The "Less-Than-Lethal Weapons Effect"—Introducing TASERs to Routine Police Operations in England and Wales: A Randomized Controlled Trial

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THE "LESS-THAN-LETHAL WEAPONS EFFECT"—INTRODUCING TASERS TO ROUTINE POLICE OPERATIONS IN ENGLAND AND WALES

A Randomized Controlled Trial

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We used a randomized controlled trial to test the effect of mass deployment of TASERs on policing. The findings show that the presence of a TASER is causally linked to statistically significant increases in the use of force more generally—a 48% higher incidence during treatment conditions for TASER-equipped officers, a 19% higher incidence for non-TASER-equipped officers, and a 23% higher rate force wide, compared to control conditions. Assaults of officers doubled. However, there were fewer complaints during treatment compared to control conditions (five versus nine complaints). We conclude that, as is the case with other types of weapons, the presence of TASERs leads to increased aggression. The visual cue of a TASER in police–public interactions leads to aggression. Given other benefits of TASERs for policing identified by previous studies, our findings suggest that both enhanced training as well as concealment of TASERS should be considered.

Keywords: aggression; assault; GAM; general aggression model; hostility; less-than-lethal weapons; officer injury; TASER; weapons effect

For more than 40 years, electroshock weapons such as conducted energy devices (CEDs) have been in use in law enforcement. Once fired, CEDs discharge an electric shock through the body of the subject, causing temporary incapacitation. Most policy guidelines

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allow police officers to use CEDs on aggressive or threatening suspects when alternative de-escalation tactics are not feasible in the circumstances (Police Executive Research Forum [PERF], 2011). Their main goal, therefore, is to provide police officers with an additional tool that can be used in lieu of deadly firearms to deal with violent individuals (American Civil Liberties Union [ACLU] of Michigan, 2013). Yet, despite being a multibillion dollar industry, with nearly every force implementing electroshock weapons to various degrees (PERF, 2011), the body of empirical research on these devices is scant. Certainly, from the perspective of causal research, evidence on the effectiveness or efficiency of CEDs is largely missing from the debate regarding their utility to law enforcement.

TASER, the most famous CED brand name, has been the topic of contemporary scrutiny in various forums, although most of the writing originates in the United States and in non-academic circles (Dymond, 2014). Critics argue that TASERs are significantly overused and can lead to adverse health-related consequences, and that accountability measures for their use are insufficient. Some also question the efficacy of TASERs in achieving their goal of subduing offenders. Proponents contend that thousands of lives have been saved by using TASERs in lieu of lethal weapons, that TASERs reduce assaults against officers, and that, with proper use, TASERs are safe—at least in comparison to any type of police use of force exceeding hand-to-hand tactics (Kroll & Ho, 2009; see also Ready, White, & Fisher, 2008). To be sure, this debate—while it continues around the globe—has had little impact on the continued proliferation of TASERs within law enforcement.

We are particularly interested in the role that TASERs play in police–public interactions, namely, what is the effect of introducing these devices into routine operations? More than 850,000 TASERs have been deployed over the past three decades (Axon Enterprise, n.d.), yet how police officers behave with them, and the ways in which suspects and offenders act around them, is poorly understood. Will the sight of a TASER reduce the propensity of offenders to act aggressively or have the opposite effect? Do police officers apply a different set of decision-making processes once they are equipped with CEDs? In direct consequence of these questions, do officers apply less or more force as a result of carrying TASERs, and are suspects and officers more or less prone to injuries? Answering these questions will have direct implications for our understanding of the role that weapons have in policing and for theories of aggression, as well as practical implications for the ways in which TASERs are used by law enforcement agencies worldwide.

The optimal settings for testing these questions are countries such as the United Kingdom, because the overwhelming majority of frontline police officers are not equipped with firearms. This allows the ways in which carrying TASERs alters policing to be tested independently of the effect of lethal weapons (since the presence of a firearm will probably overshadow or interact with the effect of the presence of a TASER). Importantly, it is necessary to draw inferences about causality from randomized trials, which have the best chance of singling out the effects of TASERs from the multitude of confounding variables that can either increase or mask the treatment effect—here, the role of TASERs in police–public interactions. Situational and contextual factors are critical to understanding the mechanisms of TASER effects, but in the first instance, a basic causal model is required. To date, such a test—and other causal designs more broadly—has been missing.

We begin by reviewing the literature on aggression in police work, which is manifested most poignantly as the use of force by officers and injuries sustained by officers or suspects—or both—during violent police–public interactions. We then explore the psychological dimensions of aggression in the context of policing, specifically through the theoretical framework of the general aggression model (GAM). We argue that GAM is appropriate for explaining workplace aggression in policing, especially in relation to the effect of TASERs. TASER, a less-than-lethal weapon, is hypothesized to have a similar effect as has been detected in studies on the presence of weapons on aggression: they are construed as a proximate, situational causal factor that increases the likelihood of aggression. We argue that much like the "weapons effect," there is a "less-than-lethal-weapons effect" on aggression. We then review the available evidence on the use of TASERs within law enforcement. A description of our experiment follows, wherein we provide details in relation to the research design, measures, experimental procedure, interventions, and statistical procedures used to analyze the results. Finally, the article concludes with a discussion of the findings and their implications for theory and practice.

LITERATURE REVIEW

AGGRESSION IN POLICING

Police Use of Force

A review of the literature suggests several perspectives on police use of force from the social science research of the last 40 years. Numerous factors, as well as countless interactions between these variables, lead to the use of force in each incident (Terrill & Mastrofski, 2002), yet these factors can be broadly categorized as situational, organizational, and psychological (Sherman, 1980). The perspective most pertinent to our article—the psychological—suggests that it is the officers' and suspects' personal characteristics, experiences, views, and cognitions that determine the application of force (Terrill, 2005). There is evidence to suggest that some officers are more aggressive in stressful situations while others show greater restraint when confronted by disrespectful conduct (Engel, Sobol, & Worden, 2000). In a similar way, some individuals (i.e., suspects) are more aggressive or hostile toward the police, given an individual propensity—a variation that in any event exists in the general population. This is particularly evident in law enforcement; many of the suspects with whom the police engage have mental illnesses (see Engel & Silver, 2001; Lamb & Weinberger, 1998), and many officers themselves have varying degrees of "tough-mindedness" characteristics, all of which predict greater use of force. These and other studies (e.g., Manzoni & Eisner, 2006) indicate that psychological variables are important to any study of the use of force, but we recognize that this area remains understudied in policing, especially from a psychosocial theoretical perspective; a robust model is missing from the literature. We discuss below one prominent model that can potentially "tie up" the different approaches to the understanding of aggression in policing. However, we first discuss aggression against police officers more broadly.

Aggression Against Police Officers

The underlying assumption is that officers are at high risk of becoming the victims of physical and psychological violence resulting in serious trauma. Reiser and Geiger (1984, p. 315) noted that "posttraumatic reactions to shootings and other life- and ego-threatening events are influenced by situational factors such as authority role, peer-group pressures, and macho values," which are more pronounced in policing than in any other public-facing profession. These, in turn, are associated with higher levels of posttraumatic syndromes and psychosomatic illnesses (see Abdollahi, 2002).

Injury to officers during arrest most commonly occurs when officers attempt to subdue a suspect with bodily force (e.g., punching, takedowns or wrestling); these techniques account for most recorded injuries (Smith & Petrocelli, 2002). Kaminski and Sorensen (1995) found that officers are more likely to suffer injury when employing levels of force at the lower end of the "force continuum," such as "hands-on tactics" that require close contact with a suspect.

GAM

Aggression in policing is a complex, multifunctional behavior that manifests in various forms. Yet a grounded "theory of aggression in policing" is necessary to better explain and prevent such aggression. We defend the view that of the three approaches to explaining this phenomenon—situational, organizational, or psychological—the psychological perspective should play a more pivotal role. Social cognition is the leading theoretical framework in the field of aggression and suggests that "learning, mental representation, and subsequent interpretation are important routes for the development of aggressiveness" (Fiske, 2009, cited in Gilbert, Daffern, Talevski, & Ogloff, 2013, p. 119). This approach to understanding aggression—most notably represented in the work of Anderson and Bushman (2002), Crick and Dodge (1994), and Huesmann (1998)—argues that a range of cognitive constructs, such as attitudes and interpersonal knowledge, can trigger hostility, violence, or aggression. Certain individuals are more susceptible to aggression than others, which is a direct result of engrained aggression-related cognitions (Berkowitz, 1993). There is no reason to assume the model falls short when it comes to explaining aggression by or against police officers.

One of the latest, yet also most comprehensive cognitive models of aggressive behavior that may also explain the use of force by and against police officers is the GAM (Anderson & Bushman, 2002). GAM is an integrative framework for understanding human aggression. It incorporates elements from "domain-specific theories of aggression, including neoassociation theory, social learning theory, script theory, excitation transfer theory, and social interaction theory" (Allen, Anderson, & Bushman, 2018, p. 75). The principal mechanism of aggression is assumed to be affected by "knowledge structures," which influence a wide variety of socio-cognitive phenomena, including perception, interpretation, decision-making, and behavior (Huesmann, 1998). In practical terms, GAM holds that both personal and situational variables can influence a person's internal state and ultimately lead to aggressive behavior. These factors include, among others, aggressive cognition, aggressive affect, and physiological arousal levels. The model contends that both proximate and distal processes lead to aggression and that these are equally important in the generation of aggressive behavior (for a more elaborate discussion, see Gilbert, Daffern, & Anderson, 2017; on the development of aggression, see Lansford, 2018).

Certain elements within GAM, especially measurable and otherwise easily observed stimuli and outcomes, are well grounded in both theory and evidence. We are particularly drawn to the "proximate processes" that play a part in the formulation of aggressive or hostile cognition: the inputs, outputs, routes, and outcomes that explain individual episodes of aggression (see review in Eisner & Malti, 2015). The inputs affect the present internal state of the individual, which in turn influences their appraisal and decision-making processes, subsequently leading to either aggressive or nonaggressive outcomes. In the context of inputs, we find both personal and situational factors. Here, we are concerned with situational factors—those elements external to the individual that increase the propensity for aggression (see Gilbert et al., 2013). The literature is rich in evidence regarding situational factors that exacerbate aggression (see review in Carlson, Marcus-Newhall, & Miller, 1990), including provocation, alcohol intoxication, violent media, anonymity, noise, and fear-inducing stimuli (see Anderson & Carnagey, 2004). One such stimulus is weapons (Benjamin, Kepes, & Bushman, 2017).

WEAPONS AS SITUATIONAL PROXIMATE FACTORS THAT INCREASE THE LIKELIHOOD OF AGGRESSION

The evidence compellingly shows that weapons increase aggression. Originally, guns were understood to serve as classically conditioned stimuli to aggression responses, whereas they have more recently been considered as part and parcel of GAM in the sense that they increase the accessibility of hostile cognitions. GAM suggests that hostile appraisals can facilitate aggression (Anderson & Bushman, 2002). The model therefore predicts that the mere presence of weapons increases "aggressive thoughts, hostile appraisals, and aggression, suggesting a cognitive route from weapons to aggression" (Benjamin, Kepes, & Bushman, 2017). In a similar mechanism suggested by Crick and Dodge's (1994) social information processing model, the external stimuli of weapons are cues that are encoded differently by certain individuals and can be seen as hostile. For many, a weapon deters from further provocation. However, some individuals interpret these aggressive cues as threats, stimulating aggressive memories and leading to the perceiver constructing the environment as hostile. The appropriate response is consequently a "fight or flight" dilemma, and in certain circumstances the behavioral manifestation is assault, violence, and aggression (Baron & Richardson, 1994).

In the words of Berkowitz and LePage (1967, p. 202), the presence of a gun "evidently elicited strong aggressive responses from the aroused men." Their laboratory experiment was replicated repeatedly—78 times, to be exact (Benjamin et al., 2017; Carlson et al., 1990)—and the synthesized evidence is strong: a "weapons effect" exists. The mere presence of these cues in the environment is often enough to bring aggressive thoughts and feelings to mind, which under the right circumstances can engender increased aggressive behavior in the perceiver (Anderson, Benjamin, & Bartholow, 1998).

The "weapons effect" is so robust that study participants need not even be in the presence of a weapon (Benjamin et al., 2017); the visual cue of a gun, for instance in an image or video, is sufficient to prime hostile cognitions, and some research suggests that the names of weapons by themselves are sufficient to bring about automatic priming effects (Anderson et al., 1998). Thus, we are likely to act more aggressively when weapons are in sight. Although this effect is not homogeneous and does not always occur, the "weapons" effect on aggression has been replicated repeatedly, including by Leyens, Camino, Parke, and Berkowitz (1975) and Turner, Simons, Berkowitz, and Frodi (1977), to name only two of the earlier experiments (for a more recent meta-analysis, see Bettencourt & Kernahan, 1997).

CEDS IN BRIEF

CEDs are a tactical option that is meant to provide officers with a method of managing violent and threatening situations from a safe distance. They were introduced chiefly designed to protect officers and citizens from aggressive, noncompliant subjects (DeLone & Thompson, 2009). The implementation of such devices in American policing dates back to the late 1970s (Smith, Kaminski, Rojek, Alpert, & Mathis, 2007). The proliferation of CEDs parallels the rise in demand for alternatives to lethal force (Gau, Mosher, & Pratt, 2010). In practice, CEDs—and specifically TASERs—appear to be the weapon of choice: TASERs are sold to 17,800 of the United States' 18,000 law enforcement agencies (Wilkes, 2017), with approximately 500,000 officers carrying a TASER on a regular basis (Smith, 2016). This rise in deployment mirrors the rising interest of academics, particularly in the context of the use of force (Terrill & Paoline, 2017). The principal research agendas have included health-related concerns, injuries and assaults against officers, and police policy–related studies (e.g., Gau et al., 2010), which are reviewed below.

The "force continuum"—a standard that provides officers with guidelines as to how much force may be used against a resisting subject in a given situation—positions CEDs directly below lethal weapons (see Terrill, Paoline, & Ingram, 2018), although the most crucial policy guidelines on the use of TASER are proportionality, legality, and necessity under the circumstances. TASERs incapacitate the target by interrupting the normal functioning of the skeletal muscles, which is accomplished by causing repetitive contractions of those muscles via electric shocks (Council on Science and Public Health, 2009). CEDs are highly effective at subduing aggressive suspects (the ability to sustain the electric shock is rare; see Jauchem, 2015). Observational studies suggest that TASERs are useful in policing. White and Ready (2007) reported that 85% of offenders who were TASERed were arrested without further incident. DeLone and Thompson (2009) also concluded that the use of TASERs is "overwhelmingly effective." Using data from multiple U.S. police departments, Thomas, Collins, and Lovrich (2010) found that 56% of departments recorded a reduction in lethal force after implementing a TASER program. Similarly, Sousa, Ready, and Ault (2010) reported that TASER-armed officers were less likely to use firearms in response to resistance from suspects. Ferdik, Kaminski, Cooney, and Sevigny (2014) contextualized these findings in terms of policy. They found restrictive TASER policies to be linked with both lower levels of TASER use and higher fatal police shootings, suggesting that officers' enhanced discretion in respect of the use of TASERs can be beneficial.

TASERS AND INJURIES SUSTAINED BY SUSPECTS

Kunz and Adamec (2017), in the most recent review of the medical evidence, concluded the following about TASERs:

> According to current scientific information, it can be assumed that with the proper use of stun guns no clinically relevant pathophysiological effects on the heart of a struck, healthy person can be expected. A use of CED following the principle of purposefulness and proportionality can therefore be classified as harmless. (p. 79)

Nevertheless, the potential for injuries and even fatalities features prominently in the criminological literature (PERF & Community Oriented Policing Services, 2011; White & Ready, 2010; White et al., 2013). The latest count (Wilkes, 2017) suggests the occurrence of 732 police TASERing fatalities in the United States between 2001 and 2016. As of November 6, 2017, 22 of the 1,093 deadly shootings involving police officers in the United States were deemed to have come about as a result of the use of a TASER ("The Counted," n.d.). However, these assessments do not consider additional factors. Some studies (e.g., White & Ready, 2010) indicate that the suspect's weight, drug or alcohol use, violence, and the distance between the officer and the suspect may play a part in the TASER's effect. Police misuse of TASERs (Stinson, Reyns, & Liederbach, 2012) should also feature as a predictor in these counts. In this regard, Smith et al. (2007) found mixed results regarding TASER injuries but concluded that TASER use may be preferable to the absence of less-than-lethal tactics, primarily because hand-to-hand combat tactics increase the odds of injury to suspects.

TASERS AND OFFICER INJURY

Although the incidence of use of force is relatively low in comparison to the total number of police–citizen encounters, the prevalence of injury to officers is very high (MacDonald, Kaminski, & Smith, 2009). A recent national survey of officers in Germany, for example, showed that 58.9% of police officers had been verbally assaulted during their career, and 36% of them had at least been shoved, if not worse (Ellrich & Baier, 2016).[1] However, up to 70% of such injuries result from hand-to-hand combat tactics (Alpert & Dunham, 2010). Findings such as these often lead to the conclusion that the adoption of less-than-lethal weapons such as TASERs can reduce the likelihood of officer injuries, and the evidence generally supports this recommendation (see below). This assumption is logical because, once the use of force is required, the possibility of being hit is reduced as the distance between the officer and the combative suspect increases.

DeLone and Thompson (2009) found that the officer injuries in the data they analyzed were not TASER-related. Taylor and Woods (2010) suggested that the officers at agencies that use TASERs had lower rates of injury and fewer injuries requiring medical attention than those at agencies not using them. The authors of observational studies have reported that the risk of officer injury decreases when TASERs are used in isolation (Paoline, Terrill, & Ingram, 2012), but increases when TASERs are used alongside other weapons (e.g., batons and guns). Lin and Jones (2010) observed that the use of TASERs can replace other tactics, with fewer forms of force being used overall, consequently decreasing officer injury rates. Similarly, Griffith (2009) found that Australian police forces experienced a 93% decrease in violent confrontations and a 40% decrease in police officer assaults as a result of using TASERs. However, Paoline et al. (2012) found a reduced likelihood of officer injury when a TASER was the only tactic deployed during a police–public encounter but observed a backfiring effect when the TASER was used in conjunction with other force options. Therefore, it is important not to consider the effect of TASERs in isolation; rather, a holistic approach is required.

"LESS-THAN-LETHAL WEAPONS EFFECT"

More profoundly, we lack a "theory of CED" that explains how the mechanism of harm reduction works, aside from the assumption that, given the popularity of TASERs, officers use them effectively to achieve the goal of subduing aggressive suspects who might otherwise hurt them, without causing overall harm to the suspects. Furthermore, "[t]he majority of current human literature has not found evidence of clinically relevant pathophysiological effects during and after an exposure to professionally applied CEDs" (Kunz, Zinka, Fieseler, Graw, & Peschel, 2012, p.1591). However, in the absence of either strong evidence or a theoretical framework, there is no reason not to assume that CEDs in fact increase aggression against officers. The available literature on GAM provides grounds to hypothesize a "less-than-lethal weapons effect"—that is, that CEDs increase aggression. They are indeed an instrument of force and can therefore be understood as a "visual cue" that could exacerbate aggression. If "lesser" cues such as videogames have been found to elicit hostile cognitions (Calvert et al., 2017), there is no reason to assume that TASERs would not provoke the same cognitions. In this context, GAM is able to explain how the presence of a TASER leads to aggressive behavior.

Understanding whether these hostile cognitions take place poses practical difficulties: wherever we find TASERs, we are also very likely to find lethal firearms. At least in American policing, virtually all officers trained and equipped with a TASER would also be equipped with a firearm, which has nearly always been a part of the standard equipment of field officers. To single out the effect of TASERs, that is, to measure the impact of the "less-than-lethal weapons effect" of TASERs in the context of GAM, we must first find a law enforcement agency untainted by the weapons effect of firearms.

THE CITY OF LONDON TASER EXPERIMENT

Our objective was to address the void that exists in the literature by rigorously assessing the relative effectiveness of carrying less-than-lethal weapons such as TASERs on aggression, violence, and the use of force. As these are related to both officer and suspect injuries, the ability to identify a causal link between TASERs and aggression is critical. To emphasize, we did not conduct a test of TASER efficacy. Instead, we attempted to illustrate whether the presence of a TASER leads to aggression. Police officers do not need to "use" TASERs for the weapons effect to take place; GAM suggests that the mere visual cue of a weapon can lead to aggression, and we tested whether the same can be said about less-than-lethal weapons such as TASERs.

METHOD

SETTING

Our field experiment took place at the City of London Police (COLP) in England. COLP provides policing services to the one square mile of the City of London, in the heart of London. The force comprises 728 serving officers, 75% of whom are frontline officers—a proportion similar to that prevailing at the national level. Around 300 of these officers are deployed in the Uniformed Policing Directorate, which is responsible for the bulk of policing services. In addition to "classic" policing jobs, the COLP also prioritizes counterterrorism and public order given the high number of events that take place in the City and its appeal as a venue for protest (Her Majesty's Inspectorate of Constabulary, Fire & Rescue Services [HMICFRS], 2018). The number of victim-based crimes the COLP deals with is .01 per person, as compared to the national level of .06.

The overwhelming majority of officers in the United Kingdom are not equipped with firearms, and COLP is the first force in England and Wales to test the extended deployment of personal-issued TASERs to frontline officers. By implication, it is the first to test the utility of the device under rigorous conditions. Specifically, we are interested in TASERs' effects on the use of force in police–public interactions, assaults on police officers, and injuries sustained by suspects. To emphasize, we sought to evaluate the broader effects of carrying TASERs rather than merely the effects of TASERs on suspects.

CLUSTER RANDOMIZATION

To test the effects of TASERs on force and aggression in policing, we designed a randomized field trial in which the unit of analysis is a temporal cluster during which all TASER-equipped officers patrol the streets of the City of London. We ruled out individual officers as the unit of randomization given the likelihood of treatment-to-control contamination (Ariel, Sutherland, & Sherman, in press). As officers patrol in pairs, or at least attend most calls for service in formations of more than one officer, the individual officer unit immediately violates the stable unit treatment value assumption (SUTVA), which requires that the response of a particular unit depend only on the treatment to which it was assigned, not the treatment conditions of others around it (Cox, 1958). Similarly, we ruled out a geographic unit of randomization since the City of London is relatively small. Instead, a temporal cluster aligned with the deployment schedule of officers in the City of London was used, rendering treatment-to-control spillover unlikely. We randomly allocated temporal clusters during the course of the study period (Table 1), with a one-to-one split of the temporal clusters, such that "treatment clusters" were patrolled by TASER-equipped officers and "control clusters" were patrolled by no-TASER officers.

Thus, the unit of randomization was not the individual officers: officers who were trained to use TASERs were allocated into treatment conditions, whereas control conditions were assigned to officers that were neither trained in the use of TASERs nor equipped with TASERs. We aimed to eliminate treatment contamination as much as possible. However, there were occasions when TASER officers patrolled during control conditions, but without their TASERs, and occasions when non-TASER officers patrolled during treatment conditions, but without TASERs (see Table 1). We acknowledge that, theoretically, the treatment effect on TASER officers may carry over to control conditions by a learning mechanism (i.e., operant conditioning or another type of effect whereby TASER officers behave during no-treatment conditions as if they are exposed to the manipulation, despite not carrying the equipment). It is also possible that the behavior of no-TASER officers who patrolled during treatment conditions was affected by the presence of the TASERs carried by TASER officers when they jointly responded to calls for service. However, two empirical factors reduce the risk of contamination to our causal estimates. First, potential contamination in both arms of the test implies that the presence of a TASER affects solely the police officer, not the suspect. Given what we know about the cycle of use of force in modern policing—namely that the use of force is often determined by the suspect's demeanor rather than the other way around (Engel et al., 2000; Hine, Porter, Westera, & Alpert, 2016; Reisig, McCluskey, Mastrofski, & Terrill, 2004 cf. Terrill & Mastrofski, 2002)—the presence of a TASER has at least as much of an effect on suspects as on officers. Thus, the lack of stimuli during control conditions vis-à-vis suspects creates two discrete study conditions, notwithstanding the learning mechanism that carries over from one set of conditions to the next.

Second, if there is contamination, it prejudices the study against detecting a statistically significant difference because it increases the statistical noise due to the pooled standard variation of the two study conditions in the denominator of the statistical test. Admittedly, this scenario could mask a stronger effect size of the intervention, but it does not inflate the

TABLE 1: Random Allocation by Temporal Clusters

Shift	Control	Treatment	Total
Monday	48 (15)	48 (101)	96 (116)
Early	16 (4)	16 (37)	32 (41)
Late	16 (6)	16 (34)	32 (40)
Night	16 (5)	16 (30)	32 (35)
Tuesday	48 (17)	48 (95)	96 (112)
Early	16 (14)	16 (35)	32 (49)
Late	16 (0)	16 (29)	32 (29)
Night	16 (3)	16 (31)	32 (34)
Wednesday	48 (23)	51 (120)	99 (143)
Early	16 (13)	17 (45)	33 (58)
Late	16 (1)	17 (38)	33 (39)
Night	16 (9)	17 (37)	33 (46)
Thursday	49 (13)	50 (135)	99 (148)
Early	17 (8)	16 (57)	33 (65)
Late	16 (3)	17 (39)	33 (42)
Night	16 (2)	17 (39)	33 (41)
Friday	50 (35)	46 (111)	96 (146)
Early	17 (23)	15 (34)	32 (57)
Late	15 (4)	17 (40)	32 (44)
Night	18 (8)	14 (37)	32 (45)
Saturday	50 (2)	46 (117)	96 (119)
Early	16 (0)	16 (45)	32 (45)
Late	17 (1)	15 (30)	32 (31)
Night	17 (1)	15 (42)	32 (43)
Sunday	46 (1)	50 (106)	96 (107)
Early	15 (0)	17 (32)	32 (32)
Late	16 (1)	16 (42)	32 (43)
Night	15 (0)	17 (32)	32 (32)
Total	339 (106)	339 (785)	678 (891)

Note. In parentheses, the number of TASER-trained police officers in treatment versus control conditions.

Type I error. In the absence of the ability to randomly assign discrete clusters of spatio-temporal units, our design can be viewed as the most appropriate given the operational challenges.

TREATMENT AND CONTROL CONDITIONS

Uniformed frontline officers were required to patrol the streets of the City of London as they ordinarily would. Their tasks included “classic” police work, including responding to calls for service, traffic policing, community and neighborhood policing, maintaining public order at events, and actively engaging with members of the public and potential offenders. No variations in terms of the scope and type of work emerged between the treatment and control conditions; the random assignment created similar distributions of police-attended incidents per cluster (i.e., early, late, and night shifts) in the treatment and control clusters (34.3% vs. 35.1%; 39.0% vs. 39.0%, and 26.7% vs. 26.0%, respectively, with 5,981 incidents in total).

PROCEDURE

Prior to random assignment, 84 COLP frontline response officers were allocated to training to provide them with the technical and behavioral knowledge required to use TASERs in field operations. Rigorous training was provided by City of London instructors as per the College of Policing Axon© course. The training included scenario-based assessments and a certification test that attested graduates of the training course as eligible to carry and use TASERs in field operations. Of the initial cohort of officers, 58 (69%) were eventually certified.

Following training, standard operating procedures were put in place dictating the conditions under which the use of TASERs was permissible, namely in the presence of imminent danger to life or when de-escalation could not be attained given the circumstances. As noted, within the use of force continuum, the TASER is positioned relatively high, reflecting the severity of the cases in which it is deemed permissible to use TASERs—and COLP is no different in this regard.

Random allocation of the clusters was communicated bimonthly to a sergeant in charge of equipping officers with their TASERs. During any given treatment cluster, the sergeant confirmed that TASER officers had removed the equipment from a specially designated locker. Similarly, the sergeant in charge ascertained that TASER officers had not removed the equipment from the locker during control clusters. This procedure was meticulously maintained throughout the entire experimental period, and there were zero deployments of TASERs during control conditions, except for 3 days following a terrorist attack on London Bridge in June 2017, during which time a Chief Superintendent (in his position as Gold Commander) required all TASER officers to carry TASERs, regardless of the random assignment protocol, to enhance the personal safety of officers.

MEASUREMENTS

Crime Incidents per Temporal Cluster

To produce more meaningful estimates of the treatment effect, we sought to identify the rates of our dependent variables per 1,000 incidents. We were granted access to Metropolitan Police Service records on the number of crimes recorded within the jurisdiction of the City of London per temporal cluster. We used the date, time, and location of each incident to quantify the number of incidents per cluster ($n = 678$).

Use of Force

MacDonald et al. (2009) showed a consistent trend in police use of force in multiple locations. It remains a fairly low percentage of police–citizen encounters (only an estimated 2% of all police–citizen interactions require the use of force). From a practical perspective, the police Orders require all officers to document any instance of the use of force, which encompasses any physical force, including the use of handcuffs on compliant or noncompliant suspects and the use of physical restraints, batons, PAVA sprays, police dogs, TASERs, and deadly force. The City of London requires all frontline officers to use a standardized police tracking system to record and account for all use-of-force incidents. This system enabled us to count the number of incidents occurring during the experimental period, in both treatment and control conditions. Force was used a total of 164 times in police–public interactions during the study period (frequency), although a given incident may have included the use of more than one type of force (e.g., the use of physical restraints in addition to PAVA spray).

Assaults on Officers

Officers are often assaulted and injured in the line of duty. These self-reported events are captured by the responding police officer, who files a report detailing the event. When possible, charges are brought against the offending party. In contrast to U.S. police departments, most countries, including the United Kingdom, view verbal assault as a serious offense. Consequently, the term "assaults" in this context includes both physical and verbal assaults on officers.

Injuries to Suspects

Does the presence of a TASER increase the rate of injury to suspects? Such injuries can be a function of the use of TASERs or may come about as a result of other types of force applied to the suspect. Importantly, these data are captured by a police officer other than the arresting officer; instead, a "well-being checklist" is maintained by the booking officer, who is responsible for ascertaining the health of arrestees. The data captured include the date and time of the incident, the incident type, and a short description of the event. These data were collected independently of the study. We further note that the booking officer had no knowledge of the random allocation sequence.

Complaints Against Officers

The COLP tracks formal complaints lodged against its officers through its Professional Standards Directorate. Formal complaints entail a potentially aggrieved party filing a complaint form detailing alleged misconduct or what they perceive to be unprofessional policing. We used the data captured by the Directorate to count the number of complaints filed against police officers as a proxy for the use of force.

TREATMENT FIDELITY

Ideally, treatment conditions would consist of 100% TASER-trained officers carrying TASERs, and 0% no-TASER officers—and vice versa during control conditions. However, this was not feasible due to operational requirements. Given operational needs and the shortage of available staff to patrol the streets, some crossovers were recorded (Table 1). Nonetheless, these did not entail officers carrying TASERs during control conditions (i.e., no TASERs were deployed during control conditions) but rather involved the occasional assignment of TASER-trained officers to control conditions. Phrased differently, during control conditions, some TASER officers were deployed, but without their TASER equipment. We determined a level of treatment fidelity of 88%, which is relatively high in policing studies (Wain & Ariel, 2014).

STATISTICAL PROCEDURES

We utilized generalized linear models for count data with a Poisson distribution, with the treatment condition as the parameter and a constant. This approach echoes that taken in previous experiments with low base rates and overdispersed data (e.g., Ariel, Farrar, & Sutherland, 2015). We report the parameter and exponential parameter estimates as a magnitude of the treatment effect.

This procedure was repeated several times. First, we examined the use of force. We modeled the outcome variables for TASER officers only, for non-TASER officers only, and then force-wide effects. This granular analysis allowed us to understand the effects of the intervention at different levels, that is, the effects of the presence of a TASER on those equipped with them but also vicariously on officers positioned in the proximity of an officer carrying a TASER. Next, we sought to estimate the treatment effect, first in terms of assaults against officers and then in terms of injuries sustained by suspects. Finally, we provided the raw counts of complaints lodged against officers as an additional proxy of the effect of TASERs in policing.

STATISTICAL POWER

Statistical power is probability of detecting a statistically significant difference in a comparison of two groups when such a difference truly exists. As our study included 678 temporal shifts randomly assigned into treatment and control conditions, our design follows the same sample size used in some previous temporal cluster experiments (Ariel et al., 2015). Such a sample size with an anticipated effect size in the magnitude of .2 would suffice for a study with statistical power of 80%.

RESULTS

BASELINE COMPARABILITY

While random assignment into treatment and control conditions should in principle create two groups of clusters that are on average similar to one another at baseline, we ran several tests for comparability. We used all the available and relevant indicators for this comparison (Table 1). As shown, the two groups were noticeably similar across the different variables at baseline at the .05 statistical significance threshold.

MAIN EFFECTS

Use of TASERs

During the entire study period, officers "used" TASERs in police operations nine times, or at a rate of 1 TASER use per 700 incidents. All of uses occurred during treatment clusters. However, the COLP, in line with the College of Policing guidelines, also considers the de-holstering of a TASER (i.e., without applying an electric shock to the suspect), a "use" of the device. In addition to de-holstering and physically driving the TASER barbs into the body of the suspect, the officer may also present, point, or arc the TASER at the suspect. In the United Kingdom, based on Home Office data reviewed by Turner:

> Deploying a taser but not firing it can include "drawing" the weapon, "aiming" it at the suspect; and "red dotting," where the taser is "aimed" and partially activated so that a laser "red dot" is placed on the suspect. In addition, there is the "drive-stun" method, where, with a live cartridge installed, the taser is held against the subject's body, causing pain, but does not deliver an incapacitating effect (Home Office, 2013a). The "drive stun" method was used only on about

TABLE 2: Parameter and Exponential Parameter Estimates—Modeling Use of Force (TASER Officers Only, Non-TASER Officers Only, and Force Wide)

	Parameter Estimates				95% CI	
Parameter	B	*SE*	*p*	Exp(β)	*LL*	*UL*
Use of Force—TASER Officers Only						
Treatment Effect	0.391	.0785	<.001	1.478	1.267	1.724
Intercept	2.928	.0557	<.001	18.690	16.756	20.848
Use of Force—Non-TASER Officers Only						
Treatment Effect	0.171	.0772	.027	1.186	1.019	1.380
Intercept	4.591	.0546	<.001	98.608	88.602	109.743
Use of Force—Force Wide						
Treatment Effect	0.209	.0771	.007	1.233	1.060	1.434
Intercept	4.765	.0545	<.001	117.295	105.403	130.529

Note. CI = confidence interval; LL = lower limit; UL = upper limit.

> 4% of deployments in 2009–13 (but dropped to less than 2% of deployments in 2015) (Home Office, 2016b); the "red dot" accounted for the most taser use between 2009 and 2015, averaging about 50% of every deployment. (Turner, 2017, p. 117)

During the experimental period, police officers applied electric shocks to suspects twice (or at a rate of 1 per 3,000 incidents), and the remaining "uses" involved officers either deholstering or pointing the TASER at suspects.

Use of Force

Table 2 lists the parameter estimates for the main effects in terms of the use of force. We report the beta values, the standard errors, and their associated *p* values for the intercept and treatment. We then present the exponential parameter estimates and the respective 95% confidence intervals (CIs) of these parameters. We report these estimates separately for TASER officers, non-TASER officers patrolling alongside TASER officers, and the entire force. As shown, in all three estimates, there was a statistically significant increase in the use of force during treatment conditions compared to control conditions, at least at the .05 level. This means that the presence of TASERs caused an increase in the rate of use of force per 1,000 incidents per temporal cluster, particularly for TASER-carrying officers, whose use of force increased by nearly 50% compared to control conditions, Exp(β) = 1.478, 95% CI [1.267, 1.724]. However, the presence of TASERs is causally linked to increased rates of use of force during treatment conditions by non-TASER officers as well, in what appears to be a contagion effect in these police–public encounters, Exp(β) = 1.186, 95% CI [1.019, 1.390]. Collectively, this explains why there was an overall rise in the use of force throughout the police force during treatment compared to control clusters, Exp(β) = 1.233, 95% CI [1.060, 1.34].

Injuries to Suspects

No injuries to suspects were recorded during control conditions, whereas only one incident occurred during treatment conditions. From both the substantive and statistical perspectives, there are no differences between the rates of injury in the two arms of the

TABLE 3: Parameter and Exponential Parameter Estimates—Modeling Injuries and Assaults (All Officers, All Suspects)

Parameter	Parameter Estimates				95% CI	
	Β	*SE*	*p*	Exp(β)	*LL*	*UL*
Assaults on Officers						
Treatment Effect	0.748	.1633	<.001	2.113	1.534	2.909
Intercept	−1.563	.1305	<.001	0.209	0.162	0.270
Injuries Sustained by Suspects						
Treatment Effect	0.268	.2680	.317	1.308	0.773	2.212
Intercept	0.000	.1895	1.000	1.000	0.690	1.450

Note. CI = confidence interval; LL = lower limit; UL = upper limit.

experiment (Table 3), which at least indicates that the use of TASERs and the presence of TASERs do not lead to sustained injuries to suspects.

Assaults on Officers

While suspects did not sustain injuries due to TASER use, we detected a significant doubling of assaults on police officers in the line of duty in treatment compared to control conditions (Table 3). We measured .4425 versus .2094 physical assaults per 1,000 incidents in treatment and control conditions, respectively, Exp(β) = 2.113, 95% CI [1.534, 2.909]. Notably, the recorded assaults were all physical rather than verbal in nature. The nil recording of verbal assaults strongly suggests that the direction of the findings is not driven by a recording artifact, that is, by an enhanced registering of events during treatment compared to control conditions. We would expect to have found an increase of some level in documented verbal assaults on officers were the results driven by a design–outcome interaction.

Complaints

As expected, there were only a handful of complaints against officers, and more of these occurred during control (n = 9) than treatment conditions (n = 5). This implies an overall reduction linked to the treatment effect. However, the number of complaints related to the use of force did not differ significantly between the two study arms (four vs. three complaints).

DISCUSSION

While electronic control devices have been in widespread circulation for nearly half a century, with a dramatic push since the early 1990s by TASER International Inc./Axon, surprisingly limited academic attention has been paid to these devices. A wide range of questions about TASERs remain unresolved: Are TASERs always “effective” at subduing violent offenders, and if not, then under what conditions may this be the case? How should we define “effectiveness,” and when does a “use of TASER” commence—when it is deholstered or at the point of probing? What are the behavioral impacts that a TASER may have on suspects, officers, and witnesses? Does TASER use raise concerns in terms of the legitimacy of the police, including in the context of the disproportional use of the device against certain demographic groups (see Ariel & Tankebe, 2018)? Thus far, studies testing TASERs' efficacy, utility, and cost-effectiveness have been either observational or characterized by relatively small samples or weak causal designs. In the specific context of examining the effects of TASERs on violence and aggression more broadly, this study appears to be the first, yet it leaves a number of questions to be addressed in future research. These are discussed below.

CONTEXTUALIZING THE EFFECT: WEAPONS EFFECT

It is well established that weapons are aggression-eliciting stimuli. Within this theoretical framework and given the mature body of evidence on "weapons effects," it is perhaps unsurprising that we found significant increases in the use of force by, and assaults on, officers in this study. While the weapon in this case took the form of a TASER, it appears that the GAM principle remains the same: the weapons effect is ubiquitous and extends to less-than-lethal weapons.

Nevertheless, our experiment contributes to this line of research in some respects. To begin with, this is the first time that the model has been applied in between-subjects, randomized field trial conditions, where law enforcement agents either displayed or did not display weapons in controlled settings. This alone has practical implications, which we discuss in more detail below. From a theoretical perspective, the experiment indicates the robustness of the GAM model in relation to weaponry in the broadest sense, even when the activator of the weapon is an entity that is guaranteed to respond violently to transgression against him or her. There is little room to believe that an officer who is the target of aggression would not respond with force. Our current knowledge regarding force responses to abusive or resistant suspects indicates that police officers will respond to aggression directed at them and will either match or exceed the level of force used by offenders. Thus, while directed aggression toward police officers is irrational, the cue of a weapon "activates" those internal conditions that affect one's decision-making processes, ultimately leading to assaults and attempted assaults on weapon-carrying officers and by implication to a rise in police use of force.

Admittedly, this study cannot pierce the "black box" of how offenders decide to assault officers, but it provides concrete evidence of these cognitive processes: behavior. We did not aim to understand offenders' decision-making processes through surveys or qualitative methods and call for more research in this area in the future. We cannot estimate to what extent people perceived the weapons effect, yet the data demonstrate behavioral changes in police–public interactions. In the treatment group, offenders committed more assaults against officers, and officers more frequently responded with force. The only difference between the two study conditions was the presence of a TASER in the treatment arm and its absence in the control arm. We therefore suggest that the TASER was causally related to behavioral manifestations of aggression.

To emphasize, GAM studies that measure behavioral manifestations rather than psychosocial or cognitive processes make up the bulk of the existing research; Benjamin et al. (2017) determined that 38 out of 78 studies focused on the weapon's effect on aggressive behavior (d = .21; 95% CI [.04, .37]) rather than cognition, affect, or appraisal. While more studies are required on these other dimensions, the focus on the way in which an incidental exposure to a TASER affects behavior alone nevertheless provides valuable theoretical and practical implications.

A CLOSER LOOK AT USE OF FORCE AND AGGRESSION AGAINST OFFICERS IN THE CONTEXT OF TASERS

The available literature on police use of force points out that, on average, the causal mechanism begins with the suspect rather than the officer. The evidence suggests that a suspect's demeanor, rather than situational or officer-based individual factors, is the strongest predictor of force responses (although the latter two factors can serve as antecedents of use of force Sherman, 2018). We believe our study supports these findings and extends them to the context of less-than-lethal weapons more broadly.

Officers are significantly more likely to apply force when a TASER is present. They are also significantly more likely to be assaulted when a TASER is present. However, the odds of suspects sustaining injuries show no statistically significant difference from those under control conditions, just as the rate of complaints against police officers for using excessive or unnecessary force does not appear to increase as a result of the presence of TASERs. None of these outcomes operates in isolation; they are in fact interrelated: if the causal chain of aggression commenced with the officer rather than the suspect (e.g., the proposition that officers carrying TASERs feel more confident and therefore more likely to instigate a use of force contact), we would have expected to find significantly higher rates of injury to suspects and complaints against officers. The evidence suggests otherwise; in line with previous research on assaults, Brown (1994) found that half of assaults occur when they try to "calm or pacify" or even before officers have the opportunity to speak with assailants. Hence, the presence of a TASER precipitates a pattern where suspects become more aggressive toward officers, who in turn retort with more forceful responses, and not vice versa.

POLICY IMPLICATIONS: CONCEALED TASERS

As our findings suggest, the ubiquity of the weapons effect under the GAM can be extended to include less-than-lethal apparatus. Consequently, the effect of the presence of a TASER on aggression in police–public interactions has one practical implication: to conceal the TASER so that it is not plainly visible. TASER equipment is highly noticeable, with the device clearly demarcated on officers' uniforms. Concealing it from sight may help reduce the weapons effect on suspects as it is then less likely to trigger a "hostility cue" with certain offenders. As a result, it may reduce the likelihood of both assaults on, and the use of force by, police officers. As our review shows, it is more likely that an aggressive encounter "begins" with the suspect and his or her demeanor (Engel et al., 2000), which tends to suggest that the mechanism at play is a hostile starting-off point that begins with the suspect (see also Ariel et al., 2016a, 2016b, Ariel et al., 2018). Consequently, removing the TASER from plain view while allowing the officer to use it when necessary seems advisable. This relatively inexpensive change is not expected to limit the efficacy of TASERs at achieving their tactical goal of subduing suspects and replacing the lethal use of force, but it could reduce the weapons effect.[2]

This conclusion can be generalized to all types of police armory. Police officers in the United States, for example, are equipped with firearms, while their counterparts in England and Wales rarely carry any kind of weapon for self-protection. The present study is unique in a global context as we are the first to test the weapons effect in the context not only of law enforcement but also of less-than-lethal weapons. Can the findings and the policy recommendation therefore be extended to the concealment of lethal weapons? There is no logical reason to think otherwise. The meta-analysis of the evidence does not show prominent differences between various types of weapons (effect sizes in the magnitude of .26 and .27 were detected for guns and knives, respectively Benjamin et al., 2017). Therefore, the presence of any weapon can lead to aggression by offenders, so its concealment should be able to reduce aggression. At the very least, researchers should test this presumption in future studies.

LIMITATIONS AND ADDITIONAL FUTURE RESEARCH AVENUES

We hold the view that mixed methods and direct evidence in relation to decision-making processes are required to provide more robust responses to some of the questions we raised earlier. We made assumptions about the ways in which offenders perceive risk, and we discussed their decision-making processes at an abstract level. While we believe the findings to be rigorous, much like experiments in criminology more broadly, we are only able to report on objective crime variations and cannot provide evidence of the psychosocial mechanisms at play here. Such data would also be useful when the incidence of TASER use is relatively low, as feedback from officers or TASERed suspects would provide a richer understanding of the use of TASERs in policing.

NOTES

1. We note that "assaults of officers" means different behaviors and expressions when compared cross-nationally or even cross-jurisdictionally. The legal definition of what would constitute an attack on a law enforcement agent is not universal. In some countries, a "verbal assault" is a criminal offense. So is intimidating, threatening, or even insulting an employee of the state, which would then be classified in official statistics as an "assault on/of a police officer" (see, for example, Ariel et al., 2016a, 2016b). In other countries, particularly in the United States, courts have accorded greater weight to constitutionally protected freedom of speech, which encompasses insults, verbal abuses, slurs, profanities, spitting, and what more restrictive countries refer to as "verbal assaults" against police officers. As the majority of studies on use of force—at least those published in English and that are traceable in major academic search engines—originate in the United States, "verbal assaults" have been hidden from the discussion and in fact from the research on abuse of officers more broadly, as these incidents are not likely to be registered or subsequently reported in official statistics. The lack of documentation of these encounters is problematic, particularly when it is logical to assume that a verbal assault would predict a physical assault. Moreover, it is also likely that some officers would react with a force response to verbal abuse, which again would predict both the physical assault by the officer as well as injuries sustained by suspects. We finally note, as argued by Sherman, Neyroud, and Neyroud (2016), that we need to place more emphasis on harm than on crime counts in our understanding of the crime problem. In the context of "assaults" on officers, as well as in reference to the injuries sustained by suspects, a harm-based or severity-based model would qualify the gravity of each type of assault—verbal, physical, or threat—in a substantive and useful way.

2. In this context, we note that our outcomes did not look at the efficacy of TASER or its necessity more broadly. The stack of evidence on the availability of TASERs, as reviewed earlier, tends to suggest prominent benefits for law enforcement. Our findings do not suggest otherwise. Our recommendations, therefore, suggest ways to improve rather than to reduce the deployment of TASERs in policing.

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