interval; *N* = analytical subpopulation sample size. *Combative* is the reference category for *Resistance*, *Incidents* is the reference category for *CED Reporting*, and *South* is the reference category for *Regions*.
†$p \leq .10$. *$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

variables in the model. Model 2 similarly assesses the impact of authorization of CEDs but for drive-stun mode across levels of resistance, and Model 3 assesses the impact when either mode is authorized for a given level of resistance. In all cases, the reference level of suspect resistance is combative.

We hypothesized that less restrictive CED policies would be associated with greater numbers of CED deployments across agencies. As indicated in all three models in Table 2, a policy or practice that allowed the use of a CED in probe, drive, or either mode on passive resisters is substantively and significantly associated with increases in the number of CED deployments. Specifically, compared with departments that authorized the use of CEDs on combative suspects, those that authorized their use on passive resisters is associated with expected increases in the rates of CED deployments of between 1.49% and 1.60%, holding all other variables constant. The direction of the effects for tensing/pulling away is consistent with expectations, but the effect is statistically significant at the .10 level only in Model 3. The effects regarding CED use on passive resisters and to a lesser extent active resisters (tensing/pulling away) are consistent with policy expectations and prior research (Thomas et al., 2010), attesting to how more permissive policies are associated with increased deployment of this less lethal technology. Overall, these findings support the claim that police department policies governing the use of CEDs specifically have an influence on whether and how officers use this device in the field.

Our second primary policy variable, *CED Rank*, is also substantively and statistically significant across all models. The effect varies only slightly across each, indicating that every one-step increase toward the deadly force level is associated with between a 0.82 (Model 1) and 0.86 (Model 2) reduction in the rate or expected number of CED deployments (or 18% and 14%, respectively), regardless of CED mode (probe, drive, either). Conversely, each step decrease from the deadly force level is associated with an expected increase in the rate of CED deployments of between 1.22 and 1.17 (or 22% and 17%, respectively) regardless of CED mode.[13] These results are consistent with prior literature (Thomas et al., 2010) and lend additional support to the notion that agency policies influence police use of force.

Regarding the significant effects among the control variables, we see that whether agencies reported CED deployments per officer or per incident is irrelevant, though relative to incident-based reporting, *other* reporting method is significantly and inversely related to the outcomes across the three models. The meaning of this effect, however, is unclear; suffice to say, it appears that it is important to adjust for it.

We also observe a significant positive association between agencies using a use-of-force continuum and the number of CED deployments, regardless of CED mode (though the effect is significant only at the .10 level for probe mode), and a significant inverse relationship between the number of CED training hours and the number of CED deployments (with the effect significant only

at the .10 level for the drive-stun and either modes). These countervailing influences are difficult to reconcile, and explanations regarding their effects would be purely speculative at this point. We suggest, therefore, that interpretations regarding these associations await additional research. This may be especially important regarding the influence of use-of-force continua, given recent variations in types and debates about whether law enforcement agencies should abandon them (Fridell & Ijames, 2011).

Not unexpectedly, higher rates of Part I crimes are positively associated with more CED deployments across agencies in all modes (incidence rate ratios [IRRs] range between 1.42 and 1.45). We also observe a significant inverse association between CED deployments and agencies located in the Northeast versus those located in the South regardless of mode, which suggests that agencies in the Northeast are more discriminating in their use of CEDs. No significant differences, however, are observed between agencies located in the South versus those in the West or Midwest. Finally, the rates of CED deployment in all modes among officers employed by municipal agencies are more than double the rates for deputies employed by sheriffs' agencies. This finding is deserving of future investigation, particularly because we control for a fairly large number of relevant variables.

Table 3 presents findings from our second research question—whether less restrictive CED policies are associated with decreases in police fatal shootings. As with our first question, we included both operational modes of the CED device (dart/probe and drive/touch-stun) and a combined indicator in which either mode was authorized for a given level of suspect resistance. Model 1 assesses the impact of authorization of probe mode for different levels of resistance on the total number of fatal police shootings, controlling for other variables in the model. Model 2 similarly assesses the impact of authorization of CEDs but for drive-stun mode across levels of resistance, and Model 3 assesses the impact when either mode is authorized for a given level of resistance. As in Table 2, the reference category of suspect resistance in all cases is combative.

We hypothesized that less restrictive CED policies would be inversely related to the number of suspects shot and killed by police. As indicated in all three models in Table 3, a policy or practice that allowed the use of a CED in probe, drive, or either mode on passive resisters is substantially and significantly associated with decreases in the number of fatal police shootings. Specifically, compared with departments that authorized the use of CEDs on combative suspects, those that authorized their use on passive resisters is associated with expected decreases in the rates of police fatal shootings of between 0.34 and 0.39, holding all other variables constant (or 66% and 61%, respectively). We found, however, that a policy or practice that allowed the use of CEDs in probe, drive-stun, or either mode on actively resistive suspects (tensing/pulling away) is significantly associated with increases in the number of fatal police shootings. Compared with departments that authorized the use of CEDs on combative suspects, those that

Table 3. Negative Binomial Regression Models of the Number of Fatal Police Shootings, 2005.

	Model 1				Model 2				Model 3			
Variable	IRR	*SE*	CI		IRR	*SE*	CI		IRR	*SE*	CI	
Resistance												
Probe-passive	0.39**	0.14	0.19	0.79								
Probe-tensing	3.45**	1.36	1.58	7.48								
Drive-passive					0.34***	0.11	0.18	0.64				
Drive-tensing					3.08*	1.46	1.21	7.81				
Either-passive									0.34***	0.11	0.18	0.63
Either-tensing									2.93*	1.38	1.16	7.39
CED Rank	1.07	0.16	0.79	1.44	1.04	0.16	0.77	1.39	1.05	0.16	0.77	1.41
CED50	0.52	0.21	0.23	1.14	0.65	0.25	0.31	1.36	0.59	0.22	0.28	1.24
Continuum	0.33*	0.15	0.13	0.81	0.30**	0.13	0.12	0.69	0.30**	0.13	0.12	0.70
Effects	1.06	0.48	0.43	2.60	1.13	0.44	0.52	2.44	1.30	0.51	0.59	2.82
CED Review	1.77	0.78	0.75	4.19	2.04	0.94	0.82	5.07	2.05	0.97	0.81	5.17
Force Training	0.66	0.26	0.30	1.41	0.69	0.27	0.32	1.47	0.74	0.28	0.34	1.57
CED Training	5.39**	3.15	1.70	17.04	6.14**	3.63	1.92	19.61	5.70**	3.40	1.76	18.41
CED Retrain	0.33**	0.12	0.16	0.67	0.36**	0.13	0.18	0.71	0.40**	0.14	0.21	0.79
CED Restrictions	0.94	0.42	0.39	2.27	0.93	0.47	0.34	2.52	0.95	0.48	0.35	2.59
Sworn	1.00	0.01	0.98	1.01	1.00	0.01	0.98	1.00	1.00	0.01	0.98	1.00
Female	1.02	0.04	0.96	1.08	1.03	0.03	0.97	1.09	1.03	0.03	0.97	1.08
Crime	1.42***	0.12	1.19	1.67	1.41***	0.13	1.17	1.68	1.43***	0.13	1.19	1.70
Region												
Northeast	0.29*	0.14	0.11	0.75	0.31**	0.14	0.12	0.76	0.33*	0.15	0.13	0.80
Midwest	2.35*	1.00	1.02	5.42	2.38*	0.96	1.07	5.23	2.28*	0.95	1.00	5.16
West	2.87†	1.64	0.94	8.82	2.37	1.30	0.80	6.97	2.51	1.42	0.82	7.65
Municipal	1.40	0.52	0.67	2.92	1.47	0.45	0.80	2.69	1.33	0.44	0.69	2.55
Population (offset)												
F test	$F(18, 343) = 55.63$; $p \leq .0000$				$F(18, 343) = 83.16$; $p \leq .0000$				$F(18, 345) = 78.22$; $p \leq .0000$			
N	225				225				227			

Note. IRR = incidence rate ratio; *SE* = linearized standard error, CI = 95% confidence interval; *N* = analytical subpopulation sample size. *Combative* is the reference category for *Resistance*, *Incidents* is the reference category for *CED Reporting*, and *South* is the reference category for *Regions*.
†$p \leq .10$. *$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

authorized their use on active resisters is associated with expected increases in the rates of fatal police shootings of 3.45 (Model 1), 3.08 (Model 2), and 2.93 (Model 3). Thus, only the least restrictive CED policy appears to be associated with reductions in fatal shootings. Why there is a positive association between

policies or practices allowing the use of CEDs on actively resisting suspects versus combative suspects and shootings is unclear, but it may have something to do with the nature of the different types of encounters. For example, officers confronting combative suspects where the threat is obvious may have more time to plan a nonlethal response compared with officers confronting suspects who initially appear to present less of a threat, but then suddenly resist leading to an escalation in the use of force. Again, however, we can only speculate at this point, and further research is required to investigate the mechanisms involved in these encounters.

Our second primary policy variable, *CED Rank*, was not statistically significant in any of the models in Table 3. The results do not change when the models were reestimated without the scenario-based variables, suggesting that this measure may have limited or no utility in predicting fatal shootings. However, because this is the first study to use this measure, we recommend future tests of it.

Regarding significant effects among the control variables, we found that compared with departments not using a use-of-force continuum, departments that do are associated with expected decreases of 0.30 and 0.33 in the rate of police shootings, regardless of CED mode. Similarly, we found significant reductions in the rate of fatal shootings of between 0.33 and 0.40 among departments that required annual retraining in the use of CEDs across all three models, but significant increases in fatal shootings among agencies that required more hours of initial CED training (IRRs range between 5.39 and 6.14). It may be that agencies that use use-of-force continua and conduct annual in-service CED training provide greater control and direction to their officers in the use CEDs. These factors may be associated with greater restraint in the use of deadly force and greater use of less lethal force such as CEDs. In fact, agencies that used use-of-force continua were significantly and positively associated with the number of CED deployments across all models in Table 2, providing some support for this notion (though *CED Retrain* was unrelated to deployments). The positive association between more initial CED training hours and the number of fatal shootings appears counterintuitive, but perhaps this is due to the possibility that agencies experiencing high rates of officer-involved shootings provide substantially more hours of initial force-related training, including training on CEDs. In any case, the training variables have large confidence intervals, and we should be cautious in interpreting their effects.

As expected, higher rates of Part I crimes are significantly and positively associated with more fatal shootings across agencies in all modes (IRRs range between 1.41 and 1.43). Compared with agencies located in the South, those located in the Northeast were significantly associated with fewer fatal shootings across all three models (IRRs range between 0.29 and 0.33), whereas agencies located in the Midwest were significantly associated with increases in fatal shootings relative to those located in the South (IRRs range between 2.28 and 2.38).

Except for the probe model (IRR = 2.87; $p \leq .10$), no significant differences were observed for agencies located in the West versus the South.

Discussion and Conclusion

Law enforcement officials are required to establish a degree of safety and order within their respective communities. Fulfillment of these objectives often necessitates the use of force or coercion, including the use of CEDs and other less lethal and lethal weapons. For several decades now, however, police use of force has come under increased scrutiny by media outlets, policy makers, governments, members of the general public, and other interested parties, with claims that police officers too often use more force than is necessary or reasonable (American Civil Liberties Union of Northern California, 2005a; Amnesty International, 2004). Furthermore, it has been noted that currently there is no standard national use-of-force continuum to regulate the manner in which law enforcement officers apply force (Alpert & Dunham, 2010; Smith et al., 2009; Thomas et al., 2010). Moreover, although a growing body of empirical work found CEDs to be associated with reductions in the use of lethal force by police as well as reductions in the number and severity of citizen and officer injuries (e.g., Ho et al., 2007; MacDonald et al., 2009; Paoline, Terrill, & Ingram, 2012; Smith et al., 2007; Taylor & Woods, 2010), few studies to date have specifically examined the influence of CED-related policies on the number of CED deployments and fatal police shootings at the national level (Thomas et al., 2010). The current study responded to this gap by examining associations between two new force continua measures and the numbers of CED deployments and fatal police shootings using a national sample of law enforcement agencies.

Our findings suggest that the most liberal policies governing the use of CEDs were associated with substantially more CED deployments and fewer fatal police shootings. Regarding the first outcome, we found that agency authorization of CEDs on passively resistive subjects was associated with marked increases in the number of CED deployments, and that more restrictive policies (i.e., the closer the relative placement of CEDs to lethal force) were associated with fewer CED deployments. Regarding fatal outcomes, we found that the least restrictive CED policy was associated with substantial and significant reductions in the number of fatal police shootings (though the placement of CEDs relative to lethal force was unrelated). These findings suggest that departmental policies exert a significant influence on police use of CEDs, which is consistent with the limited prior research (Thomas et al., 2010).

Although our study advances the use-of-force literature, our results should be interpreted in light of several limitations. First, the survey's agency response rate of 55%, though adequate for a mail-in survey, raises concerns about potential bias if the responding agencies differ systematically from nonresponding agencies. Although we have no reason to believe this is the case, future survey-based

research on police use of force should strive for higher agency response rates. Second, the survey data are cross-sectional in nature, which limits our ability to make causal inferences. It is possible, for instance, that agencies experiencing high numbers of lethal police shootings will tend to adopt less restrictive CED policies. This limitation speaks to a critical need for research that takes into account temporal order, such as panel models, interrupted time series, and other quasi-experimental designs to examine how variation in the structure and implementation of use-of-force policies impacts fatal police shootings and related outcomes.

If our results are confirmed by future research, they pose a dilemma for policy makers and police administrators. On one hand, if less restrictive policies increase CED deployments, such policies would be concerning to those who call for greater restrictions on their use because of CED-proximate deaths and other adverse outcomes (American Civil Liberties Union of Northern California, 2005a; Amnesty International, 2004;). On the other hand, if less restrictive policies reduce police fatal shootings, a reasonable recommendation would be to loosen existing restrictions on CED use during use-of-force encounters. This recommendation could potentially improve existing strained police–community relations due to police shootings, while also enhancing the image of the police within mainstream media. With these insights in mind, it is important that this study's findings be evaluated against the backdrop of the extant literature on the topic and that future police use-of-force researchers continue to expand on this literature by using more rigorous research designs.

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Notes

1. Standard CEDs are handheld devices that use compressed nitrogen to launch two or four (depending on the manufacturer and device) tiny barbed darts or probes tethered to a power source by insulated wires that project outward to maximum distances of 15 to 35 feet. When the darts attach to clothing or penetrate the skin, they deliver short electric pulses with very low average current that interrupts the electrical signals from the central nervous system to the peripheral body, typically leading to neuromuscular incapacitation. CEDs also have a touch stun mode used for pain compliance (for details, see Kroll & Ho, 2009).
2. It is important to note that in the study by Terrill and Paoline (2007), reporting of CED related injuries was left to officer discretion. Thus, how often routine dart punc tures were counted as injuries by officers was unknown.

3. TASER International® estimated that as of December 31, 2011, there were more than 1.5 million field applications of the TASER™. As a very rough estimate, this implies about three fatalities for every 10,000 exposures.
4. Although CED proximate deaths are rare and the majority have been attributed to causes other than CEDs, Amnesty International (2004) reported that CEDs contrib uted to or caused more than 60 deaths as determined by medical examiners. Furthermore, some subjects without any apparent risk factors also have died follow ing CED exposure. Thus, although CED proximate deaths are statistically rare and most injuries are minor, the deployment of a CED by law enforcement personnel should be considered a significant use of force with potentially serious consequences.
5. Respondents were asked to indicate where their agency placed CEDs on a scale of 1 to 10, with 1 indicating officer presence, values in the middle range indicating "con trol/compliance/restraint," and 10 representing lethal force (Thomas et al., 2010, p. 308). Although placement ranged from 2 to 9, the majority of respondents (84.3%) ranked CEDs between 3 and 8 (Table 3; Thomas et al., 2010, p. 301).
6. The substitution of zero shootings for missing values for four agencies was based on media searches alone. It is unlikely, however, that media searches would fail to uncover such events. For example, one of the authors has been collecting data in one state for the Bureau of Justice Statistic's Arrest Related Deaths program (see http://www.bjs.gov/index.cfm?ty tp&tid 82) for nearly a decade. When coroner reports indicated a fatal shooting of a suspect by police, one or more corresponding media accounts were located. This indicates that fatal police shootings are reliably reported by the media. Nevertheless, to check the robustness of the findings, we reestimated the fatal shooting models with the dependent variables set to missing for the 26 jurisdictions. No substantive differences were observed in either coefficients or significance values for any of the variables. These results are available on request.
7. An additional available scenario involved a suspect fleeing on foot, but it was excluded for two reasons. First, both flight on foot and tensing and pulling away from an officer's grip represent similar levels of resistance (e.g., active resistance) and thus conceptually overlap to a great degree. Second, including both levels in the regression models presented estimation problems.
8. Due to the relatively small sample size, one reviewer suggested reestimating the models for both outcomes after removing statistically insignificant predictors. Following the removal of *CED50*, *Effects*, *CED Review*, *Force Training*, *Restrictions*, *Sworn*, and *Female*, however, no substantive differences in either the magnitude of estimates or significance levels of the retained variables were observed. These results are available on request.
9. The topics are defensive tactics, arrest and control techniques, mediation skills, use of CEDs, use of other less lethal weapons, de escalation techniques, use of deadly force excluding qualification, officer survival, and dealings with subjects with mental illness.
10. The original variable was discontinuous. The number of hours ranged from 2 to 40, with 33% of agencies reporting 4 hr of training and 45% reporting 8 hr (78% of the sample overall). Few of the remaining agencies reported other values, which ranged from 0.42% (one agency; 40 hr) to 6% (15 agencies; 6 hr). Dichotomizing the variable to 2 to 6 h of training (46% of agencies) and 8 to 40 hours of training (54% of agencies) seems reasonable.

11. Not all agencies reported monthly crime figures for the full year, and for these agencies, we imputed annual crime numbers using the following formula: $C(12)/m$; where C is the number of crimes reported, 12 represents the number of months in a year, and m is the number of months for which crime data were reported.
12. One reviewer recommended estimating zero inflated negative binomial regression models in place of the negative binomial models. However, zero inflated models assume the presence of two types of zeros in the data. In this study, the zero inflated part would assume there are some jurisdictions that will be in the *always zero* group, that is, that it is not possible for a fatality or the use of a CED to occur. The count portion of the model would consist of jurisdictions in which fatalities or the use of a CED may or may not occur. Thus, on a conceptual basis, zero inflated models tech nically are not appropriate (see, e.g., Hardin & Hilbe, 2012; Long, 1997). We recog nize, though, that in practice researchers often estimate zero inflated models when there are more zeros than assumed by the negative binomial regression model. Unfortunately, when estimated, the zero inflated models failed to converge. Therefore, for both conceptual and technical reasons, we believe the best analytic approach is to apply the negative binomial model to the data.
13. One might question the inclusion of the scenario based variables and *CED Rank* in the same models simultaneously. However, the conclusions regarding their effects when entered alone without the other remain virtually the same in regard to both the size of the coefficients and their statistical significance.

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Author Biographies

Frank V. Ferdik is an assistant professor in the Department of Criminal Justice at the University of West Florida. His research interests include criminological theory, criminal justice actor decision making, and risk-related studies. He has recently published in the *Journal of Criminal Justice*.

Robert J. Kaminski is an associate professor in the Department of Criminology and Criminal Justice, University of South Carolina. His research focuses on violence against the police, police use of force, less lethal technologies, and the causes and prevention of officer and suspect line-of-duty injuries. His has published in a variety of journals, including *Criminology*, *American Journal of Public Health*, *Criminal Justice and Behavior*, *Justice Quarterly*, *Homicide Studies*, and *Violence Against Women*.

Mikaela D. Cooney is an assistant professor in the Department of Criminal Justice at Tusculum College. Her research interests include police practices and accountability issues and crime and victimization among the homeless.

Eric L. Sevigny is an associate professor in the Department of Criminology and Criminal Justice at the University of South Carolina. His research focuses on

drug policy, particularly around issues of sentencing and incarceration, the measurement of drug use consequences, and the collateral consequences of mass incarceration.