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The History, Policy Implications, and Knowledge Gaps of the CCTV Literature: Insights for the Development of Body-Worn Video Camera Research

Eric L. Piza[1]

Abstract

Closed-circuit television (CCTV) and body-worn video cameras (BWVCs) have rapidly spread throughout policing. Such widespread deployment has heightened the importance of identifying best practices for both of these technologies. The research community has worked toward the identification of such best practices, with bodies of knowledge emerging for both CCTV and BWVCs over recent decades. Given its earlier emergence, research on CCTV is more developed. Nonetheless, the BWVC literature is quickly becoming robust, with BWVC research developing at a much more rapid pace than research on most other police technologies. This essay reviews the CCTV and BWVC literatures across four main areas of inquiry: (1) *program effect and common outcome measures*, (2) *contextual factors* influencing program effect, (3) *intervention costs*, and (4) *implementation issues*. Specific attention is paid to knowledge gaps within the CCTV literature and how BWVC research can avoid (or, in certain cases, already has avoided) similar knowledge gaps.

Keywords

body-worn video cameras, BWVC , closed-circuit television, CCTV, evidence-based policing, police technology

The Proliferation of Closed-Circuit Television (CCTV) and Body-Worn Video Cameras in Policing

Video-recording technologies have rapidly spread throughout law enforcement over recent decades. Phillips (1999) conducted the first review of CCTV research, documenting evaluations

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dating as far back as 1978 (Burrows, 1978; Musheno, Levine, & Palumbo, 1978). The time since has seen a dramatic increase in the use of CCTV as a crime prevention tool. By 2002, estimates suggested the presence of over 4.2 million cameras in the United Kingdom, a ratio of 1 per every 14 citizens (Norris & McCahill, 2006). Enthusiasm for CCTV spread to the United States, as 49% of local police departments report using CCTV, with usage increasing to 87% for agencies serving jurisdictions with populations of 250,000 or more (Reaves, 2015). The last several years have seen the emergence of another video-recording technology in policing: body-worn video cameras (BWVCs). BWVCs have been adopted rapidly, with nearly a third of police agencies in the United States reporting implementing the technology as of 2013 (Reaves, 2015). While similar estimates are not available in other countries, evaluations have been conducted in England (Ellis, Jenkins, & Smith, 2015; Grossmith et al., 2015; Owens, Mann, & McKenna, 2014), Scotland (ODS Consulting, 2011), and Norway (Phelps, Strype, Le Bellu, Lahlou, & Aandal, 2016), suggesting BWVC use is international in scope.

In addition to their popularity, BWVC and CCTV share similarities in terms of their assumed causal mechanisms. Both BWVC and CCTV are rooted in deterrence theory (Ariel, Sutherland, Henstock, Young, & Sosinski, 2017), with their presence expected to convince potential offenders to desist from engaging in delinquent behavior. In this sense, the deterrence effect of BWVC and CCTV can be considered situational, contingent on the individual experiencing a requisite level of fear in the presence of situational risks (Cusson, 1993). As such, the causal mechanisms of both BWVC and CCTV cannot be put into play if the cameras are not recognized by potential offenders (Ariel, Farrar, & Sutherland, 2015). Subsequently, potential offenders must perceive that the presence of cameras significantly increases the likelihood of apprehension in response to crime or delinquency (Gannoni, Willis, Taylor, & Lee, 2017; Gill & Loveday, 2003).

This article focuses on the intersection of the CCTV and BWVC research literatures. It begins with a discussion of evidence-based policing and evaluations of criminal justice technologies, highlighting the challenges inherent in generating "transferable lessons" for police-implemented technology. The subsequent sections discuss these challenges in the context of the CCTV and BWVC literatures. The primary aim is to inform the developing BWVC research agenda, highlighting opportunities to advance the current body of knowledge in a manner that leads to fewer knowledge gaps than what was experienced in the CCTV literature. Tangentially, I hope to also highlight opportunities to further develop CCTV research.

Evidence-Based Policing and Video Surveillance Technology

Contemporary criminology has seen increased calls for the use of scientific evidence in the formation of public policy. Policing has been at the forefront of this movement, with evidence-based policing receiving considerable attention in both the academic and the practitioner communities (Sherman, 1998; Sherman, Farrington, Welsh, & Mackenzie, 2002). Scholars have garnered support for evidence-based policing by drawing comparisons to evidence-based medicine, in which practitioners have advanced training in the scientific method, kept up to date with the most recent research evidence, and used rigorous research findings to guide medical practices (Sherman, 1998). Others, conversely, have noted that such a description of medical research is overly narrow, given the emphasis on the full range of considerations involved in medical treatment (Greene, 2014; Sparrow, 2011). In addition to outcomes (i.e., whether or not the treatment worked), medical research uses multiple methodological and interpretive approaches to explain procedural aspects of treatment such as physician–client interaction, unintended side effects, and the practice of treatment delivery (Greene, 2014). Hence, some scholars have argued that evidence-based policing's stringent focus on program effect can constrain the development of tangible policy implications (Clear, 2010; Sparrow, 2011).

Salvemini, Piza, Carter, Grommon, and Merritt (2015) demonstrated how the aforementioned issues are heightened in the case of criminal justice technology. Procedural aspects of technology are interrelated, with latter tasks contingent on the successful completion of earlier tasks. Salvemini et al. (2015, p. 313) demonstrated this issue through the example of CCTV, which requires a range of procedural and human factors components to follow camera installation in order to maximize the benefits of the technology. The commentary of Salvemini et al. (2015) suggests that, in generating a knowledge base on policing technology, evaluations should be expanded to include multiple outcomes of interest while also accounting for contextual factors that can influence program success. Newly advanced methods of evidence generation may better account for the considerations advocated by Salvemini et al. (2015). In particular, Johnson, Tilley, and Bowers (2015) developed the effect, mechanisms, implementation, (EMMIE) coding system for distilling the quality and coverage of evidence relating to crime prevention interventions. The EMMIE scale builds upon the principles of realist synthesis and review to provide a more holistic assessment of "the probity, coverage, and utility of evidence" for use in policy development (Johnson, Tilley, & Bowers, 2015, p. 459).

Taken together, the observations of Salvemini et al. (2015) and the EMMIE framework (Johnson et al., 2015) suggest four main areas of inquiry that should be explored in evaluations of criminal justice technology: (1) *program effect and common outcome measures*, (2) *contextual factors* influencing program effect, (3) *intervention costs*, and (4) *implementation issues*. In the subsequent sections, the CCTV and BWVC literatures are reviewed according to each of the aforementioned avenues of inquiry. Specific attention is paid to knowledge gaps within the CCTV literature and how BWVC research can avoid (or, in certain cases, already has avoided) similar knowledge gaps.

Program Effect and Outcomes of Interest

CCTV. The effect of CCTV has most often been conceptualized as the technology's ability to deter potential offenders, operationalized via observed reductions in crime incidence. The collective knowledge of this research is synthesized in the systematic reviews and meta-analyses conducted by Welsh and Farrington (2002, 2009). These reviews selected CCTV evaluations for inclusion according the following criteria: (1) CCTV was the main focus of the intervention; (2) the evaluation used an outcome measure of crime; (3) the research design involved, at minimum, before-and-after measures of crime in experimental and control areas; and (4) both the treatment and control areas experienced at least 20 crimes during the preintervention period. Welsh and Farrington's initial review (2002) identified 22 evaluations for inclusion in the meta-analysis, finding that CCTV had a small, but significant, effect on vehicle crimes and no effect on violent crimes. Welsh and Farrington's most recent review (2009) included 41 evaluations and examined CCTV effect across four main settings: city and town centers, public housing, public transport, and car parks. The cumulative studies identified an overall 16% drop in crime. However, the reduction was driven by the 51% reduction in car parks, with the CCTV systems in the other settings having small and nonsignificant effects on crime.

Following the reviews of Welsh and Farrington, Alexandrie (2017) reviewed seven randomized or natural experiments on CCTV, all of which were published following Welsh and Farrington's (2009) latest review. The focus on randomized and natural experiments was meant to alleviate concerns of endogeneity common with nonequivalent control areas, the most common control areas used in CCTV research (Welsh & Farrington, 2008). Alexandrie (2017) found that CCTV reduced crime between 24% and 28% in public streets and urban subway stations but had no desirable effect in parking facilities or suburban subway stations, which diverge with the findings of Welsh and Farrington (2002, 2009). Alexandrie (2017) identified the smaller effect sizes associated with

quasi-experiments, varying study settings (i.e., countries), and differing integration with police practices as contextual factors that could explain this divergence.[1]

While most CCTV studies have utilized reported crime incidents to measure deterrence, some studies have incorporated alternate outcome measures. Sivarajasingam, Shepherd, and Matthews (2003) used emergency room (Accident & Emergency in United Kingdom) visits to measure incidents of assault injury in five English cities. They found that visits from CCTV target areas significantly decreased compared to those from control areas. Reid and Andresen (2014) used insurance data along with police-recorded data to evaluate a Canadian car park system in Surrey, British Columbia. Both measures suggested that there was little evidence of a significant reduction in vehicle-related crime. Through a natural experiment, Priks (2014) analyzed the effect of CCTV on unruly spectator behavior at Swedish football (soccer) stadiums, namely, the throwing of objects (such as bottles, coins, lighters, firecrackers, batteries, etc.) onto the playing field. By collecting data from referee game reports, Priks (2014) found there was much less unruly behavior in stadiums that installed CCTV when compared to matches when cameras were not yet in use. A recent study by Scott et al. (2016) analyzed CCTV's effect on the public injection of heroin in Footscray, a suburb of Melbourne, Australia, through a survey of 688 hypothermic drug users. The authors found that the introduction of CCTV was associated with a significant 13% decrease in heroin injections.

While the CCTV literature has predominately focused on crime deterrence, police departments largely invest in CCTV for its ability to detect and identify offenders for investigatory purposes (Ratcliffe, 2006). The analysis of Piza, Caplan, and Kennedy (2014a), to the author's knowledge, represents the only case-controlled test of CCTV's ability to facilitate on-scene offender apprehension. Piza et al. (2014a) found that crime incidents detected and reported by CCTV were closed by an enforcement action at a significantly higher rate than crimes reported via the 9-1-1 emergency line, suggesting that certainty of punishment, a key component of deterrence (Durlauf & Nagin, 2011), was heightened by CCTV. Ashby (2017) recently analyzed the effect of CCTV in retrospective criminal investigations (rather than on-scene apprehension) of the British Transport Police. Ashby (2017) found that CCTV provided video evidence to investigators in 45% of cases, which was judged to be useful in 29% (65% of cases in which it was available). Useful CCTV footage significantly increased the likelihood of crimes being solved for all crime types except drugs/weapons possession and fraud.

Outside of the studies conducted by Ashby (2017) and Piza et al. (2014a) research on CCTV's capacity to facilitate offender apprehension is largely descriptive and presents mixed findings. Gill and Spriggs (2005) found support for CCTV as an investigatory tool in England. During the evaluation, CCTV systems in car parks provided 14 pieces of evidence to police, which represented a significant proportion of the 44 crimes reported per month in the car parks (Gill & Spriggs, 2005, p. 30). Police attributed an increase in the detection rate for criminal offenses, from 9% in 2001–2002 to 27% in 2003–2004, to the introduction of CCTV. Observations from other studies are much less supportive. King, Mulligan, and Raphael (2008) reported that San Francisco detectives requested footage for investigatory purposes 120 times over a 3-year period, with footage being used to charge suspects in only six cases. King et al. (2008) also found anecdotal evidence that the presence of CCTV cameras may have actually deterred witnesses from cooperating in criminal investigations, owing to the assumption that cameras have captured all of the necessary evidence for suspects to be charged and convicted. La Vigne et al. (2011) conducted interviews with stakeholders in Washington, DC, Baltimore, and Chicago to measure perceptions of CCTV's contributions to retroactive investigations. In Washington, DC, La Vigne et al. (2011) found that, while respondents generally viewed CCTV as useful for retroactive investigations, they did not find CCTV to be consistently useful due to poor image quality and events not being recorded in their entirety. Investigators in Chicago reported that certain technological aspects of CCTV, namely, preprogrammed panning tours of cameras and the limited number of days archived footage was available for review, limited

the technology's utility as an investigatory tool. Officers in Baltimore, however, reported that CCTV footage was helpful in identifying witnesses as well as perpetrators present during the incident but who were reluctant to voluntarily share their knowledge with police.

Researchers have periodically attempted to measure CCTV effect on citizen fear of crime through public opinion surveys. Gill and Spriggs (2005) found that members of the public worried less about becoming victims of crime in the intervention area following the installation of CCTV. However, this finding was statistically significant for only 3 of 14 CCTV systems. Winge and Knutsson (2003) found that fear of crime, as well as perceptions of disorder and criminality, was not impacted by CCTV in the city center of Oslo. Reid and Andresen (2012) found that CCTV had no significant impact on perceptions of personal safety in a Surrey City, British Columbia, car park. Williams and Ahmed's (2009) English lab study of CCTV and fear of crime measured participant responses to pictures of a male "skinhead," a "studious" female, or no one within an urban setting in which an obvious CCTV camera was either present or absent. The only statistically significant interaction was between presence of CCTV and the male target, which was associated with the highest levels of fear. Interestingly, this suggests that the presence of CCTV cameras may play into a subject's inherent stereotypes of others, exacerbating their levels of fear.

BWVC. In contrast to the systematic reviews conducted on CCTV (Welsh & Farrington, 2002, 2009), BWVC reviews have not focused on specific outcome measures but have rather sought to explore the research questions explored in the literature (Cubitt, Lesic, Myers, & Corry, 2017; Lum, Koper, Merola, Scherer, & Reioux, 2015). This approach has allowed for a consideration of a wider range of outcome measures than what has occurred within CCTV research. The wide focus of the reviews allows for the identification of areas of strength within the BWVC literature as well as avenues of inquiry that are currently lacking.

A recent systematic review conducted by Cubitt, Lesic, Myers, and Corry (2017) included 11 studies: 5 peer-reviewed articles and 6 articles from the gray literature. The studies predominately focused on BWVC effect on crime occurrence, police officer use of force, and complaints against police personnel. The low number of studies did not allow for a statistical meta-analysis. However, Cubitt et al. (2017) noted particular trends in the study findings, specifically that BWVC generally was found to reduce crime rates and use of force incidents.

A subset of studies reviewed by Cubitt et al. (2017) focused on police officer and public perceptions of BWVC technology. Findings of this survey research were less consistent than the tests of crime rates and police officer use of force. In their survey of Orlando, Florida, police officers, Jennings, Fridell, and Lynch (2014) found that, of the 95 respondents, 62.7% believed that BWVC should be implemented, 77% of respondents felt comfortable wearing the camera, but that only 18.2% of officers felt safer wearing a BWVC. Jennings and colleagues also found little support among officers regarding BWVC's capacity to reduce use of force and complaints against officers. In Victoria, Canada, 53% of officers agreed or strongly agreed that BWVCs had been a positive introduction to the agency, while 47% agreed or strongly agreed that they act more professional when wearing a BWVC (Laur, LeBlanc, Stephen, Lane, & Taylor, 2010). Laur, LeBlanc, Stephen, Lane, and Taylor (2010) also found that police officers believed BWVCs had a mediating effect on citizen encounters, with 66% reporting they agreed or strongly agreed that people become less aggressive when they are aware that an officer is equipped with a BWVC. However, officers reported much less perceived support from their colleagues with 78% disagreeing or strongly disagreeing that BWVC was well received by their fellow officers. Ellis, Jenkins, and Smith (2015) surveyed 991 members of the public in the Isle of Wright, United Kingdom, both pre- and post-BWVC implementation. Ellis et al. (2015) found significant increases in citizen awareness of BWVC technology, perceived likelihood of conviction as well as significant decreases in perceived reduction of complaints, reduced assaults on officers, and reduced crime and antisocial behavior.

Interestingly, police officers surveyed by Ellis et al. (2015) had significantly lower confidence than the public that BWVCs would reduce assaults on officers but had higher confidence that BWVC would reduce complaints against officers.

Lum, Koper, Merola, Scherer, and Reioux (2015) conducted a systematic review of both existing and ongoing research on BWVCs. Lum et al. (2015) first identified current research demands and further questions that warrant more empirical attention. In doing so, Lum et al. (2015) reviewed a number of information sources—including government reports, congressional proceedings, conference proceedings, BWVC guidebooks, and opinion pieces—to identify relevant avenues of inquiry. The research team identified seven total topic areas of BWVC research: (1) impact of BWVCs on officer behavior, (2) officer attitudes about BWVCs, (3) impact of BWVCs on citizen behavior, (4) citizen and community attitudes about BWVCs, (5) impact of BWVCs on both criminal and internal investigations, (6) impact of BWVCs on police organizations, and (7) examination of national prevalence and use of BWVCs.

Lum et al. (2015) identified 12 existing empirical studies of BWVCs with an additional 30 studies in progress. The most common research questions explored the impact of BWVCs on officer use of force and the quality of officer–citizen interactions. Police officer attitudes toward BWVCs, citizen satisfaction with police, and community attitudes and perceptions of BWVC commonly appeared in the literature. Other key aspects of BWVCs, such as impact on explicit or implicit bias, officer compliance with Fourth Amendment standards,[2] citizen behaviors related to BWVCs, citizen cooperation with police, BWVC effect on criminal investigations, and privacy concerns, were largely absent (see Lum et al., 2015, p. 20). Lum et al. (2015) concluded that the rapid adoption of BWVCs by police is occurring within a "low information environment," with researchers only beginning to develop knowledge about the effects of the technology. However, the presence of almost 3 times as many in-progress studies as completed analyses suggests that BWVC research is expanding at a historically unprecedented rate (Lum et al., 2015, p. 10).

A number of studies have emerged since the reviews conducted by Cubitt et al. (2017) and Lum et al. (2015). These studies have focused on outcomes previously addressed in the literature, including citizen complaints against officers (Ariel, Sutherland, Henstock, Young, Drover, et al., 2017; Braga, Coldren, Sousa, Rodriguez, & Alper, 2017; Hedberg, Katz, & Choate, 2016; White, Gaub, & Todak, 2017; Yokum, Ravishankar, & Coppock, 2017), police officer use of force (Ariel et al., 2016a; Braga et al., 2017; Headley, Guerette, & Shariati, 2017; Henstock & Ariel, 2017; Jennings, Fridell, Lynch, Jetelina, & Reingle Gonzalez, 2017; White et al., 2017; Yokum et al., 2017), officer decisions to arrest or issue citations (Braga et al., 2017; Headley et al., 2017; Hedberg et al., 2016; McClure, LaVigne, Lynch, & Golian, 2017; Yokum et al., 2017), and police officer attitudes toward BWVCs (Kyle & White, 2016; Pelfrey & Keener, 2016). Findings of these studies were mixed, with BWVC deployment being associated with decreased levels of use for force in certain studies (Braga et al., 2017; Henstock & Ariel, 2017; Jennings et al., 2017; White et al., 2017), while Ariel et al. (2016a), Headley, Guerette, and Shariati (2017), and Yokum, Ravishankar, and Coppock (2017) found null effects. Findings were similarly mixed regarding citizen complaints against officers, with both negative (Braga et al., 2017; Hedberg et al., 2016) and null (Ariel, Sutherland, Henstock, Young, Drover, et al., 2017; Yokum et al., 2017)[3] relationships with BWVC observed. Both Hedberg, Katz, and Choate (2016) and McClure, LaVigne, Lynch, and Golian (2017) found a significant reduction in arrests. Interestingly, McClure et al. (2017) also found that community members frequently had difficulty remembering whether an officer was wearing a BWVC. Conversely, Braga, Coldren, Sousa, Rodriguez, and Alper (2017) found that the introduction of BWVCs in Las Vegas were associated with increased numbers of arrests and citations enacted by officers assigned to the treatment groups when compared to the control group. Similarly, Headley et al. (2017) found that the introduction of BWVC was associated with increased numbers of field contacts and traffic citations but decreased numbers of arrests in Hallandale Beach, Florida. Regarding police officer attitudes,

Kyle and White (2016) found that support for BWVCs was linked to their perceptions of organizational justice and Pelfrey and Keener (2016) found BWVCs were supported by both commanders and officers, although officers expressed concerns regarding suspect privacy and administrator expectations. Headley et al. (2017) found that officers were pessimistic about BWVC, with officers reporting that the cameras would not improve transparency and accountability, reduce citizen complaints, or reduce officer use of force.

Other recently published studies have addressed research questions identified as lacking in the BWVC literature by Lum et al. (2015). Ariel (2016) tested the effect of BWVCs on citizen willingness to report crime to the police, finding an overall increase in reported crimes. Morrow, Katz, and Choate (2016) analyzed BWVC effect in intimate partner violence cases, finding that, compared to a control group, BWVC cases were more likely to result in arrest, have charges filed, have cases furthered, result in a guilty plea, and result in a guilty verdict at trial. Yokum et al. (2017) analyzed the evidentiary value of BWVCs in Washington, DC, finding that BWVC did not significantly affect a range of judicial outcomes including prosecutions and guilty pleas.[4] Through coding of BWVC footage and the use of computational linguistic models, Voigt et al. (2017) found that police officers spoke with consistently less respect toward Black citizens than White citizens during traffic stops. However, while the findings of Voigt et al. (2017) suggest the presence of implicit bias among police officers, they did not speak to whether (or how) BWVC can play a role in mitigating (or promoting) such activity.

Contextual Factors

CCTV. The primary contextual finding with CCTV relates to effect heterogeneity across different settings. Findings of the aforementioned meta-analyses of Welsh and Farrington (2002, 2009) suggest that CCTV works better in well-defined settings (specifically car parks) than public places, most greatly impacts vehicle crime, and has little to no effect on violent crime. Studies published since Welsh and Farrington conducted their latest review present evidence both in support of and contrary to the review findings. In their analysis of the first 73 cameras installed in Newark, New Jersey, Caplan, Kennedy, and Petrossian (2011) found that auto theft was the only crime type that experienced a reduction, with replicating this finding once Newark's system expanded to 146 cameras. In respect to car parks, Piza (2018) Farrington, Gill, Waples, and Argomaniz (2007) also found that CCTV was much more effective in car parks than public places, while Reid and Andresen (2014) found no evidence of positive effects on crime in a City of Surrey, British Columbia, car park. While other studies have similarly found CCTV to have no effect in public places (Cameron, Kolodinski, May, & Williams, 2008; Farrington, Bennett, & Welsh, 2007; King, Mulligan, & Raphael, 2008), others have found some positive effects for street-level crime and disorder (LaVigne, Lowry, Markman, & Dwyer, 2011; McLean, Worden, & Kim, 2013; Ratcliffe, Taniguchi, & Taylor, 2009).

While these studies suggest that CCTV effect can vary across systems, recent research suggests that effect can also vary within a given system. While Ratcliffe, Taniguchi, and Taylor (2009) found that Philadelphia's CCTV system generated a 13.3% reduction in overall crime, just as many individual cameras had no effect on crime as there were locations that showed a benefit. Similarly, while Caplan et al. (2011) found auto theft to be the only offense to experience a system-wide reduction in Newark, some individual CCTV sites were highly effective across all crime types. Of the 73 cameras in place at the time, 58 experienced reduced levels of shootings, 34 experienced reduced levels of auto theft, and 41 experienced reduced levels of theft from auto.

Recent research suggests that contextual aspects of CCTV camera sites can explain such intra-system heterogeneity. In Cincinnati, Lim and Wilcox (2017) found that, while the overall system produced minimal crime control benefits, individual camera sites within residential areas

experienced reductions in assault, robbery, and burglary with diffusion of benefits being observed much more often than displacement. In Newark, Piza, Caplan, and Kennedy (2014b) found that the presence of particular facility types differentially influenced crime occurrence, with bars associated with reductions in violent crime and robbery, retail stores associated with increases in property crime and theft from auto, and schools associated with increased levels of auto theft. Piza et al. (2014b) also found that enforcement actions (i.e., arrests, summonses, or field interrogations) generated by proactive CCTV monitoring were related to decreases in overall crime, violent crime, and theft from auto.

Piza et al.'s (2014b) finding on the effect of CCTV-generated enforcement actions suggests that camera presence alone may not be enough to deter potential offenders. Rather, perceived threat of apprehension, as signaled by the police enforcement, may be necessary to influence offender behavior. The aforementioned review of Alexandrie (2017) provides a level of support for this observation. In particular, in discussing why the findings of his review diverged from those of Welsh and Farrington (2002, 2009), Alexandrie (2017) noted the importance of understanding the extent to which a given CCTV system was integrated with proactive police practice. In this sense, process evaluation findings of La Vigne and Lowry (2011), the sole parking facility included in the review, support Alexandrie's argument on the importance of integration. La Vigne and Lowry (2011) found that budget cuts led to the disbandment of the host agency's auto theft unit, the party primarily responsible for leveraging the benefits of the cameras in crime control strategies. Therefore, the intervention, which did not generate any significant reduction in crime, amounted to the placement of cameras and signage absent any enhancements of police practices.

Studies conducted in public settings further support the hypothesis that CCTV systems that support proactive police activities are more likely to generate crime reduction than passive systems. In their study of CCTV in three cities in the United States (Baltimore, Chicago, and Washington, DC), La Vigne et al. (2011) found the systems that effectively reduced crime were those incorporating active monitoring of cameras and direct integration of CCTV into proactive police functions. Piza, Caplan, Kennedy, and Gilchrist (2015) directly tested the influence of proactive enforcement activity on CCTV effect through a randomized controlled trial (RCT) that integrated directed police patrol alongside active CCTV monitoring in Newark, New Jersey. During the RCT, CCTV operators monitoring a subset of cameras in high-risk areas relayed incidents of concern directly to the patrol supervisor via two-way radio, with the patrol units responding immediately to incidents when notified. Cameras in the control group were monitored and policed as normal, with two operators monitoring all nonexperimental cameras and reporting incidents of concern through the computer-aided dispatch system; police officers were dispatched to incidents in a differential response manner, a process that typically results in large queue times (see Piza, Caplan, & Kennedy, 2017). This reconfiguration of the Newark Police Department's CCTV operation resulted in a dramatic increase in CCTV-generated enforcement activity (see Piza, Caplan, Kennedy, & Gilchrist, 2015, pp. 56–57) and led to statistically significant, and sizable, reductions in violent crime and social disorder in target areas when compared to control areas. While the evaluation of Piza et al. (2015) provides support for this causal mechanism, a quasi-experimental evaluation conducted by Gerell (2016) found the implementation of an actively monitored CCTV system, in which CCTV operators directly notified police officers of incidents of concern, did not reduce assaults in a nightlife area of Malmö, Sweden. It should be noted that Gerell (2016) was not able to measure changes in enforcement levels following the CCTV system, so it is unclear whether the Malmö system incorporated the same causal mechanism as the study of Piza et al. (2015). Nonetheless, the emerging body of work on the merging of proactive police enforcement and CCTV activity suggests that this issue is worthy of additional inquiry from the research community.

BWVC. An interesting theme in the BWVC literature is the fact that findings have not always been consistently replicated across studies. As discussed previously, divergent findings, even across different studies by the same authors, have appeared for outcome measures such as citizen complaints against officers (Ariel, Sutherland, Henstock, Young, Drover, et al., 2017; Hedberg et al., 2016) and police officer use of force (Ariel et al., 2015; Katz, Kurtenbach, Choate, & White, 2015). What has not typically accompanied such observations is a discussion of the contextual factors that may help explain such divergent findings.

A noteworthy exception is a series of studies conducted by Ariel and colleagues. Ariel, Sutherland, Henstock, Young, Drover, et al. (2017) conducted 10 RCTs in partnership with eight police forces in six jurisdictions, involving a total of 2,122 officers and covering a population of more than 2,000,000 citizens. In each RCT, police officer shifts were randomly assigned to either experimental or control conditions on a weekly basis. Using meta-analytic procedures to summarize mean differences across each RCT, Ariel, Sutherland, Henstock, Young, Drover, et al. (2017) found that BWVCs had no discernable effect on police use of force and was associated with an increased likelihood of officers being assaulted during experimental shifts when compared to control shifts. Ariel, Sutherland, Henstock, Young, Drover, et al. (2017, p. 750) concluded that these "puzzling results flip the theoretical basis for the study on its head" as there was little reason to expect BWVCs to increase use of force. However, supplemental analyses conducted by Ariel et al. (2016a) confirmed that the findings exhibited a significant level of heterogeneity. While the pooled results pointed toward a null effect on use of force and aggravating effect on assaults against officers, the 10 departments had different experiences with BWVC. Thus, Ariel, Sutherland, Henstock, Young, Drover, et al. (2017) concluded that the observed variability meant that BWVCs "worked in *some place, some of the time*, but did no work in others" (p. 752, emphasis in original).

Ariel et al. (2016b) explored potential sources of this variability for police use of force in a follow-up study. The researchers looked at levels of treatment integrity as defined in the preestablished RCT criteria as a potential explanatory factor of effect heterogeneity. The experimental sites were categorized into three subgroups: high compliance (no officer discretion applied to when and where BWVCs should be used; $n = 3$), no compliance (treatment integrity failure in both treatment and control conditions; $n = 4$), and cases where officers applied discretion during experimental shifts but followed protocol during control shifts ($n = 4$). Ariel et al. (2016b) found support for the hypothesis that adherence to the experimental protocol influenced study findings as sites in the high-compliance group experienced decreased use of force, while the no compliance group experienced a null effect. In addition, when officers applied discretion during experimental conditions but followed the protocol in control conditions use of force increased.

The obvious policy implication from the work of Ariel and colleagues is that police departments should enact policies clearly requiring the use of BWVC. Unfortunately, nearly one third of the 63 police departments surveyed by Miller, Toliver, and Police Executive Research Forum (2014) reported not having a written policy governing BWVC use. This issue is compounded by the fact that police officers report that they do not activate their BWVC in each instance. Hedberg et al. (2016) found that police officers in Phoenix activated their BWVCs in only 32% of incidents. Young and Ready (2015) similarly reported that officers in in a Southwestern U.S. department activated their devices in only 66% of incidents despite department policy mandating the activation of BWVC by responding officers. This same study reported that a change in policy from mandatory to discretionary activation reduced the activation rate 40%. This shows that, even in instances where BWVC is mandated, the expected prevention mechanism (i.e., recording of police officer actions leads to positive outcomes) may not be in effect.

Other research suggests contextual considerations regarding both police officer and citizen perceptions of BWVCs. Fouche (2014) found that University of Georgia police officers between 21 and 25 years old reported the highest levels of support with BWVC use and that police officers with

bachelor's degrees were more supportive of BWVCs than less educated officers. Years on the police force also seemed to be negatively related to support for BWVCs, as officers with less than 2 years' experience reported higher mean agreement rates than officers with 3–10 years' experience. Pelfrey and Keener (2016) similarly found that police officer rank was associated with higher expectations and more positive attitudes toward BWVCs. In addition, Kyle and White (2016) found that female officers held more positive attitudes of BWVC than males. Young and Ready (2015) argued that acceptance of BWVCs was largely contingent on officers' shared experience, which creates a "diffusion of cognitive frames" by which a positive opinion of one officer influences the opinions of other officers in his or her network. Ariel's (2016) study in Denver also suggests a contextual effect on citizens, with low-crime street segments experiencing higher levels of reported crimes post-BWVC deployment, while street segments in hot spots experienced no change in reporting. Ariel (2016) attributed this finding to the different socioecological contexts of street segments, with high-crime segments most often comprising busy nighttime economies such as entertainment complexes and commercial facilities. In such settings, the improved sense of police legitimacy necessary to increase citizen reporting may be harder to generate than within residential areas most often comprising low-crime street segments. McClure et al. (2017) found that citizen satisfaction with police was contingent on the nature of their interaction with the officer. In their RCT, McClure et al. (2017) compared a control group of officers without BWVCs with two separate treatment groups: officers wearing BWVCs and officers wearing BWVCs while also following a script meant to maximize procedural justice. While an officer simply wearing a BWVC improved citizen satisfaction, the benefits of procedurally just practices were 60–360% larger than the benefits of wearing a BWVC alone. The script also involved officers overtly informing community members that the interaction was being recorded. This is an important insight, as the President's Task Force (2015, p. 32) articulated a commonly held belief that "when officers tell citizens that the cameras are recording their behavior, everyone behaves better." The findings of McClure et al. (2017) provide support for this belief, as does the RCT of Ariel, Sutherland, Henstock, Young, Drover, et al. (2017), which also instructed officers to inform citizens of BWVC presence during all encounters (see also Ellis et al., 2015, as the Hampshire Police enacted policy requiring all officers to announce the presence of a BWVC).

Intervention Costs

CCTV. The installation of CCTV cameras typically costs millions of dollars (Babwin, 2007; Goldstein & Eiserer, 2012) with maintenance expenses requiring similar financial commitment after installation. Ratcliffe and Groff (2011) found that Philadelphia spent US$200,000 a month in maintenance costs, while La Vigne et al. (2011) found that the cost associated with maintaining Chicago's system exceeded the start-up costs by the fifth year of the program. The installation of a CCTV system further requires investment in personnel to conduct surveillance-related functions. Chicago reported that their personnel costs (US$3,341,000) totaled more than the initial start-up (US$1,431,000) and maintenance (US$1,713,000) costs combined (La Vigne et al., 2011, p. 69). Taken together, the expenses associated with CCTV represent a substantial financial commitment. Norris (2003, p. 256) estimated that CCTV systems have cost over £3 billion in Great Britain over the 10-year period of 1992–2002, not including personnel. While comparable figures are not available for the United States, they are arguably similar given the widespread adoption of CCTV by American police agencies.

Despite such cost accounting, CCTV researchers have seldom measured whether program costs were offset by monetary benefits realized from crime reductions generated by the program. To the author's knowledge, only three cost–benefit analyses have been conducted on CCTV to date. In their national evaluation of CCTV in the England, Gill and Spriggs (2005) found that financial benefits

outweighed costs in only one of the six schemes that generated a crime reduction. La Vigne et al. (2011) found that systems in Chicago and Baltimore were largely cost effective, although benefits were much more pronounced in Chicago (between US$2.81 and US$4.30 saved for every US$1 spent) than Baltimore (between US$1.06 and US$1.49 saved for every US$1 spent). Piza, Gilchrist, Caplan, Kennedy, and O'Hara (2016) conducted a cost–benefit analysis of an intervention pairing proactive CCTV monitoring with directed police patrol in Newark, New Jersey, finding such a strategy to be cost effective for agencies with existing (and paid for) CCTV systems but cost prohibitive for agencies needing to first invest in CCTV. The presence of only three studies translates to a very low ratio of CCTV evaluations to cost–benefit analyses. This is especially the case given that Piza et al. (2016) focused on a temporary, specialized intervention involving CCTV rather than the CCTV system itself.

BWVC. Costs associated with BWVC deployment are multifaceted. Like CCTV, start-up costs of the BWVCs themselves represent only a fraction of the total expenditures, and recurring funds must be allocated toward storing recorded video, managing video, providing copies of video to the public upon request, training officers, and administering the program. Additional infrastructure also needs to be purchased such as docking stations for video upload (Sousa, Coldren, Rodriguez, & Braga, 2016, p. 366). Costs of the physical BWVCs range from US$800 to US$1,200 per unit, based upon the survey conducted by Miller et al. (2014). These figures pale in comparison to recurring costs, with agencies reporting spending between hundreds of thousands to US$2 million per year, with the bulk of expenses going toward data storage costs (Miller, Toliver, & Police Executive Research Forum, 2014). For some agencies, such costs may hinder the implementation of a BWVC program, as 39% of the agencies surveyed by Miller et al. (2014) reported cost as a primary reason for their lack of a BWVC program.

Inroads have begun to be made into cost–benefit analysis of BWVC (Lum et al., 2015). While early BWVC studies typically restricting their exploration of costs to documenting the expenses associated with the program, Braga et al. (2017) recently conducted a cost–benefit analysis of BWVCs in Las Vegas. Braga et al. (2017) estimated the annual financial costs per BWVC user at between US$828 and US$1,097 per year including camera installation, training, operation, maintenance, public data requests, and video storage costs. Financial benefits of the BWVCs were operationalized as decreased complaints in misconduct, the reduced costs to investigate said complaints, and the reduced amount of time it takes to resolve said complaints when BWVC footage is available. In all, the reduction in citizen complaints resulted in an estimated savings of US$40,006 per officer per year. Accounting for the costs of the cameras, this represents a net annual savings of between US$2,909 and US$3,178 per user per year.

While the cost–benefit analysis of Braga et al. (2017) is an important contribution to the literature, it should be noted that the study findings may actually underestimate the financial benefits of BWVCs. While reduced counts of complaints were used to monetize the BWVC effect, other benefits of BWVCs can provide substantial monetary benefits. Braga et al. (2017) acknowledged this fact while noting that the necessary data to monetize other BWVC benefits were not accessible during the study period. Other outcomes of interest in BWVC research involve factors such as enforcement actions (i.e., arrest or citation) and officer use of force. Costs of these events have not been systemically estimated in prior research. This is also the case regarding several outcome measures that Lum et al. (2015) suggest should be included in future BWVC studies, such as officer compliance with Fourth Amendment standards, citizen willingness to call police, police managerial systems, and resolution of citizen complaints. Such roadblocks are not present in cost–benefit analysis of programs that aim only to reduce crime, as there exists a robust literature estimating the cost of various crime types as well as the entity most affected by said costs (i.e., victims, the criminal justice system, or society as a whole; Wickramasekera, Wright, Elsey, Murray, & Tubeuf,

2015). Therefore, continued cost–benefit analysis of BWVC would be assisted by the rigorous creation of cost estimates for such outcome measures. For certain measures, cost estimates may be obtained by consulting literature outside criminology. For example, costs of use of force incidents could be informed by cost of necessary medical treatment for suspects, such as emergency room visits, which may be available in the medical research. Costs of other outcome measures would require novel approaches, such as those incorporated by Braga et al. (2017), to create sufficiently rigorous cost estimates.

Implementation Issues

CCTV. Unlike policing strategies reliant purely on human actors, CCTV programs are contingent on a variety of interconnected steps (Salvemini, Piza, Carter, Grommon, & Merritt, 2015). Any "glitch" in one area can have negative consequences for the overall operation. An obvious consideration is the image quality of cameras. The performance of CCTV cameras during nighttime has been somewhat variable, with cameras in certain systems providing higher quality images than others (Gill & Spriggs, 2005). Poor weather has also been seen to interrupt wireless signals that stream footage from cameras to control rooms, which can lead to footage disruption and, in certain cases, loss of video all together (Keval & Sasse, 2010). In San Francisco, image quality was negatively impacted by the limited storage capacity of the system. The recording frame rate was set to much lower than system capacity, resulting in "choppy" footage with widespread image gaps in order to comply with storage limitations (King et al., 2008). CCTV systems are also compromised when authorities are not able to repair damaged cameras for prolonged periods. In San Francisco, cameras damaged through vandalism were left unrepaired for an extended period of time (King et al., 2008, p. 130), while a subset of Newark's cameras damaged during Hurricane Sandy in 2012 were not repaired for over a year (Piza, 2018, p. 26). The type of camera can also impact what actually is captured on footage. For example, Gill and Spriggs (2005) found that cameras were often programmed to an auto-tour, which monitored a target according to a predetermined pattern. This caused frustration among CCTV operators, as those reviewing images often found that cameras had only recorded part of an incident before being trained somewhere else by preprogramming.

Camera placement and complexity of monitoring systems can also negatively influence operator performance. Camera blind sports and obstructions caused by trees and bunting has been frequently reported in prior research (Keval & Sasse, 2010; Piza, Caplan, & Kennedy, 2014b; Smith, 2004). Through structured observations of control rooms and interviews with CCTV managers and operators in London, Keval and Sasse (2010) reported additional aspects of CCTV systems than can negatively affect operator performance. In particular, cameras were sometimes left in useless positions (i.e., facing the road or sky) by operators on previous shifts, and the lack of integration of information sources presented hardships to monitoring activities. Operators also complained about the illogical numbering and ordering of cameras in the system, with cameras close in spatial proximity to one another placed far apart on the numbered list. This often delayed the operator's identification of the necessary camera to track a target of interest. Operator performance can also be influenced by the layout of screens they are expected to monitor. However, an experiment conducted by Stedmon, Harris, and Wilson (2011) found that screen layout (with camera footage presented in a logical sequence vs. random presentation) had no effect of task accuracy, reaction time, or subjective workload levels.

BWVC. BWVC programs involve the successful integration of a number of different operational components. Ellis et al. (2015) recommended that police better align and integrate the totality of their data systems, as doing so would maximize the effect of BWVC, and ensure more effective deployment of resources generally. Seemingly arbitrary decisions related to various factors can have

important implications for BWVC deployment. For example, video footage can be stored on either an in-house server or an online cloud database. Each of these solutions has their own benefits and drawbacks in terms of security and data accessibility. In this vein, Ellis et al. (2015) recommended that police databases should be enhanced through the development of fail-safe systems to allow for easy identification of the specific occurrences in which BWVCs were used. In addition, legislation that often varies across states can require specific security features for the storage solution to be in compliance with current law (Miller et al., 2014). Such requirements can go a long way toward determining how footage is managed and precisely who in an agency is authorized to participate in data review efforts.

Data retention policies can present similar challenges. Due to the importance of maintaining privacy, police agencies restrict the amount of time that footage remains on their servers. While precise time frames can vary across cities and states, there is general consensus that "retention periods should be measured in weeks not years" as shorter time frames help maximize privacy (Stanley, 2015, p. 6). However, shorter time frames obviously mean that investigators have a finite amount of time to review footage for evidentiary purposes. This is an important consideration, as limited retention of CCTV footage has been previously identified by officers as an impediment to the technology's utility in criminal investigations (La Vigne et al., 2011). Short retention times may also unintentionally hinder transparency in the event that citizen complaints arise after the departmentally mandated retention period (Miller et al., 2014). In such cases, footage pertaining to the complaint would not have been previously flagged as evidentiary, and, thus, would have been deleted.

The deployment of BWVCs requires the installation of complementary devices, which may complicate BWVC deployment. During the Las Vegas RCT, Sousa, Coldren, Rodriguez, and Braga (2016) reported a number of technical issues, many of which involved the BWVC-docking stations that uploaded video recordings at the conclusion of each shift. Docking stations were needed at each of the eight police department commands, to prevent officers from traveling outside of their areas to pickup and drop off the equipment. Unfortunately, resource and time constraints led to docking stations being installed in only four of eight commands, which compromised the RCT (Sousa et al., 2016, pp. 369–370).

There are also human aspects related to BWVC implementation. As noted previously, a key impediment to BWVC success is officers exercising undue discretion in activating cameras, a matter that is complicated by the fact that written policies do not lead to universal activation of cameras. Therefore, gaining officer compliance seems to be a key challenge facing police agencies. However, police unions have been shown to object to BWVCs over several issues including the opinion that BWVCs could jeopardize officer safety or that video can be used by leadership to spy on frontline officers (Sousa et al., 2016). Indeed, Nowacki and Willits (2016) found that agencies in the United States represented by collective bargaining units were significantly less likely to implement BWVCs than their counterparts. This suggests that agencies in which police unions have heightened bargaining power enjoy more leverage to resist pressures to use BWVCs. Police officers themselves have expressed concerns that the continuous recording of police/citizen encounters may damage positive relationships officers have built up with the community. In such instances, citizens may look to the police with distrust or may feel less comfortable providing intelligence if they worry about being videotaped (Miller et al., 2014). In other instances, police officers have lamented the loss of discretion that accompanies BWVCs, particularly in departments mandating that all citizen interactions be recorded (Drover & Ariel, 2015). The manner by which BWVCs are deployed can also raise suspicion among rank and file officers. For example, the Las Vegas Metropolitan Police Department (LVMPD) originally placed their Organizational Development Bureau (ODB) in charge of their BWVC program. Because ODB was a subunit of LVMPD's Professional Standards Division, which also housed the Internal Affairs Bureau, this decision aroused officer suspicions

regarding BWVC footage being used to identify and punish officers for minor infractions (see Drover & Ariel, 2015 for similar officer concerns related to discipline in Wolverhampton, United Kingdom). It was not until administration of the BWVC program was moved to the Patrol division that the LVMPD received sufficient officer buy-in to launch the project (Sousa et al., 2016). Given that administrative considerations influenced officer motivations, they may similarly play a role in whether anticipated benefits of BWVC are achieved.

Conclusion

Researchers have recently documented the challenges associated with conducting field experiments of BWVC and offered insights into how they can be overcome (Drover & Ariel, 2015; Sousa et al., 2016), providing important guidance to the research community. The current article, which sought to identify gaps in knowledge that future research can aim to fill, can be seen as a compliment to such scholarship as well as recent studies examining how technology is generally leveraged by police for public safety purposes (Koper, Lum, Willis, Woods, & Hibdon, 2015; Lum, Koper, & Willis, 2017).

A general review of the BWVC and CCTV literatures highlights some pertinent themes. For one, BWVC research has incorporated a wider range of outcome measures than CCTV research. CCTV studies are predominately concerned with deterrent effects measured through changes in crime levels. Given that police commonly invest in CCTV for the purpose of apprehending offenders following criminal acts (Ratcliffe, 2006), replications of the small number of studies that have explored this aspect of CCTV (Ashby, 2017; Piza et al., 2014a) would be a welcome development. Conversely, while acknowledging that there remains a number of unanswered research questions in the BWVC literature (Lum et al., 2015), BWVC studies have cast a wider net in terms of potential outcome measures. This is a key development, as the literature may provide guidance to a multitude of police agencies looking to solve different problems through the adoption of BWVCs. However, cost-effectiveness is one measure that has rarely been examined in either the CCTV or BWVC literatures. For BWVC research, further exploring cost-effectiveness may require the systematic creation of cost estimates associated with events such as officer use of force, citizen willingness to call police, and biased policing, among others.

The overall methodological rigor of BWVC research is additionally superior to CCTV, with findings from seven studies (as of the date of this writing) generated from RCTs (Ariel et al.2016a, 2016b, Ariel, Sutherland, Henstock, Young, Drover, et al., 2017; Braga et al., 2017; Grossmith et al., 2015; Jennings, Lynch, & Fridell, 2015; Owens et al., 2014) and findings from one study generated from a quasi-random experimental design (Headley et al., 2017). La Vigne and Lowry (2011), who randomized parking decks to receive cameras, and Piza et al. (2015), who randomized the allocation of a directed patrol function, represent the only RCTs of CCTV in public places.[5] Piza (2018) noted that, because CCTV sites are permanent fixtures (hard wired to physical structures and configured to wireless communications networks), moving locations postexperimentation would require additional expenditures. Therefore, practitioners understandably install cameras at locations of their choosing, giving little to no thought to the implications for research design. BWVCs don't present such limitations, which have allowed researchers to maximize the rigor of research designs by employing random assignment.[6] However, it should be noted that CCTV researchers have conducted natural experiments by taking advantage of opportunities afforded by exogenous variation in the time of camera installation across camera sites (Gomez, Mejia, & Tabon, 2017; King et al., 2008; Munyo & Rossi, 2016; Priks, 2014, 2015), providing greater causal validity than less rigorous quasi-experiments.

While BWVC research benefits from more rigorous research designs, CCTV studies have done more to explore issues of effect heterogeneity. In that sense, a body of knowledge on contextual

factors that can promote or mitigate effect has begun to emerge for CCTV. This is an important consideration, as researchers have recently stressed the need to move beyond the typical research question of "*Does CCTV work?*" toward "*In which context does CCTV work best?*" (Piza et al., 2014b, p. 238). Indeed, such a mind-set does not only relate to CCTV, as scholars have stressed the importance of understanding the causal mechanisms underlying successful (and unsuccessful) programs rather than just identifying whether a given program "worked" (McGloin & Thomas, 2013; Sampson & Knight, 2013). While contextual factors have been highlighted in certain BWVC studies (Ariel, 2016; Ariel et al., 2016a, Ariel, Sutherland, Henstock, Young, Drover, 2017; Ellis et al., 2015), they should be emphasized more in future research.

Finally, both CCTV and BWVC research have documented an array of implementation issues that can derail successful implementation. While technological challenges are reported, a number of human factors can have negative influence such as operator performance, officer discretion, and officer buy-in to the program. This points to the importance of a strong, rigidly enforced policy in compliment to technological considerations. In this sense, both the CCTV and the BWVC literatures have provided significant guidance to agencies interested in adopting these technologies.

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Notes

1. The contextual factors highlighted by Alexandrie (2017) are discussed more in depth later in the article.
2. The Fourth Amendment of the U.S. Constitution protects citizens from unreasonable searches and seizures of their property. In numerous cities, findings that police enforcement activities routinely violated Fourth Amendment standards led to oversight of local police agencies by the federal government as well as policy reforms, which oftentimes included the implementation of body-worn video cameras (BWVC) (see, e.g., Floyd et al. v. City of New York, 2013; U.S. Department of Justice Civil Rights Division, 2014).
3. The null findings of Aerial et al. (2016a), Ariel, Sutherland, Henstock, Young, Drover, et al. (2017), and Yokum et al. (2017) warrant further discussion in light of the randomized experiment led by Aerial in Rialto, CA (Aerial et al., 2015). The Rialto study found the BWVCs had a very large effect, with the reduction of complaints so large that not enough incidents occurred for the authors to conduct any meaningful analyses of the experimental and control groups. As noted by Ellis et al. (2015, p. 40), such a large effect may have been due to the small scale of the study (with only 54 patrol officers) and noted that findings had to be balanced against a drop of complaints that began before implementation of BMVCs. Given these observations, Ellis et al. (2015) argued that larger urban police forces may not experience the same effect of BWVC as observed in Rialto. The findings of the multicity studies conducted by Aerial and colleagues may reflect this issue, as the agencies served cities with populations greater than 100,000. Similarly, Yokum et al. (2017) analyzed BWVC in Washington, DC, which boasts one of the largest municipal police forces in the United States. However, see Note 6 for a note on potential treatment contamination in Yokum et al.'s (2017) randomized controlled trial (RCT).
4. However, it bears repeating that Yokum et al. (2017) found some evidence of treatment contamination in their study (see Note 6).
5. Hayes and Downs (2011) used an RCT to evaluate closed-circuit television in retail stores, a setting that was outside of the scope of this article.

6. This is not to say that implementing random assignment has been an easy undertaking. Both Drover and Ariel (2015) and Sousa et al. (2016) reported trouble convincing police leadership to agree to random assignment of officers and/or shifts to receive a BWVC. As noted elsewhere, conducting rigorous field experiments is largely contingent on good will of police leadership as well as the current political climate they are operating within (Braga, 2010; Braga & Schnell, 2013). In addition, BWVC studies may be highly prone to contamination given the fact that officers without cameras may be affected by their awareness of nearby colleagues with cameras. For example, Yokum et al. (2017, p. 20) found that 30% of calls for service generating case numbers (which were expected to be accompanied by an officer wearing a BWVC) had no treatment officers recorded on scene, providing a level of support for the contamination explanation.

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