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Abstract | This study examines the impact of CCTV footage on clearance rates for crimes occurring on the rail network in New South Wales.

Nearest neighbour matching was used to compare criminal matters with and without camera footage. Cases were matched on principal offence type, spatial and temporal characteristics and offence severity.

Overall, 24.8 percent of matters where footage was requested were solved by police, compared with 21.0 percent of matters where footage was not requested—an 18 percent increase in clearance rates. Footage was provided to police for nine out of 10 requests and was associated with an estimated 20 percent increase in clearance rates. Results varied by offence type, with larger increases observed for theft and property damage than for assault, and for offences at night.

Timely access to CCTV footage for criminal investigations is associated with increased clearance rates for crimes on the rail network.

Does CCTV help police solve crime?

Anthony Morgan and Christopher Dowling

One of the reasons for the significant growth in closed-circuit television (CCTV) in public spaces (see Hulme, Morgan & Brown 2015) has been its perceived value as a source of evidence in the investigation of criminal offences. Police regularly use CCTV footage as part of criminal investigations, whether it is to identify offenders, secure guilty pleas, verify witness statements or identify potential witnesses (La Vigne et al. 2011; Levesley & Martin 2005). However, most of the empirical research on the impact of CCTV has focused on its crime prevention effects (Piza 2018; Welsh & Farrington 2009). Comparatively less is known about the investigative benefits of CCTV evidence, including whether access to footage increases the likelihood an offender will be arrested, charged and convicted.

There is growing evidence that police frequently request footage from camera operators after a crime has occurred as part of the investigative process (Ashby 2017; Hulme, Morgan & Brown 2015; Morgan & Coughlan 2018). This can place significant pressures on camera operators (Carr 2016, 2014). Recent research by Morgan and Coughlan (2018) revealed the frequency with which police request footage of the rail network in New South Wales. Requests for footage were more likely when there was a higher concentration of incidents at places or times where other forms of passive surveillance were less likely. The overall volume of CCTV requests suggested that camera footage is highly valued by police, which has also been observed in descriptive studies overseas (La Vigne et al. 2011). However, the authors were quick to highlight that demand for footage does not in itself demonstrate effectiveness.

The best evidence of CCTV's impact on investigations comes from a recent UK study. Ashby (2017) examined more than 250,000 crimes recorded on the British railway network over a five-year period, finding that CCTV footage was available to investigators in almost half of all cases, and useful in two-thirds of those cases where it was available (equivalent to 29% of all cases). Ashby found that cases in which the footage was assessed as being useful were significantly more likely to be solved for almost all offence types. CCTV was more useful for certain types of crime (especially violent crime), for crimes that occurred at the station, for crimes committed during a smaller window of time and crimes which were detected more quickly. Further, other UK studies which examined the contribution of CCTV evidence alongside other solvability factors for crime on the rail network found that the availability of CCTV footage increased the solvability of pickpocketing offences (Sharp 2016) and metal theft (Robb, Coupe & Ariel 2015).

Other research, focused on locations where the level of coverage is likely to be much lower than on the UK rail network, has produced less favourable results. In their study of CCTV use in night-time entertainment districts in Sweden, Kindgren and Marklund (2014) found that police requested CCTV footage for one in eight incidents, and that the footage was useful in one in four cases in which it was accessed. King, Mulligan and Raphael (2008) examined the use of public space CCTV footage by detectives in San Francisco, finding that 120 requests for footage were made over a three-year period, resulting in an offender being charged in just six cases.

There is some evidence that incidents detected using CCTV actively monitored from a control room are more likely to result in an arrest than those reported by members of the public (Piza, Caplan & Kennedy 2014). However, these constitute a small proportion of overall offence numbers (Piza, Caplan & Kennedy 2014; Wells, Allard & Wilson 2006). In one of the few Australian studies to examine the use of CCTV by police, 181 incidents were observed by camera operators, and these incidents resulted in 51 arrests; however, only seven of these arrests could be directly attributed to the camera network, with many other arrests the result of police being on the scene and simultaneously detecting the offender (Wells, Allard & Wilson 2006). Other Australian research has relied on anecdotal reports by law enforcement (Fairfield City Council 2002) or camera operators' estimates of how often police use footage (Hulme, Morgan & Brown 2015).

These mixed results, coupled with the significant investment by police and other agencies in the use of CCTV to apprehend offenders (Hulme, Morgan & Brown 2015; Piza 2018; Ratcliffe 2006), have led to growing calls for further research into the use of CCTV by law enforcement (Piza 2018).

Aim and method

Research questions

This paper presents the results from an Australian-first study of the impact of CCTV footage on clearance rates for crimes that occur on the rail network in New South Wales. It aims to address two questions:

- Does the use of CCTV footage by investigators increase the likelihood of an offender being proceeded against?
- Does the impact of CCTV footage vary by offence type?

This study is specifically focused on the investigation of crimes occurring on the NSW rail network. Alongside other security measures, including security officers and help points, Sydney Trains operates approximately 11,000 cameras across the metropolitan and intercity train networks. Cameras are located inside the trains, at train stations, including platforms, and are also directed at station entry gates and ticket machines. Cameras operated by Sydney Trains are also located outside some train stations, covering adjacent areas, such as car parks and bus interchanges.

The camera network is actively monitored from a security control room. While monitoring CCTV cameras is one of the primary roles for staff in the security control room, they also spend a significant amount of time retrieving footage requested by internal and external parties, including the New South Wales Police Force (NSWPF). There was an average of 30 requests per day from all sources in 2014 (Morgan & Coughlan 2018). The impact of providing this footage, including to police, is largely unknown.

Data sources

Sydney Trains manages a database that records information on all requests for CCTV footage received by the agency, including whether that footage has been provided. These data were linked using the NSWPF's Computerised Operational Policing System event ID number with data from the NSW Bureau of Crime Statistics and Research (BOCSAR) on all criminal events recorded by NSWPF on the rail network between 2014 and 2017. BOCSAR also provided data on all offenders proceeded against, whether by court action, an infringement notice, or some other legal action. Where there was no corresponding information on an offender (or offenders) who had been proceeded against, an event was deemed to have not been cleared by way of legal action (hereafter referred to as 'solved'). Similarly, if there was no record of a footage request relating to an event, it was assumed that no rail network footage was provided. Transport regulatory offences (eg ticket infringements) were removed from the dataset. Events that took place after September 2017 were excluded to ensure all matters in the sample had a minimum three-month observation period prior to data extraction (early 2018). More than 93 percent of all matters are cleared within 100 days of the most recent reported incident.

There were 29,511 recorded events between January 2014 and September 2017 across the metropolitan and intercity rail networks (as defined by location codes used by the NSW BOCSAR). Events (also referred to as 'matters') refer to unique occurrences attended by or reported to police. These events can involve more than one incident, which can in turn involve multiple offences (eg multiple property damage incidents, each involving both damage and trespassing offences, which occur over the course of an evening and are reported to police at the same time). A matter was classified as cleared when at least one offender had been proceeded against in relation to at least one recorded criminal incident.

Cases that were detected by police or solved on the day of the most recent incident were excluded from the analysis. These cases are, for obvious reasons, significantly more likely to be solved (Burrows et al. 2005; Greenwood & Petersilia 1975; Olphin 2015). Although CCTV footage may have been requested and used to later convict or exonerate an offender, it is less likely that it played a role in whether an offender was charged or issued with an infringement notice. Rather, many of these incidents would have been detected by, rather than reported to, police. Others may have been cleared because the incident was identified through live monitoring of CCTV and police were deployed to the scene. However, information on the role of CCTV in these incidents was not available in the data provided.

The final sample comprised 22,370 criminal matters occurring between January 2014 and September 2017. Police requested footage in 27 percent of all matters (n=6,122), while footage was provided to police in 24 percent of all matters (n=5,444; 89% of all matters where a request was made). Reasons for not providing footage included that the request did not meet the guidelines set by Sydney Trains, the request did not fall within the 14-day data retention period, or camera operators were unable to find any footage related to the event. Importantly, vetting footage for useful information was usually left to the officer who requested the footage.

Sample characteristics

Characteristics of matters with and without a footage request are presented in Table 1. There was a strong association between the principal offence type and the likelihood of footage being requested ($\chi^2(11)=4,040.74$, $p<0.001$, Cramér's $V=0.43$). Violent offences—assault, sexual assault and robbery—along with property damage offences, were significantly over-represented among criminal matters with a footage request. In other words, police were much more likely to request CCTV footage for certain offence types.

Footage requests were also significantly associated with the day of week ($\chi^2(6)=126.93$, $p<0.001$, Cramér's $V=0.08$) and time of day ($\chi^2(7)=218.35$, $p<0.001$, Cramér's $V=0.10$) of the most recent incident. Matters in which the most recent incident occurred on the train ($\chi^2(2)=360.34$, $p<0.001$) and when the window of time within which the offence was thought to have occurred was less than one hour ($\chi^2(1)=99.68$, $p<0.001$, Cramér's $V=-0.07$) were also over-represented among footage requests. The time window for the most recent incident is relevant because a shorter time frame represents a narrower focus for the investigation.

A severity index, based on the equivalent custodial sentence, was created using data published by the NSW BOCSAR on the proportion of offenders sentenced to prison and the average length of a custodial sentence for each offence type, classified according to Australian and New Zealand Standard Offence Classification categories (ABS 2011; NSW BOCSAR 2017). The total index for each matter was based on the sum of all unique offences in each incident. The severity index was then categorised into groups based on where the scores were clustered. There was a statistically significant association between index score categories and footage requests ($\chi^2(5)=2,141.91$, $p<0.001$, Cramér's $V=0.31$). Footage was more likely to be requested for more serious matters; however, matters in the least serious group were also over-represented among footage requests.

Table 1: Characteristics of matters with and without a footage request, prior to matching (%)

	Footage not requested	Footage requested
Principal offence type		
Assault	7	23
Sexual assault	1	6
Dangerous or negligent behaviour	1	2
Robbery	<1	3
Drugs	18	1
Weapons	2	1
Theft and burglary	34	26

Table 1: Characteristics of matters with and without a footage request, prior to matching (%)		
	Footage not requested	Footage requested
Fraud	1	1
Property damage	14	32
Public order	10	5
Breaches	5	1
Other	5	1
Location (most recent incident)		
Station	70	68
Train	18	26
Railway line	12	5
Day of week (most recent incident)		
Monday	12	15
Tuesday	13	15
Wednesday	15	15
Thursday	18	15
Friday	19	15
Saturday	15	13
Sunday	9	11
Time of day (most recent incident)		
Midnight – 2:59 am	4	9
3:00 am – 5:59 am	4	7
6:00 am – 8:59 am	12	11
9:00 am – 11:59 am	12	10
Midday – 2:59 pm	14	13
3:00 pm – 5:59 pm	20	18
6:00 pm – 8:59 pm	16	17
9:00 pm – 11:59 pm	17	16
Time window (most recent incident)		
Less than 1 hour	62	69
1 hour or more	38	31
Equivalent custodial sentence (severity index)		
<10 days (least serious)	22	33
10–21 days	28	3
22–29 days	26	25
30–59 days	22	29
60–364 days	2	4
365+ days (most serious)	1	6
Total	16,248	6,122

Note: A matter was classified as cleared when an offender had been proceeded against in relation to at least one recorded criminal incident. Event characteristics based on most recent incident recorded by police for each matter. Percentages may not add to 100 due to rounding

Source: NSW BOCSAR 2018; Sydney Trains 2018 [computer file]

Matching process

A statistical technique called nearest neighbour matching (see Abadie & Imbens 2006) was used to compare those matters where CCTV footage was requested (the treatment group) with a group of similar matters for which CCTV was not requested (the control group). This technique aims to minimise the problem of selection bias, which arises when random allocation to the treatment and control group is not possible. Because police are more likely to request CCTV footage for certain types of matters, there are important differences between matters with and without a footage request that also influence the likelihood that they will be solved. It is not possible to attribute any observed differences in clearance rates to the presence of a request for CCTV footage without taking these differences into account.

Nearest neighbour matching was performed using the 'teffects' command in the statistical software application Stata. Cases were matched using the following variables:

- principal offence type;
- day of the week;
- time of day;
- location of the incident (station, railway or train); and
- incident severity (equivalent custodial sentence).

Prior research has also shown that police are not equally likely to request CCTV footage in all locations, and that this might be due to variation in the level of passive surveillance available (ie other witnesses to the incident; Morgan & Coughlan 2018). This needs to be taken in account when comparing matters with and without footage requests, since it would also influence the likelihood of a matter being cleared. The rate at which police requested footage was determined for each suburb by dividing the number of requests by the total number of criminal matters. Because the number of offences varies substantially by crime type, this estimate was derived for a single offence type—property damage—which accounted for more requests than any other. The suburb was chosen as the geographical unit because it represents the smallest unit that could be used, and because it helps to account for variation in locations other than stations, especially crime on the railway line. For the current analysis, 1,455 matters were excluded because they took place in suburbs with fewer than five property damage offences. This resulted in a total sample of 20,915 matters, including 5,738 matters (27%) with a footage request.

An advantage of nearest neighbour matching is that it allows for exact matches for variables that are not well balanced between the treatment and control groups. Principal offence type was included as an exact match, meaning that each matter with a footage request was matched with a matter without a footage request with the same principal offence type. Matters in the treatment and control groups were then matched using a weighted function of the covariates for each observation, according to a Mahalanobis distance measure, while meeting the exact matching requirements.

One-to-one matching was used, with a caliper of 0.001, allowing for replacement. Matching with replacement means that the same case in the control group can be matched to multiple treatment group cases. Nearest neighbour matching using 'teffects' estimates the potential outcome for each case in the treatment group (cases in which police requested CCTV footage) by using the outcome of similar cases in the control group (cases where footage was not requested; Abadie & Imbens 2006). The treatment effect (ie the effect of CCTV footage) is calculated by taking the difference between the actual and estimated outcome. The average treatment effect on the treated was estimated.

Match quality

Diagnostic methods for assessing the quality of nearest neighbour matching are similar to those used for propensity score matches. The treatment and control groups were compared on each of the explanatory variables to assess whether there were any systematic differences between the two groups. This included analysing Rosenbaum and Rubin's (1985) standardised difference estimates. In accordance with convention (Apel & Sweeten 2010; Rosenbaum & Rubin 1985), variables with a standardised difference of less than 20 indicated that the two groups were well balanced on that variable. Prior to matching, 10 of the 33 variables had a standardised difference of greater than 20, suggesting there were large differences between the two groups (Figure A1). After matching, none of the variables included in the matching process exceeded an absolute value of 6.4, indicating a good match.

There were no significant differences between matters with and without a footage request for each variable included in the matching process. Further, the combination of all covariates in a weighted logistic regression model did not significantly predict whether CCTV footage was requested ($\chi^2(33)=39.62$, $p>0.05$; AUROC=0.528; Nagelkerke $R^2=0.005$), providing additional evidence that the treatment and control groups were adequately balanced on the observed covariates.

Results

Does the use of CCTV footage by investigators increase the likelihood of an offender being proceeded against?

The impact of the use of CCTV footage by investigators was measured in two stages. The first stage examined whether matters for which CCTV footage had been requested were more likely to be solved than matters for which there was no request, irrespective of whether footage was provided. The second stage limited the analysis to those cases in which CCTV footage had been both requested by police and provided by Sydney Trains.

The first stage is, in effect, an intention-to-treat analysis. It provides a better measure of the impact of requesting footage each time a request is made. It takes into account the fact that, even if police requested footage for every case, they would not receive and therefore benefit from the footage 100 percent of the time.

The average treatment effect on the treated was 0.038 (0.019–0.057), which was statistically significant (Table 2). This equates to a 3.8 percentage point difference between the treatment and control groups, meaning that requesting footage was associated with a 3.8 percentage point increase in the proportion of matters that were solved.

Further analysis revealed that matters in which CCTV footage was requested and provided were significantly more likely to be solved than matters where footage was requested but not provided, even controlling for differences between the two groups (OR=5.0, $\chi^2(34)=566.77$, $p<0.001$; AUROC=0.73; Nagelkerke $R^2=0.188$). The second stage therefore compared matters where footage was requested and provided with cases in which footage was not requested. This comparison reveals the impact of providing footage to police investigators. Cases in which footage was not provided were excluded, and the matching process re-run with the same parameters. Relevant diagnostics (available from the authors) indicated that the treatment and control groups were adequately balanced on the observed covariates.

The average treatment effect on the treated was 0.045 (0.024–0.065), which was statistically significant. In other words, providing CCTV footage to police was associated with a 4.5 percentage point increase in the proportion of matters that were solved.

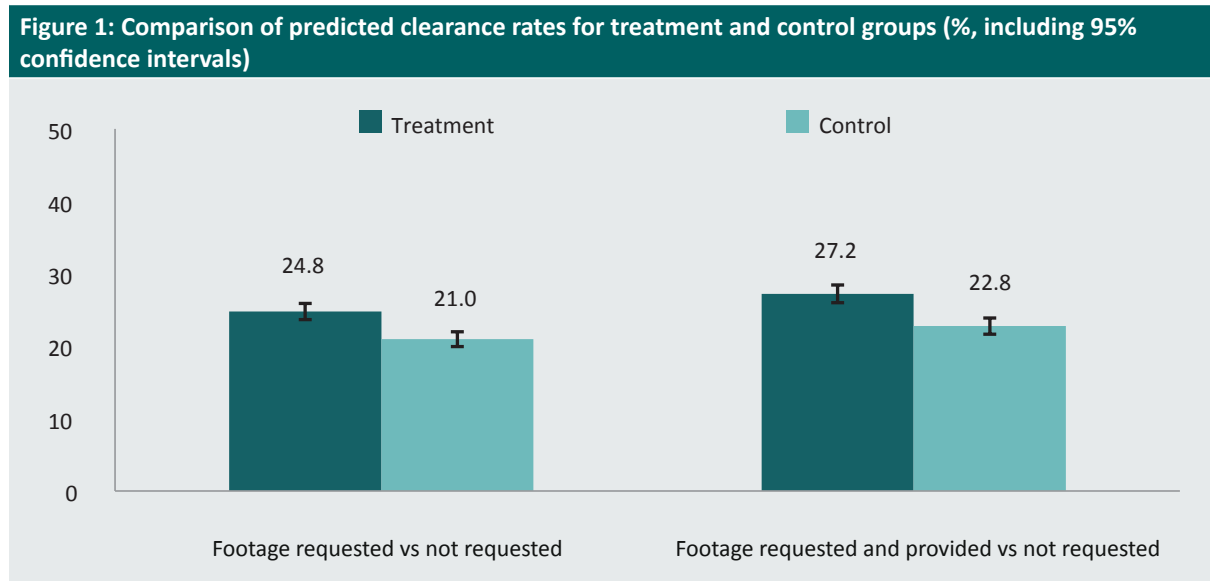
Table 2: Average treatment effect on the treated

	Coefficient of difference	Standard error	z	p	95% CI lower	95% CI upper
Footage requested vs not requested	0.038	0.009	3.98	<0.001	0.019	0.057
Footage requested and provided vs not requested	0.045	0.011	4.22	<0.001	0.024	0.065

Note: CI=confidence intervals

Source: NSW BOCSAR 2018; Sydney Trains 2018 [computer file]

These results were then used to estimate the outcome—the predicted average clearance rate—for both the treatment and control groups. As shown in Figure 1, 21.0 percent of matters without a request resulted in an offender being proceeded against, compared with 24.8 percent of matters where the investigator requested footage; an absolute increase of 3.8 percentage points, or a relative increase of 18 percent. Footage provision was associated with a 20 percent increase in clearance rates, from 22.8 percent to 27.2 percent of matters.



Note: Predicted clearance rates rounded to one decimal point. Percentage point difference is calculated from raw (unrounded) estimates

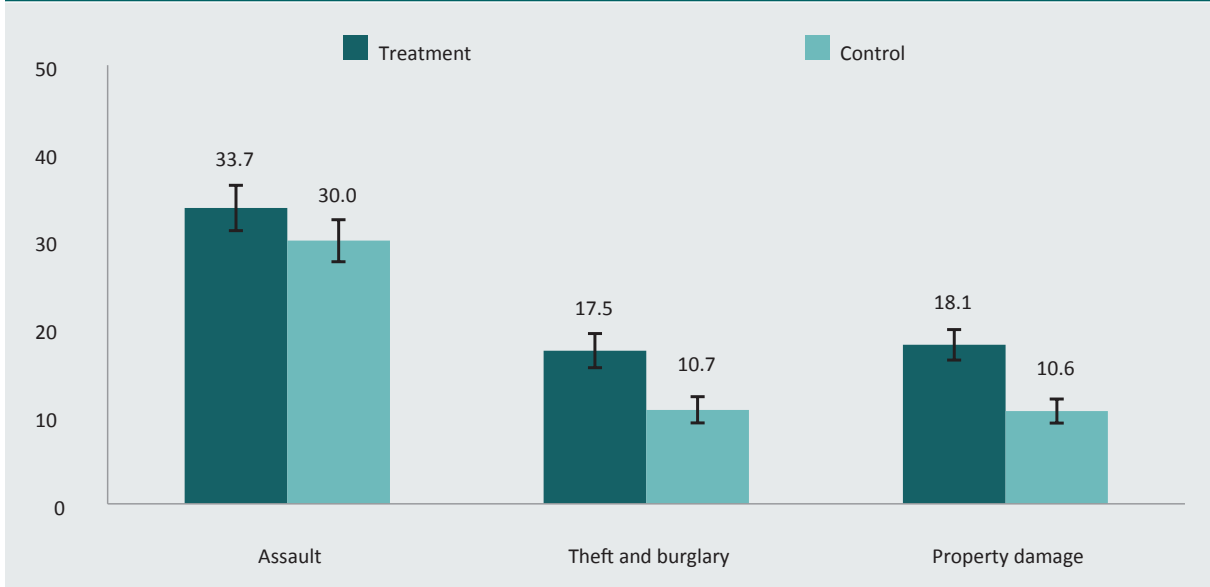
Source: NSW BOCSAR 2018; Sydney Trains 2018 [computer file]

Does the impact of CCTV footage vary by offence type?

The final stage of the analysis examined whether the impact of CCTV varied depending on the type of offence being investigated. Predicted clearance rates were estimated for each principal offence type and for the different treatment groups (based on the comparison of matters with and without a footage request). Results are presented for the three most common offence types—assault, theft and burglary, and property damage (Figure 2).

Together, these three offence categories accounted for around 80 percent of all footage requests. There was a 6.7 percentage point difference between the clearance rates for theft and burglary matters with and without CCTV footage requests, and a 7.5 percentage point difference for property damage matters. This represents a 63 percent and 71 percent increase in the proportion of matters that resulted in an offender being proceeded against, respectively.

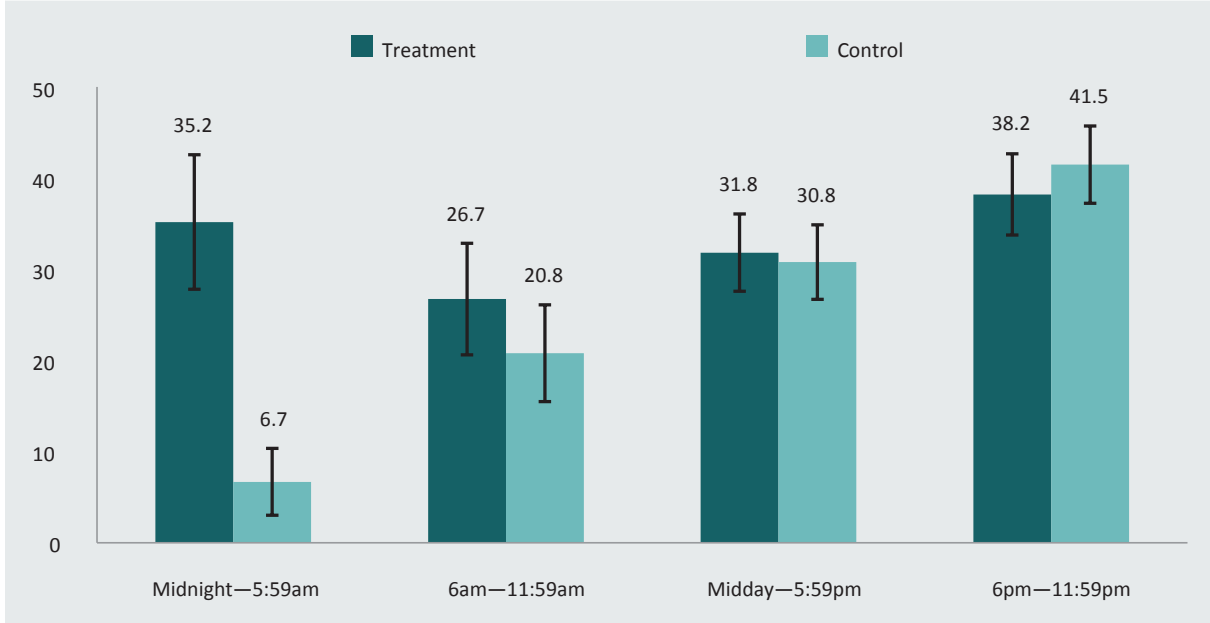
Figure 2: Comparison of predicted clearance rates for treatment and control groups, by principal offence type (% , including 95% confidence intervals)



Note: Predicted clearance rates rounded to one decimal point. Percentage point difference is calculated from raw (unrounded) estimates
Source: NSW BOCSAR 2018; Sydney Trains 2018 [computer file]

The confidence intervals overlap for assault matters, meaning there was no difference in overall clearance rates of cases where footage was or was not provided. Further analysis of assault offences revealed, however, that the impact of CCTV varied depending on what time of day the incident occurred. While CCTV footage made no difference in predicted clearance rates for assault matters that occurred between 6 am and midnight, there was a sizeable difference for matters that occurred between midnight and 6 am (Figure 3). This suggests that access to CCTV footage is beneficial in terms of solving assault matters that occur late at night.

Figure 3: Comparison of predicted clearance rates for treatment and control groups, by time of most recent incident, assault matters only (% , including 95% confidence intervals)



Note: Predicted clearance rates rounded to one decimal point. Percentage point difference is calculated from raw (unrounded) estimates
Source: NSW BOCSAR 2018; Sydney Trains 2018 [computer file]

Discussion

This study has measured the impact of CCTV footage on police clearance rates. This was based on data on more than 22,000 crime events recorded by the NSWPF across the rail network, linked with data routinely collected by Sydney Trains on requests for CCTV footage by NSWPF officers, and data from the NSW BOCSAR on legal action taken against offenders.

Impact of CCTV on criminal investigations

Overall, 24.8 percent of matters where footage was requested were solved by police, compared with 21.0 percent of matters where footage was not requested—an 18 percent increase in clearance rates. Footage was provided to police for nine out of 10 requests, and the provision of footage was associated with an estimated 20 percent increase in clearance rates. Although it is impossible to establish a causal relationship in the absence of an experimental evaluation, these results suggest that giving investigators access to footage for incidents on the rail network is associated with improved investigation outcomes. These results are supported by concurrent research involving a survey of police investigators, in which half of the investigators reported using the footage to identify or confirm the identity of a subject, two-thirds reported using the footage for the intended purpose, and nearly three-quarters reported the footage was useful or very useful (Dowling et al. 2019).

Results varied by principal offence type, with significantly larger increases in clearance rates observed for property damage, theft and burglary than for assault. However, access to CCTV footage for assault incidents that occurred late at night and in the early hours of the morning was associated with an increase in clearance rates.

There is always at least one witness (the victim) present during an assault offence, and assault offenders are more likely than property offenders to be known to the victim (Ashby 2017). Assault offences may be more likely to occur in the presence of other witnesses, since violent offending is frequently impulsive (Felson 2013) and offenders' decision making often impaired by alcohol and drug use (Morgan & McAtamney 2009). For these reasons, CCTV footage may not offer new or additional evidence to help identify the offender. This is supported by the finding that investigations into incidents occurring late at night, when it is much less likely that other witnesses will be present, benefited from access to CCTV footage. This does not mean, however, that CCTV footage is not useful to police at other times. In fact, Dowling et al. (2019) concluded that CCTV was more useful in assault matters than for other crime types, but that assault investigators tended not to request footage to identify or confirm the identity of the offender but to corroborate statements and determine whether an offence had occurred.

Conversely, theft offenders are more likely to take steps to conceal their identity and avoid being detected by the victim and other witnesses (Reynald 2017), just as they are more likely to be deterred by the presence of CCTV (Welsh & Farrington 2009). Similarly, the impact on property damage offences—which include graffiti—might be explained by offenders targeting highly visible locations which therefore have high levels of surveillance (Morgan & Louis 2009), but at times when there are fewer witnesses. Dowling et al. (2019) reported that property damage investigators were much less likely than other investigators to have collected victim or witness statements prior to requesting footage.

CCTV footage or investigative effort?

Despite the robust methods used to compare similar cases, it is possible that there were unmeasured differences between matters with and without CCTV that accounted for at least some of the observed differences in clearance rates. This includes the impact of additional investigative effort or resources. It may be that requests for CCTV footage reflect a greater investment of effort in an investigation, and this additional effort and the information and evidence it yields—not just CCTV footage—results in better outcomes. However, there are several arguments against this conclusion.

In comparing the outcomes of cases with and without CCTV footage, several other factors were considered. As well as influencing whether police request footage, these factors influence how much investigative time and resources are invested by police more generally. For example, the analysis accounted for both the principal offence type and the severity of a matter. The type and severity of an offence is a significant factor in determining how much time and effort police spend investigating, both in policy and practice (Burrows et al. 2005; Lum 2011).

The apparent solvability of a matter also influences police decision making with respect to further investigation. Solvability factors were among those variables used to match cases. These factors included the time window of an offence—the period of time within which an offence is known to have occurred—which determines the focus of an investigation and has been shown to impact clearance rates (Olphin 2015; Sharp 2016). The location and timing of the most recent incident in each matter was also used to match cases, since both influence the likelihood of there being other witnesses to the event—another solvability factor (Burrows et al. 2005; Paine 2012; Robb, Coupe & Ariel 2015; Sharp 2016).

Unfortunately, data on the availability of other forms of evidence, including witness statements, could not be obtained in this study. Dowling et al. (2019) found that two-thirds of investigators who requested CCTV already had statements from a victim, offender or witness, and one-third had CCTV footage from other sources, photographs or mobile phone footage, but it is unclear how this compares to investigations without CCTV footage. Morgan and Coughlan (2018) concluded that footage requests may actually be more likely when other forms of passive surveillance and informal guardianship are unavailable, because there are fewer witnesses to give evidence. This was the rationale for including a variable that controlled for suburb-level variation in police propensity to request footage.

Further, the availability of CCTV footage may be an important factor for police in deciding how much time to spend on an investigation, rather than simply being the product of investigative effort. In half of all matters police made the request for footage within one day of the most recent incident, and in three-quarters of all matters within five days, suggesting it is an important early step in the investigative process. In addition, cases in which CCTV footage was requested but not provided were significantly less likely to be solved than cases where CCTV footage was not requested. Access to footage of an incident may prompt further investigation, while being unable to access footage might, in the absence of other evidence, discourage officers from making further enquiries.

Finally, it is equally plausible that investigative effort had no bearing on the decision to request footage. Police may not have requested CCTV footage because they were simply unaware it was available, because the incident and related events took place in an area not monitored by CCTV, or because the officer did not believe the incident would have been captured on CCTV.

Implications for the design and management of CCTV systems

The findings should be understood in the context in which this research was undertaken. As Morgan and Coughlan (2018) and Ashby (2017) concluded, the rail network is unique in its level of CCTV coverage and monitoring arrangements. Resources are dedicated to supporting NSWPF with access to footage. These include a well-established information system for requesting and providing access to footage. Caution is needed in generalising results from this study to other locations and contexts where these conditions do not exist.

Related to this, police requested footage for less than one-third of the matters included in this analysis. It is unrealistic to expect that footage could be requested for all remaining matters and that, if footage were requested, it would benefit all cases. The results only apply to those comparable matters in the control group. CCTV footage is also not the only important source of evidence—victim, offender and witness statements, other forms of footage (including mobile phone and police body-worn cameras) and physical evidence are all likely to play a role in criminal investigation outcomes. In addition, this study only measures one possible outcome of access to CCTV footage, while assisting criminal investigations is only one of the reasons for installing CCTV. CCTV systems that are monitored (as is the case with Sydney Trains) can assist in the deployment of security staff and police, while CCTV is also frequently installed with the goal of preventing crime.

These issues aside, and read alongside the concurrent research involving surveys of police (Dowling et al. 2019) and the earlier study on CCTV request patterns by Morgan and Coughlan (2018), several conclusions can be drawn from this research. CCTV systems installed with the goal of helping investigators need to be targeted at locations where there is a higher concentration of incidents, particularly those incident types most likely to result in police requests for footage, or for which CCTV footage is most likely to be beneficial to police. This includes locations where other forms of passive surveillance are less likely, or less likely at certain times. It is also important that police are given timely access to footage for incidents where footage is likely to be available. This need for timeliness should be balanced, of course, with the capacity of camera operators to meet any increases in the demand for footage, and the significant costs associated with the installation, maintenance and management of CCTV systems. Giving investigators access to footage requires resources, cooperation between camera operators and police, and systems that enable the timely transmission of footage. Investigators also require footage that is high quality and therefore useful.

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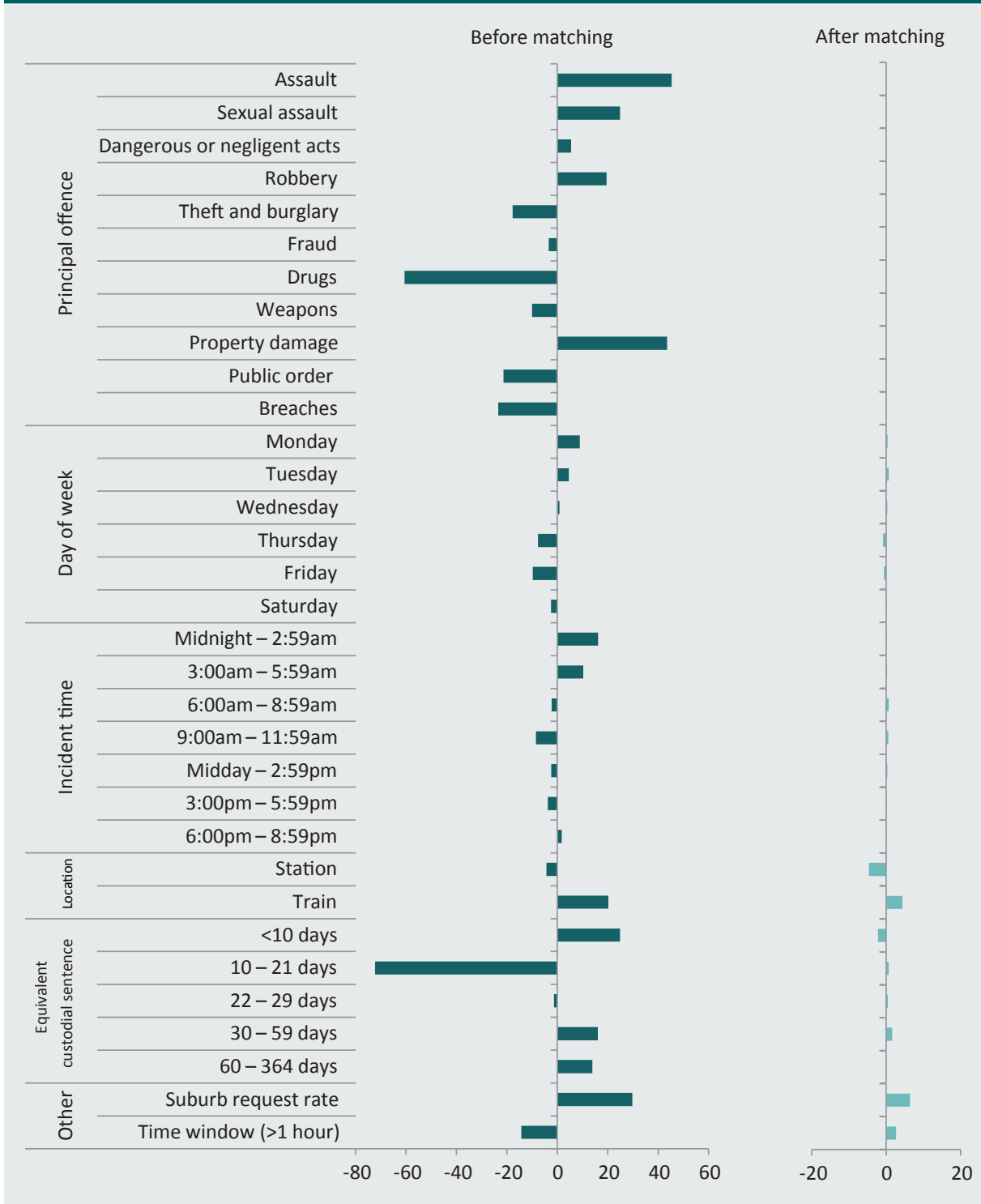
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Appendix

Figure A1: Standardised differences before and after matching



Source: NSW BOCSAR 2018; Sydney Trains 2018 [computer file]

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