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## **Harnessing CCTV as a Data Source in Social Science: A Case Study of Violence on Buses**

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### **Abstract**

*This research utilized CCTV as a novel observational device to analyze twenty cases of physical violence between drivers and passengers on urban buses. The harnessing of CCTV data enabled an examination of the ways in which crime events unfold in time and space. It permitted detailed attention to the fluid nature of violence, including processes of volatility, escalation, and the role of audiences that would be impossible to capture by any other methodological means. The study found that conflict is precipitated by a build-up of proximal factors; that aggression escalates from the verbal to the physical realm, although this pathway is neither linear nor unidirectional; and that there are termination points where the aggression appears to be resolved but later resumes. The article highlights the potential of CCTV to examine crime events, including the benefits, limitations, and ethical considerations that arise when using this unique data source.*

**Keywords:** CCTV, crime events, public transport, customer aggression, crime prevention

### **1. Introduction and Background Literature**

International research suggests that compared to those in most occupations, public transport staff, particularly bus drivers, face a high risk of abuse (Chappell, 1998; Mayhew, 2000; Essenberg, 2003; Morgan & Smith, 2006). The threat of passenger aggression toward bus drivers is correlated with a suite of situational factors inherent to their workplace. These include: working alone in a mobile setting with proximity to passengers; the problems of overcrowding, service delays, and ticketing issues; in addition to dealing with intoxicated patrons (Essenberg, 2003; Chappell & Di Martino, 2006; Morgan & Smith, 2006; Mayhew & Chappell, 2007; Fellesson, Salomonson, & Aberg, 2013). Such features have been deemed to create “flashpoints” on buses where minor conflict (e.g. verbal argument) can escalate into serious criminal behavior (e.g. physical assault) in a volatile manner (Lincoln & Huntingdon, 2013; Lincoln & Gregory, 2014a).

A tranche of studies across several jurisdictions has demonstrated that passenger aggression is a significant stressor affecting urban bus drivers. For example, the threat of physical assault from passengers was considered the highest stress factor for London bus drivers (Duffy & Mc Goldrick, 1990). Around 70 percent of Norwegian bus drivers reported experiencing workplace bullying in the previous six months, commonly involving passengers (Glaso, Bele, Nielsen, & Einarsen, 2007). In Mozambique, more than three-quarters of drivers had been victims of workplace violence in their lifetimes, and almost two-thirds in the past twelve months (Couto, Lawoko, & Svanstrom, 2009). Our earlier research yielded parallel findings, with 89 percent of a sample of Australian drivers experiencing physical and verbal assaults, incivility, and witnessing property damage in the preceding year (Lincoln & Gregory, 2014a).

While the extent of passenger aggression on bus networks has been documented, much less is known about the specific nature of these encounters. Existing research is limited, and has largely adopted a quantitative focus from the viewpoint of drivers.

This raises issues about bias and underreporting, and reveals little about the dynamics of this form of workplace violence. There is scope for more innovative and independent methods that take into account the perspectives of drivers, passengers and other patrons to examine real-world encounters. In this way a more nuanced appreciation of the multiple factors that lead to aggression in public spaces could be realized. Harnessing the digital products of ubiquitous CCTV installations on bus networks is one way to achieve this. Such data have the potential to inform our current understanding of how aggressive incidents unfold, and ultimately how they can be prevented, as the latter represents a key challenge facing transport providers globally.

### **1.1 Rationale and Outline**

The present research provides a unique methodological framework that harnesses and creatively engages with the digital imagery derived from CCTV cameras on-board buses. It also adopts qualitative procedures in the form of a thematic analysis, which runs counter to the wealth of published research within the discipline of criminology, and that still only accounts for about ten percent of the scholarly literature in this field (Copes, Tewksbury, & Sandberg, 2016). Even fewer studies within criminology and the social sciences more broadly, have availed themselves of CCTV technology as a data resource. Therefore, these studyproffers new methodological contributions, particularly but not limited to the discipline of criminology, in the manner in which crime events especially can be interrogated. It has the capacity to shed light on the utility of CCTV as an observational research tool, including canvassing its benefits, limitations, and ethical considerations.

This article begins with an abridged critique of the existing literature about the nature of violent events involving bus drivers and passengers, centering on the methods adopted. Shortcomings primarily relate to the quantitative nature of empirical works, where data collection is generally via cross-sectional surveys. It then engages in a brief discussion of the use of video technology as an emerging research device. The article describes the current research approach, which essentially comprises a qualitative repeat case study design. It canvasses the techniques and procedures used to gather and then organize the sample of digital audio-visual material, as well as how the qualitative variables were extracted and analyzed. The article summarizes the major findings and presents a discussion of the three main dynamic concepts that underpin this study, namely volatility, escalation, and audience features. Importantly though, it concludes by addressing the use of CCTV output for research, including the advantages it provides over more traditional observational methodologies, alongside the restrictions associated with using a secondary data source not formally collected for research purposes, and attendant technical problems such as the variable quality of the audio-visual materials.

### **1.2 Overview of Research on Driver-Passenger Aggression**

In examining the broad patterns and correlates of bus driver violence, studies have yielded useful but limited information about the forms and triggers of abuse. With respect to forms, verbal abuse and threats are considered the most problematic, as they can escalate into physical assaults, including the use of projectiles or weapons (Chappell, 1998; Couto et al., 2009; Couto, Tillgren, & Soderback, 2011; Nakanishi & Fleming, 2011; Lincoln & Gregory, 2015). Triggers for aggression include disputes over fares, intoxication, passenger disdain for drivers, rudeness on behalf of drivers, failure to meet passenger expectations, overcrowding, and robbery (Couto et al., 2011; Lincoln & Gregory, 2014a). Rule enforcement, late running, school or youth-related violence, and mental illness have also been implicated (Nakanishi & Fleming, 2011; Lincoln & Gregory, 2014a). It is known that incidents tend to cluster in the afternoon period, coinciding with post-school and peak-hour travel, and late evening or early morning, when transit use is linked to patrons from the late-night economy (Nakanishi & Fleming, 2011; Lincoln & Gregory, 2014a).

Most of this research, while invaluable, has been overwhelmingly quantitative in orientation, with an overreliance on cross-sectional, self-report survey data, which raises questions about bias and underreporting (Fisk et al., 2010). For example, those involved in aggressive encounters often have conflicting views about the initiation and nature of the aggressive event (Keashly & Neuman, 2008). Additionally, surveys adopt the perspective of either the “targets” or “perpetrators” (Hershcovis & Reich, 2013), denying the observation that workplace aggression tends to be a malleable phenomenon where perpetrators can become targets and vice versa (Andersson & Pearson, 1999; Groth & Grandey, 2012). The cross-sectional designs tend to treat variables as either causes or outcomes (Hershcovis & Reich, 2013; Keashly & Neuman, 2008), ignoring the fact that certain responses (e.g. frustration or retaliation) can serve as inputs for further negative behavior, leading to what has been termed a “spiral of aggression” (Andersson & Pearson, 1999; Grandey et al., 2012).

Consequently, little is known about the underlying dynamics of aggressive encounters, such as escalation and volatility, because even though reference is made to these concepts, few studies have captured them empirically.

It is also the case that research projects have rarely examined questions associated with incident context such as audience features that may accelerate or disrupt the negative exchange spiral (Hershcovis & Reich, 2013). Such information is important because customer aggression does not occur in a vacuum but often in the public realm, and can impact other patrons in the service environment (Groth & Grandey, 2012). Yet, the role of third parties in the initiation, progression, and outcomes of violent driver-passenger events remains relatively unexplored. Thus, it seems critical to employ alternate methodologies to complement existing research and examine workplace aggression in a dynamic and contextualized way (Glomb, 2002). Any attempt to gain a deeper understanding of escalation, volatility, and audience features, for example, requires a qualitative, observational, and events-based approach that considers the perspectives of both “perpetrators” and “targets”, but also firmly takes into account the situational environment in which aggression occurs. The present study attempts this by harnessing the output of CCTV cameras on-board buses normally reserved for crime reduction, investigation, or litigation purposes.

### **1.3 CCTV Technology as a Research Tool**

Video technology is emerging as a powerful new research device within the social sciences and has been used in diverse ways (Haw & Hadfield, 2011; Heath, Hindmarsh, & Luff, 2010; Jewitt, 2012). It is increasingly recognized that video technology holds a number of advantages over conventional methods of naturalistic observation, such as manual note-taking and in-situ coding. Video technology is relatively low-cost, reliable, and accessible, but also provides a permanent revisable or re-viewable record of the phenomena under examination (Knoblauch & Tuma, 2011). Such records can be subject to repeated and detailed analysis, in conjunction with features like slowing, pausing, rewinding, and zooming to uncover elements and patterns easily overlooked by the field researcher (Heath & Hindmarsh, 2002). The records can also be revisited over a longer period of time once an understanding of, and familiarity with, the data have been developed to refine the research questions and data extraction processes. In addition, audio-visual material can be scrutinized independently so that co-researchers can verify the reliability of coded observations, or consider the material from different analytic perspectives (Heath et al., 2010).

In these ways, video technology has afforded social scientists an unprecedented opportunity to analyze, in real-time, the minutiae of situated conduct and interaction across a variety of social settings (Heath & Hindmarsh, 2002). For example, audio-visual data have been employed to understand the ways in which talk, gesture, and technology inform the practical and collaborative accomplishment of workplace activities in control centers, trading rooms, newsrooms, surgical operating theatres, and medical consultations (Heath et al., 2010). These developments clearly demonstrate the potential of video technology to shed a distinctive light on a range of long-studied topics. This is particularly pertinent for the study of aggression, where analysis of audio-visual recordings can overcome the usual practical and ethical constraints associated with capturing independent data about interpersonal conflicts as they occur (Levine, Taylor, & Best, 2011). It is especially imperative for instances where violence has low prevalence and frequency. For example, in our previous study of violence on-board, given the number of buses, routes, and runs that operate daily even in a medium-size city, it was resource-prohibitive to allocate sufficient observation sessions to capture a reasonable sample of incidents (Lincoln & Gregory, 2014b).

Despite the advantages of using existing CCTV data as an observational tool, few studies to date have exploited its research potential within the social sciences. Only two relevant studies have been located: one on visitor behavior in museums (Beaumont, 2005), and another on conflict in public drinking spaces (Levine et al., 2011). In the latter study, which has most concordance to the present criminological project, the authors performed a systematic behavioral analysis of incidents of public aggression captured on the CCTV system of a local UK city center to examine the role of third parties in conflict escalation. Their analysis revealed that the presence of invested audiences serves to inhibit rather than facilitate conflict, with this effect becoming more pronounced as group size increased. This finding stands in direct contrast to long-standing and widely-held psychosocial theories about the role of bystanders and group size in undermining the regulation of aggression; even if it does emphasize the role played by “guardians” in crime events (Felson & Eckert, 2015). Thus, the use of CCTV data has the potential to challenge existing assumptions and improve our understanding of violent incidents.

## 2. The Current Study

This research centered on observations of twenty aggressive incidents occurring between bus drivers and passengers captured on the CCTV system of a publicly-contracted private Bus Company. It adopted a repeat case study design, as it is of a single enterprise operating in a major regional city in Australia, as well as treating each incident as an individual case. The present study evolved from a federally-funded research undertaking into the nature, extent, and prevention of violence and incivility against bus drivers (Lincoln & Gregory, 2014a). This umbrella project involved partnerships with government, industry, and a trade union, and adopted a multi-method design involving focus groups with drivers, on-board observations, employee surveys, examination of official incident data and policing information, plus semi-structured interviews. As a result of the synergy developed with industry in that project we were permitted access to CCTV footage, and conducted this follow-up study using the objective accounts available from the audio-visual data.

The CCTV materials were gathered from the bus company computer across several visits in 2014. Each file had been labeled with keywords (e.g. “theft attempt May 16”), while others were more ambiguous (e.g. “unknown CCTV 20th”). Each file contained multiple audio-visual clips and those where the label made reference to violence (e.g. “assault”, “brawl”, “fare dispute”) were copied onto an external hard-drive; while the more obscurely labeled ones were viewed to confirm whether they contained any element of aggression. Thus, a non-probability purposive sampling method was adopted (Weerakkody, 2008), with the aim to capture every incident of physical aggression for the period 2012 to 2014, yielding a total of 234 files downloaded. This preliminary sample was further refined because some incidents fell outside the present remit; for example, where the dispute was between passengers only or where it occurred mostly off-board. Other incidents contained only verbal aggression, and some files had to be excluded because of poor image quality. Thus, the final sample comprised twenty incidents of a physical nature occurring on or through the bus between drivers and passengers, including only those that were fully portrayed with good quality visuals suitable for the present analysis.

One of the first analytic steps was to create deep descriptive narratives for each of the incidents of aggression included in the study so that the full extent of the event was empirically captured (Denzin, 1989; Cornish, 1994). These focused on detailing the background, circumstances, and context surrounding the observed action, and in particular their complex interactions (Lincoln & Guba, 1985). They were derived by viewing the CCTV files associated with each incident on multiple occasions in their entirety, and by re-viewing areas requiring further clarification. The detailed descriptions ranged from approximately 300 words to over 4,000 words, dependent on the nature and the length of the crime event being observed. The narratives served to document the four-way intersection of drivers-passengers-guardians-settings and enabled assessment of key concepts such as escalation. Each qualitative description was followed by a set of keywords as a means of extracting themes from the narratives including any recurring issues or unique aspects (e.g. “retaliation”).

The second activity was to engage in first-cycle coding, where the data were re-examined and tentative words or phrases were manually assigned to elements of data to summarize and capture the essence of certain concepts, actions, themes, or relationships (Miles & Huberman, 1994, p. 56). The analytic process examined the contextual or environmental conditions, any intervening or influencing features, the actions and interactional/relational elements, and the consequences of actions or interactions. This primary-cycle coding process was about uncovering “what” was present in the data, or the basic activities and processes involved, noting items that were typical versus unusual, to provide a “vivid, multi-textured picture” (Tracy, 2013, p. 190). The second-cycle coding involved systematically “identifying patterns or groupings of codes within the data” and elucidating more abstract contextual themes (Tracy, 2013, p. 195). Here, similar codes were clustered together to produce higher-order codes (King, 2004), so that the individual cases were progressively assigned into abstract categories, concepts, and themes.

In terms of key features of the digital sample, the majority of files was deemed high quality, generally displayed in color, and with a modal number of four camera angles. Most did not include sound, and when audio was available the quality varied. In some incident files there was an official time and date stamp displayed (e.g. 2:11am). In others, time of day could be interpreted (e.g. around 3:00pm due to teacher ushering school children on the bus), however this was not always possible. There were multiple video clips for each incident ranging from one to 26 with an average of seven. The length of footage ranged from 30 seconds to an hour and a half, with an average of approximately 22 minutes. In terms of analysis, aggressors were initially labeled as “perpetrators” or “offenders”.

However, it was immediately apparent that offenders would often become victims and vice versa, and more neutral terminology had to be adopted. Those directly involved in incidents were called “primary” passengers; “secondary” passengers were those accompanying the aggressive person or who themselves became tangentially involved in the violence; while “tertiary” passengers comprised the audience. (For further details of the methodology adopted and a more comprehensive presentation of all the findings, see Gregory, 2016.)

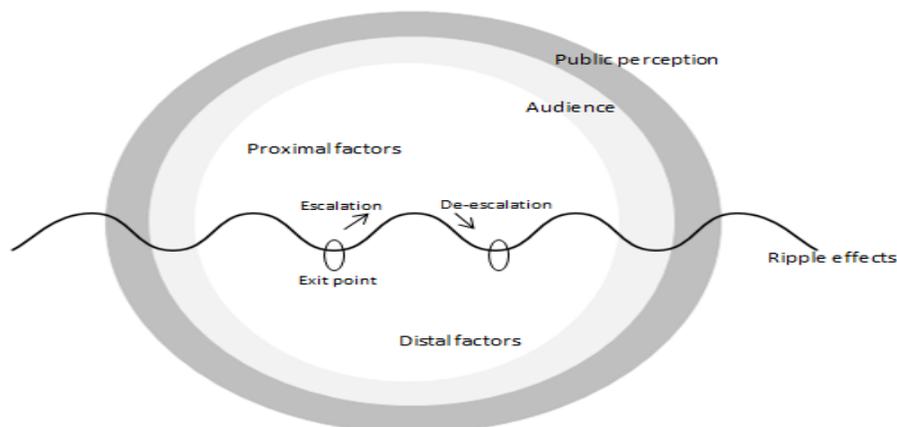
### **3. Findings from an Event Perspective**

As established in previous research, volatility has been characterized as ostensibly random violence in what has been termed a “flashpoint” (Lincoln & Huntingdon, 2013), where there is an issue around ticketing or service that immediately results in confrontation. In our previous research project, drivers described the bus environment as highly charged and apparently unpredictable in that people can “turn on you” in an instant (Lincoln & Gregory, 2014a). This scenario was evident in the CCTV data and highlights the spontaneous and volatile nature of some violent encounters that appear to erupt “from seemingly nothing” (Lincoln & Gregory, 2014a). In one case a male suddenly jumped up and threw punches at the rear vision mirror, threatened the driver, pushed the driver’s hand, and attempted to kick him. The male walked off the bus, the driver immediately closed the doors, and the young man then damaged the door as the bus was driving away.

However, a contrary finding emerged from our current CCTV analysis to suggest that crime events do not “come out of nowhere”. Notwithstanding the vignette described above, for the most part there was an absence of volatility in the incidents; that is, there was usually a sustained level of interaction prior to the physical violence. This involved a logical accrual of unresolved issues where multiple triggers and accumulated incivilities took place before the physical conflict ensued (e.g. fare evasion, wet weather conditions, influence of alcohol). Importantly, verbal aggression tended to precede incidents of physical violence so that there was an elevation from the verbal to the physical realm. In one example, there was a discussion between a male passenger and the driver about access to an automatic teller machine to obtain cash to pay the fare. Later that passenger verbally abused the driver, and attempted to open the doors while the bus was in motion. The driver appeared to restore equilibrium, until an unrelated female passenger made a comment to the aggressive male, and it was only when he responded offensively to her, that the driver left his seat and the physical altercation occurred.

Another key variable interrogated here was that of escalation, but again with the benefit of accessing CCTV footage we found that this too was more complex than implied in the literature, and our own earlier research. Generally there were multiple acts by multiple actors during a single encounter. In the logic of workplace violence it seems there is a waxing and waning, where the aggression would increase then decrease and increase again in a process of escalation and de-escalation (see Figure 1). This underscores the dynamic, reciprocal and interactive nature of the incidents where there is no linear or unidirectional pattern of escalation. In one case the driver entered a verbal dispute with a male who refused to disembark at the end of the route. The driver alerted operations staff and stepped off-board, providing the primary passenger with an opportunity to leave. He did not, and so when the driver returned he attempted to push the male off the bus. The passenger retaliated, but the driver walked away. Another two physical altercations broke out between the pair over the next few minutes until an outsider approached the bus. Thus, there were four separate but interrelated encounters during this single incident.

**Figure 1: Visual representation of the logic of violent workplace events.**



It is germane to note that there are up to fifty people on an urban bus and so our analysis of the CCTV footage was able to examine the audience who are proximal to the conflict. Secondary and tertiary passengers were observed to engage in a range of physical and non-physical behaviors in response to driver-passenger aggression. In some instances their presence or involvement served to defuse or dissuade the intensity of the encounters. Examples here included verbally trying to break up a fight, ushering the primary passenger off the bus, alerting authorities, and assisting the driver post-incident. In other cases, secondary and tertiary passengers appeared to increase or inflame the severity of the outcome by encouraging actions or becoming physically involved. For example, the CCTV data endorsed the view that young people often bring their own audience, in the sense that many youth travel with their peers and so there was an element of a built-in audience to whom they were “showing off” or who were in turn “egging them on” (Felson & Eckert, 2015). Additionally, there were cases where an audience member would intervene and this resulted in an entirely new passenger-on-passenger altercation breaking out, involving physical injury.

A subsidiary element of the audience aspect is that, even if not directly involved, other passengers are affected or impacted in some way by the violent encounters. There were observed instances of frightened elderly people and young children, passengers who disembarked due to frustration caused by the delay in their travel, and drivers who treated subsequent passengers in curt and irritated manners. It was the case that drivers were observed to resume work immediately following the aggressive incidents, where the psychological impact can influence customer service and driving quality. Passengers and other road users can be put at risk when bus drivers become distracted while dealing with disruptive passengers such as slamming on the brakes, or when aggressive passengers try to force open the doors while the bus is in motion. Clearly, these factors can have negative consequences for customer perceptions of service, safety, and security in the bus environment, and underscore the complexity of the four-way intersection among drivers-passengers-guardians-settings in the transit environment.

#### ***4. Reflections on the Utility of CCTV for Research***

The salience of CCTV data is that they provide some of the most robust representations of violent incidents occurring in-situ between bus drivers and passengers. They capture the actions and perspectives of all parties while firmly taking into account the context, including audience features and the service setting to locate the event in time and space. The method offers features such as pausing and re-winding to yield highly detailed analysis where the research questions can be reframed and applied to the data over time. For example, in the present research, the notion of volatility was initially measured by assigning a simple code of presence or absence, based on the extant literature. However, the ability to view and review these violent encounters revealed more complex and nuanced patterns rather than a binary one. Due to this unique data source, the incidents could be broken down into their component parts of aggression in detailed behavioral sequences that could not have been uncovered through cross-sectional examinations.

This is not to suggest that there are no difficulties in using secondary data in the form of CCTV gathered by other sources for other purposes. It is possible that our electronic files may have reflected a “selection bias” towards reportable violent incidents, those that were more “serious”, or ones destined for possible litigation and therefore saved by the bus company. It is also important to acknowledge that the total pool of CCTV data had been edited in the process of capturing the images. This has implications for analysis at the general and specific variable levels. Generally this was not of concern as it was clear that the footage traversed the start of each incident to its denouement. In some instances though the end-point of the incident coincided with the end-point of the footage and this limited any post-incident analysis (e.g. whether other passengers came to assist). Similarly, there were some cases where the footage did not cover the initial entry onto the bus by a problematic passenger. These types of queries are inherent to any study that uses secondary data sources that have not been collected specifically for research purposes. Clearly, the digital material cannot capture all elements of a crime event, as even the most sophisticated cameras are unable to reach all corners of even a limited environment such as a bus.

Another potential shortcoming associated with the use of audio-visual recordings from established CCTV networks (Wilson & Sutton, 2003; Goold, Loader, & Thamala, 2013; Felson & Eckert, 2015) is poor visual or audio quality to the point that the files cannot be sufficiently analyzed. Indeed, trying to capture footage of an offender committing a crime on camera in full view in a readily identifiable manner has been proclaimed elusively rare (Norris, 2012). The quality of cameras, lenses, recording devices, and tapes varies widely across systems, where the Home Office reported in 2007 that over 80 per cent of CCTV footage supplied to police is far from ideal (Norris, 2012).

In addition, the digital data reveal nothing about motives, emotions, cognitive processes, relationships, and so for those we need to turn to interviews and narratives and other qualitative methods (see Ioannou, Canter, & Youngs, 2017). However, the use of the CCTV data does uncover the behaviors, the actors, the interactions, and the sequencing within their situational context and these are fundamental ingredients of crime incidents (Felson & Eckert, 2015). Further, there are significant technological changes taking place that have improved the visual and auditory capacity of surveillance systems in public and private space, and particularly in the transit sector (see Tarrit et al., 2018).

There remain rafts of ethical considerations that may arise when re-purposing CCTV archives for observational research. These include questions about whether the source is public or private; issues around access, use, and distribution of the data; considerations relating to anonymity and confidentiality of those depicted; and procedures to obtain informed consent where appropriate. The CCTV images in this study were being used for a highly specific purpose (i.e. monitoring violent incidents) and this is compatible with the original reason for the company obtaining the images. The surveillance equipment was already constantly monitoring drivers and passengers for purposes of supervising behavior, safety, and security, and so additional interrogation related to this specific purpose is considered a legitimate use of the CCTV output. Given these issues about how CCTV data are collected and handled, further discussion and consultation is needed throughout the research community regarding the development of a code of ethics or protocols for video observation and analyses. It is also essential for the agency releasing the material to have clear policies and procedures on data access, use, and retention to ensure all parties are appraised of the constraints impacting their research and how to handle them.

Despite the value of harnessing CCTV data, few studies in the social sciences, and criminology in particular, have availed themselves of this technology (for exceptions see Beaumont, 2005; Levine et al., 2011). This is perhaps unsurprising given that much contemporary criminological discourse surrounding the impact of CCTV in everyday life has been dystopian in character, focusing on the negative, intrusive aspects of electronic surveillance (Lyon, 2001). There is, for example, a tendency to talk of an urban panopticon (Koskela, 2003), a maximum security society (Norris, 2012), an Orwellian totalitarian state (Wilson & Sutton, 2003), and the expansion of the net of social control (Cohen, 1985). It may be argued that such a bleak position has rendered the use of CCTV outputs as uninviting. Yet, as this article has endeavored to outline, surveillance technologies have significant potential benefits, particularly for some research endeavors.

Furthermore, there is now an almost infinitesimal number and range of images gathered via private and public space CCTV that comprise the “surveillant assemblage” (Haggerty & Ericson, 2000). CCTV surveillance is now augmented with policing practices such as use of drones, face recognition tools, and automated license plate checks (Smith, Bennett-Moses, & Chan, 2017). These technological advances are certainly changing the face of policing and justice, and the prospects of big data, algorithms, and smart devices indicate that the procedures of crime and justice research will be similarly transformed (Chan & Bennett-Moses, 2016; Smith et al., 2017). For example, a recent study reported that the surveillance system on railways that operate within the purview of the British Transport Police had in excess of 30,000 cameras, albeit with a range of operators, owners, and therefore a great diversity in the quality (Ashby, 2017). There was more than a quarter of a million crimes in that five-year study where CCTV could be obtained, and was deemed useful in 29 percent of these (Ashby, 2017). While the study was examining the investigative capacity of CCTV networks, it is clear that there is a wealth of extant data that could potentially be exploited for research purposes.

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