

APPLICATION FOR

		2. DATE SUBMITTED 07/23/2009	APPLICATION IDENTIFIER	
1. TYPE OF SUBMISSION Application Non-Construction		3. DATE RECEIVED BY STATE		STATE APPLICATION IDENTIFIER
		4. DATE RECEIVED BY FEDERAL AGENCY		FEDERAL IDENTIFIER
5. APPLICANT INFORMATION				
Legal Name Temple University		Organizational Unit College of Liberal Arts		
[REDACTED] (city, state, and zip code) [REDACTED] [REDACTED] 19122-6099		Name and telephone number of the person to be contacted on matters involving this application [REDACTED] [REDACTED]		
6. EMPLOYER IDENTIFICATION NUMBER (EIN) [REDACTED]		7. TYPE OF APPLICANT State related inst of higher ed		
8. TYPE OF APPLICATION New		9. NAME OF FEDERAL AGENCY National Institute of Justice		
10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE Number: 16.560 CFDA Title: National Institute of Justice Research, Evaluation, and Development Project Grants		11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT CAN VIDEO SURVEILLANCE REDUCE CRIME? QUANTIFYING THE SIZE AND GEOGRAPHIC EXTENT OF CCTV'S IMPACT		
12. AREAS AFFECTED BY PROJECT Philadelphia, PA				
13. PROPOSED PROJECT		14. CONGRESSIONAL DISTRICT(S) OF		
Start Date: 01/01/2010	Ending Date: 12/31/2011	a. Applicant PA01	b. Project PA01	
15. ESTIMATED FUNDING		16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?		
a. Federal	\$486,161	Program is not covered by E.O. 12372		
b. Applicant	\$0			
c. State	\$0			
d. Local	\$0			
e. Other	\$0			
f. Program Income	\$0	17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT?		
g. Total	\$486,161	N		
18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS REQUIRED.				
a. Typed Name of Authorized Representative [REDACTED]		b. Title Director		c. Telephone number [REDACTED]
d. Signature of Authorized Representative			e. Date Signed	



TEMPLE
UNIVERSITY



CAN VIDEO SURVEILLANCE REDUCE CRIME?
QUANTIFYING THE SIZE AND GEOGRAPHIC EXTENT
OF CCTV'S IMPACT



Abstract

Closed Circuit Television (CCTV) is an applied technology that seeks to reduce crime by increasing the perceived risk of capture (Ratcliffe 2006: 8). While there are no national estimates on the extent of CCTV across America, newspaper accounts suggest that CCTV cameras are being implemented at a rate never seen before. For example, San Francisco has spent close to \$1m on 74 cameras at 25 locations, and a further 25 cameras are planned (Bulwa 2008); and Washington DC plans a \$4.5 million expansion of its surveillance system (Klein 2008). This rapid and unprecedented expansion of video surveillance technology is not just limited to the major urban areas (Farrington & Welsh 2007). Reductions in technology cost and a perception that CCTV is a cost-effective crime prevention tool have driven investment in video surveillance in municipal areas across America.

For all this enthusiasm for video surveillance, there has been a lack of high quality, independent evaluation studies (Eck 1998, Greenberg & Roush 2009). Astoundingly, when Farrington and Welsh (2007) conducted a recent meta-analysis of evaluations of CCTV in city and town centers, they could only find a single study from the US that was methodologically and statistically robust enough to warrant inclusion in their report. This single US study examined an undisclosed number of unmonitored cameras in three areas of Cincinnati, Ohio; cameras that used technology dating from early 1999 (Mazerolle et al. 2002).

Towns and cities across the US are spending a phenomenal amount of money on CCTV. Given the current enthusiasm, there is an urgent need for a large-scale, empirically-sound and methodologically-robust evaluation of CCTV cameras in the urban environment.

In light of a recent successful pilot project, we propose to conduct a large-scale, multi-method, quasi-experimental research study that will be spatially-tailored to the viewshed of each of 220 cameras in Philadelphia, PA. Unlike traditional spatial approaches that simply measure crime out from a camera to an arbitrarily-selected distance, individually constructed polygons for each camera site will be nested within buffer areas to detect displacement and/or diffusion of benefits to surrounding areas. Advanced interrupted time-series models that can incorporate varying implementation dates of different cameras will be populated with controls for seasonality and long-term crime trends, and four years of prior crime history in the city. Field observations at each site and qualitative interviews with police camera operators across varying shifts will combine with the quantitative work to produce a definitive evaluation, and create a best practice guide for crime prevention practice with CCTV.

Resubmit response

This application was submitted one year ago as application 2008-91640-PA-IJ with the same project name (Can video surveillance reduce crime? Quantifying the size and geographic extent of CCTV's impact). For section 1 (Understanding of the Problem and Its Importance) and section 2 (Quality and Technical Merit) the reviewers found *"No relevant weaknesses were evident in this applicant's response to this section of the Application"*.

For section 3 (Impact of the Proposed Project) the reviewers wrote that *"While not a true weakness, there appears to be no immediate potential for commercialization of this project's deliverables"*.

Response: There is already sufficient commercialization of CCTV to fulfill the nation's need for video surveillance systems. The broader question, that we feel is much more pertinent, is; what is the size and geographic extent of any disorder and crime benefits of CCTV, if any? If a strong methodological study such as we propose is capable of demonstrating a benefit, then there will be an increase in cities pursuing commercial CCTV systems.

For section 4 (Capabilities, Demonstrated Productivity, and Experience of Applicants) the reviewers found "No relevant weaknesses were evident in this applicant's response to this section of the Application".

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

For section 6 (Dissemination Strategy) the reviewers found “Nothing was mentioned in the application that would indicate any special efforts to be taken to get their findings to the nation’s city managers”.

Response: This is a perfectly reasonable criticism and we have this year included two dissemination activities that would target the nation’s city managers. First, we plan to publish an article regarding this research in the Leadership Bulletin of the National Executive Institute Associates, a publication that is copied to graduates of the FBI National Academy and members of both the Major Cities Chiefs’ Association and the Major County Sheriffs’ Association. Secondly, we will seek to present the findings of our research at the annual meeting of the International City/County Management Association, a national body based in Washington DC with a large membership. Their annual meeting for 2011 will be in Wisconsin, and a budget item for this is included.

Finally, we would like to express our thanks to the reviewers from the first review, who summarized our application thus “NIJ should have the highest level of confidence that the solicitation requirements will be met, if not exceeded”. In the intervening period, we have worked even more closely with the Philadelphia Police Department and are currently engaged in a significant city-wide foot beat policing experiment with them. The experiment will conclude by the time this project would commence, but it demonstrates that we maintain excellent relations with the Police Department and NIJ should feel as confident in the completion of this research as the reviewers felt last year.

Contents

ABSTRACT	III
RESUBMIT RESPONSE	V
CONTENTS.....	VII
PURPOSE, GOALS, AND OBJECTIVES.....	1
OBJECTIVES	2
REVIEW OF RELEVANT LITERATURE.....	3
RESEARCH DESIGN AND METHODS	9
A LONGITUDINAL STUDY EMPLOYING INTERRUPTED TIME SERIES ANALYSES	10
A COMPARATIVE STUDY WITH NON-CAMERA LOCATIONS.....	13
A SPATIAL STUDY EXAMINING POTENTIAL DISPLACEMENT OR DIFFUSION	14
REGULAR FIELD OBSERVATIONS OF CAMERA LOCATIONS TO CONFIRM IMPLEMENTATION CRITERIA	18
INTERVIEWS WITH CAMERA OPERATORS AND KEY STAKEHOLDERS.....	20
EVALUATION SUMMARY	21
IMPLICATIONS FOR CRIMINAL JUSTICE POLICY AND PRACTICE	22
MANAGEMENT PLAN AND ORGANIZATION	23
DISSEMINATION STRATEGY	25
FIGURES	28
REFERENCES	30
OTHER APPLICATION REQUIREMENTS	33
DATA ARCHIVING STRATEGY	33
LIST OF KEY PERSONNEL.....	34
RÉSUMÉS OF KEY PERSONNEL	35
LIST OF PREVIOUS AND CURRENT NIJ AWARDS	38
LETTER OF COOPERATION/SUPPORT FROM THE PHILADELPHIA POLICE DEPARTMENT	38



Purpose, goals, and objectives

The history of CCTV technology is one of rapid evolution from static, low resolution cameras, to high quality technology solutions that can pan, tilt and zoom at the command, through either wireless interface or fiber optic cable, of remote operators usually connected to a police radio network. Although camera technology continues to evolve, the vast majority of camera systems planned for the US are similar to the technology to be evaluated in this research project; pan, tilt and zoom (PTZ) cameras connected to a police control room. This level of technology is fully developed and readily applicable in an operational criminal justice setting, and is either currently or soon to be utilized across the country in many towns and cities. That the maturity of the technology is apparent makes the lack of a high quality evaluation ever conducted even more difficult to fathom.

Therefore, the purpose of this study is to conduct the first, large-scale, multi-method evaluation of CCTV using robust interrupted time-series techniques applied to recorded crime, in the United States.

The goal of this research is to use advanced time-series and micro-spatial evaluation tools that are capable of measuring crime within the specific viewsheds of CCTV cameras to estimate the prevention benefits of cameras on recorded property crime, violent crime, and disorder incidents.

A second goal is to complement the quantitative research with qualitative studies that enhance our understanding of the statistical outcome with a contextual understanding of why

crime increased or decreased in camera and buffer areas, based on field observations at camera sites and interviews with key personnel and stakeholders.

Objectives

- Map the exact environment of each of 220 cameras across Philadelphia, PA
- Establish exact spatial viewsheds for each camera, and liaise with district officers and camera operators to map the likely displacement zones around each camera
- Build monthly time series models of disorder events, property crime and violent crime for up to four years prior to camera implementation
- Continue regular visits to all camera and buffer areas during the implementation period to monitor the context of the urban environment
- Assess changes in violent crime, property crime and disorder activity in target areas, buffer areas and control areas using a variety of robust statistical methods (ARIMA time series analysis, Weighted Displacement Quotient analysis, comparison analysis with control sites)
- Conduct qualitative interviews with camera operators, police department leadership, and patrol (district) officers in police districts with cameras
- Disseminate findings not only within academia, but throughout the practitioner community with publications and presentations specifically targeted to IT managers and police executives rather than college professors
- Complete final report and accompanying publications
- Archive data for future project replication

Review of relevant literature

The vast majority of CCTV schemes are currently being implemented in public areas of cities and towns. For example, Washington DC has already spent \$4m on street intersection cameras, and looks to spend about the same again expanding the camera network (Klein 2008), and New York City has already spent over \$25m on a public surveillance camera network. These implementations are indicative of a growing trend toward the use of CCTV to improve public safety in city centers and public areas. Philadelphia, Pennsylvania, is joining this trend with an anticipated implementation of 220 cameras by June 2009 (this process is about 50% complete and ahead of schedule). As a result, this project proposes to examine cameras implemented in public areas and street intersections across Philadelphia, PA. Thus, while there is a modest research history of CCTV evaluations in public housing areas, on public transport and in car parks, this literature review will concentrate on city and town center camera implementations.

From the earliest wide-scale implementation of CCTV technology in the 1980s, many evaluations have lacked independence and have been either conducted by city agencies or technology companies involved in the scheme, both of whom may be perceived to have vested interests in the evaluation outcomes (Ratcliffe 2006). The earliest independent evaluation of a CCTV implementation dates from King's Lynn, UK (Brown, 1995) where 19 cameras were installed at public car parks across the city. Like many studies that followed, this evaluation was methodologically weak and lacked controls for low numbers of initial crimes and for long-term temporal trends. As reported in Appendix A of Ratcliffe (2006), numerous studies have been conducted that, while independent, range in methodological quality from weak to strong.

Methodologically weak studies have lacked control areas, controls for seasonal variation, or have lacked any measure of potential displacement (or diffusion).

The existing evaluation literature has considerable variation in not only methodology, but also outcome measures and independent variables. Some examine the impact of cameras on crime within a defined distance of CCTV cameras (Harada et al., 2004), while others surveyed residents in camera areas for their perceptions of how crime has changed (Squires, 2003). Other studies have interviewed key stakeholders (Hood, 2003) or examined emergency room attendance levels related to assaults (Sivarajasingam, Shepherd, & Matthews, 2003).

Irrespective of the numerous universally-glowing reports of CCTV in trade magazines and technology periodicals, the number of statistically sound and independent evaluations is substantially smaller. Farrington and Welsh's (2007) systematic review identified four essential criteria for inclusion in their study:

1. CCTV was the main intervention examined;
2. The outcome measure was crime;
3. The evaluation had a minimum methodological design that incorporated at least before-and-after measures of crime in experimental and comparable control areas; and
4. There was a minimum number of crimes (20) recorded in the experimental area prior to the CCTV implementation.

Within these basic evaluation criteria, they were able to identify 44 studies, but only 22 that were applicable to city centers and public urban areas. Of these 22, 17 were conducted in the

UK, 2 is Scandinavia, and 3 from the US; however, the 3 from the US are actually on 3 locations in Cincinnati, Ohio, and are reported in one single journal article (Mazerolle et al. 2002).

Furthermore, this single study does not use crime as an outcome measure, but calls for service. While the study conducted by Lorraine Mazerolle and colleagues is methodologically sound and empirically sophisticated, the use of calls for service rather than recorded crime basically means that there has not been a single study of CCTV in America that uses recorded crime in public space as an outcome measure in a manner that satisfies Farrington and Welsh's systematic review criteria.

Since our application last year there has, however, been one US study of note. Greenberg and Roush (2009) evaluated a CCTV system at a private apartment complex in New York, NY. Though hampered by low crime counts, their methodologically sound evaluation found that CCTV may be 'moderately effective' in preventing minor crimes but the results for serious crime were unclear because of the dearth of serious crime to begin with. It is worth noting that even writing in 2009, they noted a 'paucity of American studies' (2009: 5) and on calling for more research they pointed out that 'because the benefits of reducing major crime are greater than of reducing lesser crimes, we suggest that future research focus on areas in which serious crime rates are higher' than in their researched location (2009: 22). The results from their private apartment complex may not translate to the public space environments that we seek to examine in our study and where most CCTV systems are implemented. Fortunately, with 220 cameras across Philadelphia, we anticipate significantly greater levels of violent and serious crime on which to test the effectiveness of CCTV.

Of the CCTV reviews from overseas, the vast majority stem from the UK. As Farrington and Welsh report from the 22 studies included in their review, ten had positive outcomes as regards a reduction in crime (or equivalent measure, for example calls for service), five had undesired outcomes, and the remainder had null or mixed results. While it may be tempting to simply translate these results to the US (albeit the results are too mixed in terms of outcome and methodology), there is a problem with that approach. As Andersson notes *'There is also good reason to weigh the international results and experiences against our own history and our current situation as regards the use of CCTV, which are very different from those of countries like the United Kingdom, for example, which has long been developing large-scale CCTV surveillance as a means of combating terrorism'* (Andersson 2007: 6).

The UK's attempt to combat terrorist attacks from the Provisional IRA spurred numerous technology solutions, such as CCTV across the public transport network. This camera network dates back to the mid-1980s, but evaluations of these cameras have limited applicability to the modern US experience: the camera technology has advanced significantly during the intervening years, and although we are in a post-9/11 homeland security era that has expanded the number of cameras in cities such as New York, the vast majority of towns and cities across the country still implement surveillance technology to combat street crime and property offenses rather than as a counter-terrorism measure. Moreover, violent crime rates (especially shootings and homicides) in the UK are significantly lower than in the US and the crime dynamic (in terms of the mix of street offenses and public disorder crime) is not as transferable to the US (Gill & Springs 2005). Finally, the street pattern in much of the US (often built on a grid pattern

rarely seen in the UK) better favors the linear view scheme of CCTV cameras, suggesting that cameras in the US may have greater applicability to the existing geography.

The literature on CCTV rarely addresses the theoretical perspective of camera benefit; in other words, how does a surveillance system reduce crime? Drawing on the literature of environmental criminology, Ratcliffe (2006) suggests that cameras may work to prevent crime if two criteria are met; the offender is aware that the camera may be watching their activity, and secondly that the offender perceives that the risk of capture by police may outweigh the benefits of the crime they are considering. As crime prevention is therefore a feature of offender perception, it may be that although the cameras may only be able to see a certain amount of public space, offenders perceive that the cameras can observe their activity to a greater or lesser range. The choice is therefore to define evaluation areas based on possible offender perception of camera range, or on the actual area that the camera can view. In this research we take the approach of mapping the actual areas that the cameras can see. This is because offender perception is not possible to measure without extensive and expensive interviewing, and secondly because offender perception will vary from person to person. Fortunately, as explained in a later section, the weighted displacement quotient analysis is able to incorporate a measure for diffusion or displacement, in the event of a misspecification of the surveillance zone. This will allow us to measure any diffusion of benefits or displacement to the neighboring area around each camera, and to limit the impact of areas where the boundary of the target area does not exactly match with offender perception. This approach is significantly preferable to the 'standard' method of estimating camera impact.

If there is a 'standard' method, then it is to use a simple buffer that does not reflect the underlying geography of the urban mosaic around camera locations. For example, a number of studies have mapped crime a certain distance from the cameras; Harada and colleagues' (2004) study in a Tokyo neighborhood examined crime out to 50 meters (164 feet); Mazerolle and colleagues (2002) buffered regions to 200, 500 and 1,000 feet radially out from cameras; Sarno et al. (1999) buffered out for 200 meters (656 feet); and a recent DC police evaluation examined crime within 250 feet of cameras, but did not consider displacement (Klein 2008).

The problem with examining crime by counting events within a certain set distance from every camera is that camera implementation has a significant impact on the viewshed of cameras, and no two cameras have the same range of vision. For example, road signs, trees, camera height and camera technology all enhance or limit the viewable range of CCTV cameras. Thus a robust approach is one where the actual viewable geography of the streetscape under surveillance becomes the experimental area, an area that is tailored to each camera. Mapping the actual viewshed of each camera, as we propose to do, is the most empirically-sound approach, yet it has not been conducted in any evaluation study of merit.

In summary, the literature review finds the following key points:

- There is a complete lack of empirically-sound, crime-focused evaluations of public street CCTV cameras in the United States (US).
- Much of the existing literature from overseas may lack relevance to the US environment, given the different crime dynamic from British urban centers to US cities.

- Much of the evaluation literature lacks tailoring to the individual viewsheds of the cameras, simply employing a fixed distance around cameras – a distance that varies by study.
- Existing evaluations are often methodologically weak, lacking controls for seasonality, limited historical data on which to estimate pre-camera trends, and rarely explicitly testing for displacement.

The study we propose resolves all of these issues, and does so over more cameras than ever before examined.

Research design and methods

Our research proposal builds on our experience with a pilot project conducted in the latter half of 2007. In conjunction with the Philadelphia Police Department, a pilot evaluation of 18 cameras at 10 pilot sites across Philadelphia was conducted during 2007. For the pilot, we used two years of crime data, geocoded and mapped to individually-constructed polygon areas for exact camera viewsheds. These viewsheds were established by site visits and by tracking and panning each camera during visits to the control room in Philadelphia Police Department Headquarters. The quantitative analysis was conducted using Hierarchical linear modeling (HLM), a type of statistical analysis that recognizes nested data structures. At the most basic level this can be thought of, for example, as individuals nested within a neighborhood or police beats nested within police districts. This analysis also applies to repeated observations across individuals or locations. In the pilot study, the analysis looked at time nested within camera

locations. The research incorporated controls for long-term trends and seasonality and found that the introduction of cameras was associated with a 13 percent reduction in crime. This research has been accepted for publication in *Justice Quarterly* (Ratcliffe *et al*, in press). Based on our experiences with the police and the pilot project as well as the clear need for a more expansive evaluation, we now seek to conduct an extended research project on a much greater scale.

We propose a multi-method, multi-pronged approach for this extended project. Our research design employs a number of approaches to evaluation the impact of CCTV cameras, specifically;

- A longitudinal study employing interrupted time series analyses;
- A comparative study with non-camera locations;
- A spatial study examining potential displacement or diffusion;
- Regular field observations of camera locations to confirm implementation criteria; and
- Interviews with camera operators and key stakeholders to interpret the quantitative results.

A longitudinal study employing interrupted time series analyses

We will employ two time-series methodologies to cross-reference the quantitative impact of CCTV implementation on recorded crime and calls for service (CFS). It is important to examine both crime and CFS data. Recorded crime is often the measure by which municipalities measure success of a crime prevention intervention, while CFS are a useful indication of police

workload and much of the minor public disorder that plagues urban areas but that does not rise to the level of recorded crime. We will examine both data sources.

One methodology is Auto-Regressive Integrated Moving Average (ARIMA) time series modeling. The analysis of a time series as the quasi-experimental design to be employed in this study is effectively a test of the null hypothesis, in our case, that the introduction of CCTV cameras had no significant impact on crime. The null hypothesis is tested by comparing the pre and post series. Time series analysis can also be used to estimate the impact that the intervention had on the series. In other words, if the introduction of CCTV cameras has a positive (or negative) significant impact on crime rates within the tailored viewshed of a camera, what is the estimate of that impact? For example, when a police operation to reduce burglary was examined using ARIMA modeling, it was found that the police had reduced burglaries in one Australian city by about 50 per week (Makkai et al. 2004, Ratcliffe 2008).

When examining time series, more common approaches such as Ordinary Least Squares (OLS) regression are statistically flawed and should be avoided, because time series data violate the assumption of independence of individual events. In other words, a time series is often comprised of measurements that are influenced by previous periods in the series (Ross 1982, Yaffee & McGee 2000). This could be due to seasonal variation (we know that violent crime usually increases in summer months) or interventions (rising crime rates often trigger a police reaction) (Langworthy 1989, Lawton et al. 2005). The advantage of ARIMA modeling over other types of regression discontinuity approach is the ability of ARIMA models to incorporate a measure of temporal causation such that previous event counts have an impact on future

values (Block 1984, Box & Jenkins 1976, Chatfield 1989). ARIMA modeling has been used in numerous evaluations of crime reduction schemes; including burglary prevention operations (Ratcliffe 2002), vehicle theft prevention (Krimmel & Mele 1998), heroin crackdowns (Degenhardt et al. 2005), and Compstat (Mazerolle et al. 2007).

A limitation of ARIMA modeling is that the pre-intervention model requires as many as 40 to 50 measurement points in order to establish a pre-intervention trend. For the pilot project, we were forced to use an alternative approach due to a limited historical trend history. For the pilot, we employed Hierarchical Linear Modeling (HLM). As stated earlier, this is a type of statistical analysis that recognizes nested data structures, and looked at time nested within camera locations.

Using HLM for the pilot study had a number of practical benefits. First, it included variables that statistically controlled for seasonal effects on crime. Failing to control for seasonal effects (i.e. the difference in crime between winter and summer) can limit the value of any findings. This could be especially true for street crimes, because people spend more time outside when the weather is warmer. Secondly, the analysis controlled for preexisting temporal trends at each camera location. For example, if regeneration was taking place near a camera location, this could sometimes mean that crime was slowly falling, an additional effect to the seasonal variation. Failing to control for these pre-camera implementation trends could result in under- or over-estimating the cameras' effects on crime patterns.

The results from HLM are easily converted to Incident Rate Ratio (IRR) scores and this is hugely beneficial in converting rather dense statistical outcomes into measures that the public

and policy-makers can understand. For example, a finding that the introduction of CCTV cameras was associated with a 13% reduction in street crime in the viewshed of CCTV cameras, is a great deal easier to explain than large tables of (often incomprehensible) data.

In the proposed study, we will use both methods. We have arranged for crime and call for service data going back to 2003, thus enabling the study to model enough months of crime pre-intervention that we will be able to construct ARIMA models. Furthermore, we will also construct a global model using the same HLM approach as before for both continuity with the pilot study and because the use of HLM as a regression discontinuity model will act as a cross-check on the ARIMA approach.

A comparative study with non-camera locations

Beyond the two time series techniques, comparative methodologies are a common way to conduct quasi-experimental studies. This normally involves a control group measure from which to compare changes between groups. The study cannot randomly assign cameras to street corners because the CCTV project is being implemented under considerable media and political oversight; a problem not uncommon to previous attempts to evaluate CCTV (Honest & Charman 1992). As a result, the cameras planned for the city will be implemented in areas of the highest crime activity or along important commercial corridors. Furthermore, if cameras were introduced to lower crime areas for the purposes of a social science experiment, the cost of subsequently relocating the cameras to high crime areas would be prohibitive.

Therefore to compensate for this, we will identify near-equivalent locations for the major camera sites through 'loose coupling' multiple criteria decision-making (Jankowski 1995) as a

pre-cursor to using propensity matching to identify comparison sites, due to propensity matching's ability 'to correct for sample selection bias due to observable differences between the treatment and comparison groups' (Dehejia & Wahba 2002: 151). Given the constraints that cameras are likely to be implemented in high crime areas, and that comparison areas have to reside outside of the buffer areas for any cameras, we will aim to *match with replication*, a process by which the nearest comparison unit is used, irrespective of whether it is also a comparison unit for another camera. This has a number of advantages, including that it will most likely improve the precision of the estimates, and reduces the likelihood of comparison area order selection introducing selection bias into the process (Rosenbaum, 1995).

We will also improve the process by reducing the dimensionality of the comparison areas by identifying major crime types and then using generalized socio-economic demographics derived from broad indices. This capacity to limit the number of criteria entering the matching procedure will allow a number of variables to enter the decision-making process without permitting a single factor to over-influence the selection process. Direct regression measurements will then inform the outcome of this part of the study.

A spatial study examining potential displacement or diffusion

CCTV cameras may or may not have an impact in the target area; however, it is possible that cameras may also have an impact on neighboring areas that are not directly under the surveillance of a camera. The term **displacement** is used to indicate when cameras displace crime activity out of their view and into nearby areas (Cornish & Clarke 1989, Green 1995, Ratcliffe 2002, Weisburd & Green 1995). This can happen when offenders decide the risk of

operating within the sight of a camera is too great, and move criminal activity to a nearby location. Barr and Pease (1990: 278) considered displacement as both “a frustrating side effect” and “a predictable effect of specific policies and...a manipulative tool of crime control”; however others have argued that there are still net benefits to a crime prevention initiative even if displacement occurs (Ratcliffe 2002, Clarke & Weisburd 1994). This is because the amount of crime displaced rarely, if ever, exceeds or even equals the amount of crime reduced at the target site (Hesseling 1994).

It is also possible that a **diffusion of benefits** can occur (Clarke & Weisburd 1994, Ratcliffe & Makkai 2004, Weisburd et al. 2006). This happens when the beneficial effect of a crime prevention initiative spills over into surrounding areas. While many crime prevention practitioners assume that displacement is the most likely outcome, research suggests that diffusion of benefits is a more likely outcome from a successful crime prevention initiative.

In this study, Bowers and Johnson’s (2003) weighted displacement quotient (WDQ) will be employed to determine whether or not crime displacement or diffusion of benefits has taken place. The determination of a WDQ first requires the researcher to determine three operational areas; the target area where the crime reduction strategy has been deployed (in this case, CCTV camera viewsheds), a buffer area that is estimated to be the most likely location that crime would be displaced to, and a control area that acts as a check on general crime trends that are affecting the region in general. The equation for the weighted displacement quotient is as follows,

$$WDQ = (B_{t1}/C_{t1} - B_{t0}/C_{t0}) / (A_{t1}/C_{t1} - A_{t0}/C_{t0}) \quad (1)$$

where A is the count of crime events in the target area, B is the count of crime events in the buffer area, C is the count of crime events in the control area, t_1 is the time of the intervention, and t_0 is the pre-intervention time period (Bowers & Johnson 2003). The examination of the difference between the buffer and control areas from the pre-intervention to the intervention (or post-intervention) period provides the measure of displacement or diffusion into the buffer area, while the differences between the target and control area ratios at both times provides the measure of success for the intervention (Johnson and Bowers 2003). The equation at (1) is therefore comprised of both a Buffer Displacement Measure ($B_{t_1}/C_{t_1} - B_{t_0}/C_{t_0}$) and a Success Measure ($A_{t_1}/C_{t_1} - A_{t_0}/C_{t_0}$). A positive Buffer Displacement Measure is indicative of potential displacement, while a negative value indicates possible diffusion of benefits. A positive Success Measure indicates that crime did not improve as a result of the intervention, while a negative Success Measure suggests the police operation (or other form of intervention) was successful in reducing crime.

This approach requires the designation of two areas around each camera site. The first area is designated the **target area** - the area where the cameras are expected to have a positive effect. For pan, tilt and zoom (PTZ) cameras, we will work (as we did for the pilot study) with Philadelphia Police Department (PPD) officers to map the individual viewsheds of the cameras by panning and zooming the cameras and discussing active viewing areas with the officers.

We will then designate **buffer areas** around each camera. Cornish and Clarke (1987) conceptualized displacement from the perspective of rational choice theory. From their examination of the choices made by offenders in the decision to commit crimes and their

choice of targets, they believed that displacement could best be explained and understood by concentrating on the offender's personal decisions and choices made in the commission of crime. The decisions, opportunities, costs and benefits associated with particular offenses, in Cornish and Clarke's view, work to establish the confines of displacement within different categories of offense. If this is the case, then it becomes less plausible to justify a generalized approach to displacement. In other words, standard buffers that spread out from a CCTV camera are not appropriate. Rather, the theoretical groundwork requires practitioners and researchers to be open to the possibility that displacement may or may not occur with different spatio-temporal (and other displacement typology) characteristics for different crime types and situations.

This raises the specter that displacement areas - places or distances that offenders would naturally be displaced to - may not exist; with the corollary that the spatial context of the wider environment surrounding a crime prevention operation must be considered. These areas are likely to be places in the surrounding neighborhood of the cameras where crime activity could potentially be displaced. The buffer area is also a zone where potential diffusion of benefits could occur. This can happen when the cameras exert a benefit to surrounding areas beyond their target area, and happens when offenders move out of the general area of the camera, or offenders at unviewed areas curtail their activity because they think the camera can still see them.

We will visit each site with PPD officers and discuss the spatial constraints of likely buffer areas with patrol officers familiar with the location on the ground. This ***local contact-local***

context approach enables us to incorporate into our target and buffer areas similar sets of ‘crime prone’ characteristics that attracted the need for a camera in the first place, characteristics that would be likely targets for spatial displacement.

Finally, as a control on general trends in the surrounding areas beyond the target and buffer area, we designate the surrounding police district(s) as the **control area**. The control area varies for each camera.

A unique aspect of this application over every other attempt to examine the level of crime around CCTV cameras is the customization of the camera viewshed area that we will conduct for each camera. The identification of target and buffer areas that actually reflect camera viewsheds and likely offender response is not an issue that can be left to generic measures such as uniform buffers around each camera. Rather, we will examine individual camera viewsheds, as was done in our pilot study in Philadelphia. Figure 1 shows a Temple University graduate student working with a Philadelphia Police Department officer to map the exact contours of the viewable area. From this, discussion with district officers enabled us to map unique areas, as shown in Figure 2. In this second figure, the cameras locations are identified as white crosses, while tight polygons show the limited viewshed of cameras along surrounding streets. The viewshed is unique for each camera, aptly demonstrating the limitation of fixed buffers, an approach commonly taken in the research literature.

Regular field observations of camera locations to confirm implementation criteria

Initial visits to camera locations are essential. As Pawson and Tilley pointed out, too few evaluations of crime prevention schemes fail to understand the underlying context of the environment of the evaluation (Pawson & Tilley 1994, Pawson & Tilley 1997). These initial visits will be made with patrol officers from the PPD district in which the camera is situated. We will combine the findings of discussions with the patrol officers and with camera operators at police headquarters to determine the size and shape of both viewshed (target) and buffer areas.

Regular follow-up visits are planned to every camera location **every month** along with contact with District personnel. This is important in order to establish if the environment has changed in any way; for example, have new stores opened, has the road been closed for repairs, have flowering trees impeded the view of the camera? Some of this information can be gathered from the contact with camera operators at Police Department Headquarters (see Figure 1), however there are benefits to accessing local knowledge that are essential to getting an improved understanding of the context of the 'set space' (to adapt a gang research term from Tita et al. 2005) around each camera.

It is also valuable to maintain regular contact with District personnel to see if they have noticed changes in offender behavior in the area, an expected adaptation given the (albeit limited) research in this area (Mazerolle et al. 2002). Over time, this rich source of qualitative information will inform the results of the quantitative study, and will directly feed into the interpretation of the findings of the research.

Patrol officers will be selected by the PPD with the criteria of finding officers in each District who are familiar with the area, have worked there for some time, and who are knowledgeable

about both the crime patterns for the camera area, as well as the known offenders for each site. Researchers will also attend the PPD Compstat meetings. These meetings are now closed to the public and media because individual offenders and criminal intelligence matters are now discussed at the meeting, however the research team has long had a strong relationship with the leadership of the PPD and we have open access to this meeting.

Interviews with camera operators and key stakeholders

In furtherance of the site visits and contact with District personnel at the camera locations, we will interview camera operators at the beginning and end of the project, as well as the leadership of the Philadelphia Police Department and information technology managers for the city. These will be in-depth, semi-structured interviews, structured around Greenhalgh et al.'s (2004) conceptual model for innovation diffusion and will identify the relevant roles of key factors at the intrapersonal, agency and contextual levels. These key person interviews will generate suggestions about potential cultural, structural, and incentive changes that may facilitate better integration of CCTV technology into the operational planning of the city. Most importantly, they will provide a rich, qualitative picture of the use of cameras across the city, a picture that will inform and influence our interpretation of the quantitative findings.

Topics for discussion will emphasize the relationship and levels of contact with local police, an important finding from British qualitative research into CCTV implementation (Goold, 2004), and operating conditions regarding numbers of cameras viewed at any one time and the time spent on each screen – again, an issue identified in the research literature (Fyfe & Bannister 1996).

Evaluation summary

As with most CCTV implementations, the Philadelphia experiment is unable to take advantage of a randomized control experiment due to the constraints of politics and cost. There are political imperatives in that the study cannot randomly assign cameras to trial locations that are not in the worst crime hotspots because the CCTV project is being implemented under considerable media and political oversight: this is an important project for the city. Furthermore, if cameras were introduced to lower crime areas for the purposes of a social science experiment, the cost of subsequently relocating the cameras to high crime areas would be prohibitive and not a cost that can be incorporated into this grant.

However, the multi-method design that we have proposed addresses all of the requirements of a strong quasi-experimental design and would rank highly on the Maryland Scale of Evaluation Research (Farrington 2002, Sherman et al. 1998) and specifically address issues of selection bias in the camera locations. The use of ARIMA interrupted time series analysis and HLM (employed here as a regression discontinuity tool) both address issues of temporal trend relationships that are not reliably measured by normal regression methods. The techniques we will employ are both statistically robust and will result in meaningful and reliable findings that can be converted into measurable crime reduction outcomes that practitioners and crime prevention professionals considering CCTV will be able to understand.

Furthermore, the identification through multi-criteria propensity matching of comparable street corners will allow a direct comparison with quasi-randomized control locations, and the introduction of Bowers and Johnson's Weighted Displacement Quotient as the mechanism to

evaluate displacement or diffusion will address a particularly common question directly and with methodological rigor, based on customized spatial parameters at each camera location. Finally, the scale of the implementation across Philadelphia – the sixth largest city in the country – provides sufficient levels of criminal activity and locations to establish reliable measures that are statistically valid.

Implications for criminal justice policy and practice

We will be able to explain the benefit (or not) of CCTV cameras on property crime, violent crime, and disorder activity. We will also be able to comment on the setting and operability conditions that favor greatest CCTV benefit as well as address implementation issues. The qualitative information will provide a rich vein of contextual intelligence that, when analyzed, will provide a more rounded picture of the pros and cons of CCTV implementation and flesh out the story underlying the quantitative evaluation that forms the core of this application.

By addressing property crime and disorder activity along with violent crime, we will be able to increase the value of the analysis to cities and towns that do not necessarily have the violent crime issues that plague the larger cities in the country. In other words, while we benefit from evaluating this technology in a large and diverse city, the findings will be of benefit to the whole country.

The financial benefits to cities and towns of a more effective implementation of CCTV are potentially staggering, though difficult to estimate. This research will provide the first concrete measure of crime reductions both in the immediate camera viewshed and in the surrounding

area for the US. This information will provide crucial inputs to cost-benefit analyses conducted to answer whether CCTVs benefits outweigh the costs. The research will also be able to confirm or deny the common 'myth of displacement' (Ratcliffe 2002), and clearly articulate the implications of camera implementation for not just camera areas (i.e., target areas), but also adjacent areas (i.e., buffer areas) and even the surrounding neighborhoods.

Management plan and organization

This grant is designed to commence in January 2010. The current implementation strategy of the CCTV cameras in Philadelphia, PA, is due to complete installation of 220 cameras well in advance of that time (please see letter from Philadelphia Police Department), however even if there is a delay for a few months, the management plan and timeline are able to cope with a delay. The evaluation methodology is designed to be robust enough and to a level of sophistication that it can still function when cameras come online at different times.

Four staff will be employed on this project; Dr Ratcliffe, Dr Groff and two graduate research assistants from the Department of Criminal Justice at Temple University. Ratcliffe and Groff will lead the project and share administrative and graduate student supervisory responsibilities. This builds some redundancy into the management of the project, and also maximizes the likelihood that the project will be completed on time – no phase is dependent on a single person.

Early tasks involve re-establishing contact and confirming data arrangements with the Philadelphia Police Department, and identifying and interviewing the liaison officers we will work with in all of the police districts where cameras function (up to 25 police districts).

Fieldwork commences early, in the second month of the project, where we visit and map CCTV camera locations, and work at police headquarters and the PPD camera operators to identify viewsheds for cameras. Furthermore, we will liaise with the district officers to confirm or correct the areas chosen to be both target and buffer areas.

Workload will be distributed between Ratcliffe and Groff, each accompanied by a graduate student. This spreads the workload, but it also enables the graduate students to be intimately involved with every aspect of the project. The Department of Criminal Justice at Temple University is regularly ranked in the top 10 of Criminology and Criminal Justice graduate programs, and integration of our graduate students into all of our projects is one way that we mentor future researchers.

Quantitative work commences with pre-implementation data gathering and processing prior to the building of the initial ARIMA time series models of the pre-intervention time series. We will also work with SPSS and ArcGIS to conduct multi-criteria decision making and propensity matching for comparison sites. Much of this work is scheduled for the summer of 2010, when both Ratcliffe and Groff can dedicated their full time activity to these tasks. At the same time, we will continue regularly monthly visits to camera sites (predominantly the work of the graduate students). For safety reasons, researchers will conduct camera site visits of buffer and target zones in pairs.

After completion of the required end of year report, we will complete data gathering for at least one year of post-implementation at every site. These data will feed into the complete ARIMA interrupted time series analysis and we will be able to use comparison analysis with all of the matching sites identified from the propensity matching. With the completion of the Weighted Displacement Quotient analysis we will be in a position to compile the initial evaluation results and report these back to the Philadelphia Police Department and to the city Deputy Mayor for Public Safety by the summer of 2011. We hope that early results will be available by the time of the IACP annual conference, and the NIJ technology day that precedes the conference.

With the initial quantitative findings, we will interview District liaison officers regarding the findings and also interview camera operators regarding the outcomes identified. The final report will be a comprehensive mixed model evaluation (quantitative/qualitative).

Dissemination strategy

The target audience for the findings of this research is crime prevention practitioners, city managers and police officers looking to CCTV to solve their crime problems. As a result, the traditional model of disseminating academic research is largely unhelpful in getting these findings disseminated to the target audience.

However, academic research (both at conferences and in peer-reviewed journals) does provide an opportunity to establish the legitimacy for the research that can then be used to enhance the decisions that city managers make. As a result, we will initially seek to disseminate

the findings on at least one peer-reviewed academic journal article, and at the annual meeting of the American Society of Criminology.

With the reassurance that this academic 'check-up' provides, we will then move to a second dissemination phase that will include publications targeted to the audience we seek. For example, we anticipate being able to submit articles to Law Enforcement Technology magazine, Police Chief magazine, and to attend conferences that are targeted more towards our audience. In this case we anticipate presenting the findings at the Academy of Criminal Justice Sciences conference, and at the National Institute of Justice technology day that precedes the International Association of Chiefs of Police conference.

The nation's city managers are clearly a key specific audience, and we will seek two avenues to spread this research. First we aim to publish an article regarding this research in the Leadership Bulletin of the National Executive Institute Associates, a publication that is copied to graduates of the FBI National Academy and members of both the Major Cities Chiefs' Association and the Major County Sheriffs' Association. Secondly, we will seek to present the findings of our research at the annual conference meeting of the International City/County Management Association, a national body based in Washington DC with a large membership. Their annual meeting for 2011 will be in Wisconsin, and a budget item for this is included.

Finally, we will establish a web site housed at the Department of Criminal Justice web site at Temple University that details the research and contains links to the final report and other publications. This will be a resource for practitioners at towns and cities that are starting the process with a web search. The aim of this is to bring the research and the results to the notice

of people who use web searches as their predominant research tool. The link from the Department of Criminal Justice will ensure that within a few weeks, web search bots will find and catalogue the pages.

Figures

Figure 1. Temple University graduate student Travis Taniguchi (left) works with a detective from the Philadelphia Police Department to establish individual viewpoint parameters for each PTZ camera in the city during the pilot project. Each camera view must be examined to identify obstructions, viewsheds, realistic distance estimates and camera operability constraints.



Figure 2. Target and Buffer areas around three CCTV cameras near Temple University campus, Philadelphia PA. The white cross shows the camera location, while the immediate irregular shaped cross centered on the camera shows that each camera has a distinct and unique viewshed area. The larger heavy line indicates the estimated buffer area, again unique in shape and size to each camera site.



References

- Andersson, J. (2007) 'Foreword', in D.P. Farrington and B.C. Welsh (Eds) *Closed-Circuit Television Surveillance and Crime Prevention* (Stockholm: Swedish National Council for Crime Prevention) pp. 5-6.
- Barr, R. and Pease, K. (1990) 'Crime placement, displacement, and deflection', in M. Tonry and N. Morris (Eds) *Crime and Justice: An Annual Review of Research* (Chicago: University of Chicago Press) pp. 277-318.
- Block, C.R. (1984) 'How to handle seasonality' (Chicago: Illinois Criminal Justice Information Authority).
- Bowers, K.J. and Johnson, S.D. (2003) 'Measuring the geographical displacement and diffusion of benefit effects of crime prevention activity', *Journal of Quantitative Criminology*, 19:3, pp. 275-301.
- Box, G.P. and Jenkins, G.M. (1976) *Time series analysis: forecasting and control* (San Francisco: Holden-Day).
- Brown, B. (1995). CCTV in Town Centres: Three Case Studies. Crime Detection and Prevention Series, Paper 68. London: Home Office.
- Bulwa, D. (2008) 'New criminal justice chief wants cops monitoring cameras' *The San Francisco Chronicle* (San Francisco:
- Chatfield, C. (1989) *The analysis of time series: An introduction* (London: Chapman and Hall).
- Clarke, R.V. and Weisburd, D. (1994) 'Diffusion of crime control benefits', in R.V. Clarke (Ed) *Crime Prevention Studies* (Monsey, NY: Criminal Justice Press) pp. 165-183.
- Cornish, D.B. and Clarke, R.V. (1989) 'Crime specialisation, crime displacement and rational choice theory', in H. Wgener, F. Losel and J. Haisch (Eds) *Criminal Behavior and the Justice System: Psychological Perspectives* (New York: Springer-Verlag) pp. 103-117.
- Degenhardt, L., Conroy, E., Gilmour, S. and Collins, L. (2005) 'The effect of a reduction in heroin supply in Australia upon drug distribution and acquisitive crime', *British Journal of Criminology*, 45:1, pp. 2-24.
- Dehejia, R.H. and Wahba, S. (2002) 'Propensity score-matching methods for nonexperiment causal studies', *The Review of Economics and Statistics*, 84:1, pp. 151-161.
- Eck, J. (1998) 'Preventing crime at places (Chapter 7)' (Washington DC: National Institute of Justice).
- Farrington, D. (2002) 'Methodological quality standards for evaluation research' *Third Annual Jerry Lee Crime Prevention Symposium* (University of Maryland:
- Farrington, D.P. and Welsh, B.C. (2007) 'Closed-Circuit Television Surveillance and Crime Prevention' (Stockholm: Swedish National Council for Crime Prevention).
- Fyfe, N.R. and Bannister, J. (1996) 'City watching: Closed circuit television surveillance in public spaces', *Area*, 28:1, pp. 37-46.
- Gill, M. and Spriggs, A. (2005) 'Assessing the impact of CCTV' (London: Research, Development and Statistics Directorate (Home Office)).
- Green, L. (1995) 'Cleaning up drug hot spots in Oakland, California: The displacement and diffusion effects', *Justice Quarterly*, 12:4, pp. 737-754.

- Greenberg, D. F., & Roush, J. B. (2009) 'The effectiveness of an electronic security management system in a privately owned apartment complex', *Evaluation Review*, 33:1, pp. 3-26.
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. and Kyriakidou, O. (2004) 'Diffusion of innovations in service organizations: Systematic review and recommendations', *The Milbank Quarterly*, 82:4, pp. 581-629.
- Goold, B. J. (2004). *CCTV and Policing: Public Area Surveillance and Police Practices in Britain*. Oxford: Oxford University Press.
- Harada, Y., S. Yonezato, M. Suzuki, T. Shimada, S. Era, and T. Saito (2004). *Examining Crime Prevention Effects of CCTV in Japan*. Paper presented at the American Society of Criminology Annual Meeting, Nov. 17-20, Nashville, Tennessee.
- Hesseling, R. (1994) 'Displacement: A Review of the Empirical Literature', in R.V. Clarke (Ed) *Crime Prevention Studies*, Vol. 3 (Monsey, NY: Criminal Justice Press).
- Honess, T. and Charman, E. (1992) 'Closed circuit television in public places: Its acceptability and perceived effectiveness', Police Research Group: Crime Prevention Unit, Paper No 35, pp. 41.
- Hood, J. (2003). 'Closed Circuit Television Systems: A Failure in Risk Communication?', *Journal of Risk Research* 6:3, pp. 233-251.
- Jankowski, P. (1995) 'Integrating geographical information systems and multiple criteria decision-making methods', *International Journal of Geographical Information Systems*, 9:3, pp. 251-273.
- Klein, A. (2008) 'Cameras Have Cut Violence, Study Says: Skeptics Suspect Crime 'Displacement'' *Washington Post* (Washington DC:
- Krimmel, J.T. and Mele, M. (1998) 'Investigating stolen vehicle dump sites: An interrupted time series quasi experiment', *Policing: An International Journal of Police Strategies & Management*, 21:3, pp. 479-489.
- Langworthy, R.H. (1989) 'Do stings control crime? An evaluation of a police fencing operation', *Justice Quarterly*, 6:1, pp. 27-45.
- Lawton, B.A., Taylor, R.B. and Luongo, A.J. (2005) 'Police officers on drug corners in Philadelphia, drug crime, and violent crime: Intended, diffusion, and displacement Impacts', *Justice Quarterly*, 22:4, pp. 427-451.
- Makkai, T., Ratcliffe, J.H., Veraar, K. and Collins, L. (2004) 'ACT Recidivist Offenders', *Research and Public Policy Series*, 54, pp. 83.
- Mazerolle, L., Hurley, D.C. and Chamlin, M. (2002) 'Social behavior in public space: An analysis of behavioral adaptations to CCTV', *Security Journal*, 15:1, pp. 59-75.
- Mazerolle, L., Rombouts, S. and McBroom, J. (2007) 'The impact of COMPSTAT on reported crime in Queensland', *Policing: An International Journal of Police Strategies & Management*, 30:2, pp. 237-256.
- Pawson, R. and Tilley, N. (1994) 'What works in evaluation research?' *British Journal of Criminology*, 34:3, pp. 291-306.
- Pawson, R. and Tilley, N. (1997) *Realistic Evaluation* (London: Sage).
- Ratcliffe, J.H. (2002) 'Burglary reduction and the myth of displacement', *Trends and Issues in Crime and Criminal Justice*, No. 232, pp. 6.
- Ratcliffe, J.H. (2006) 'Video surveillance of public places' (Washington DC: Center for Problem Oriented Policing).

- Ratcliffe, J.H. (2008) *Intelligence-Led Policing* (Cullompton, Devon: Willan Publishing).
- Ratcliffe, J.H. and Makkai, T. (2004) 'Diffusion of benefits: Evaluating a policing operation', *Trends and Issues in Crime and Criminal Justice*, 278, pp. 1-6.
- Ratcliffe, J.H., Taniguchi, T. & Taylor, R.B. (in press) 'The crime reduction effects of public CCTV cameras: A multi-method spatial approach', *Justice Quarterly*.
- Rosenbaum, P. (1985) *Observational Studies* (New York: Springer Verlag).
- Ross, H.L. (1982) 'Interrupted time series studies of deterrence of drinking and driving', in J. Hagan (Ed) *Deterrence Reconsidered* (Thousand Oaks, CA: Sage) pp. 71-97.
- Sarno, C., M. Hough, and M. Bulos (1999). Developing a Picture of CCTV in Southwark Town Centres: Final Report. London: Criminal Policy Research Unit, South Bank University.
- Sherman, L.W., Gottfredson, D., MacKenzie, D., Eck, J., Reuter, P. and Bushway, S. (1998) 'Preventing Crime: What works, what doesn't, what's promising' (Washington DC: National Institute of Justice).
- Sivarajasingam, V., J. P. Shepherd, and K. Matthews (2003). "Effect of Urban Closed Circuit Television on Assault Injury and Violence Detection." *Injury Prevention* 9(4):312-316.
- Squires, P. (2003). An Independent Evaluation of the Installation of CCTV Cameras for Crime Prevention in the Whitehawk Estate, Brighton. Brighton (United Kingdom): Health and Social Policy Research Centre.
- Tita, G.E., Cohen, J. and Engberg, J. (2005) 'An ecological study of the location of gang "Set Space"', *Social Problems*, 52:2, pp. 272-299.
- Weisburd, D. and Green, L. (1995) 'Measuring immediate spatial displacement: methodological issues and problems', in J.E. Eck and D. Weisburd (Eds) *Crime and Place* (Monsey, NY: Criminal Justice Press) pp. 349-361.
- Weisburd, D., Wyckoff, L.A., Ready, J., Eck, J., Hinkle, J.C. and Gajewski, F. (2006) 'Does crime just move around the corner? A controlled study of spatial diffusion and diffusion of crime control benefits', *Criminology*, 44:3, pp. 549-591.
- Yaffee, R.A. and McGee, M. (2000) *Introduction to Time Series Analysis and Forecasting* (San Diego, CA: Academic Press).

Other application requirements

Data archiving strategy

We intend to utilize an archiving strategy that both enables replication of the study at some future point, while retaining the vital requirement of masking and not retaining or recording the individual details of crime victims or survey respondents. An additional requirement is ease of data retrieval. We therefore seek a strategy that combines ease of retrieval with data storage or aggregate crime data and de-identified survey and interview responses.

We will archive the ArcGIS (ESRI) shapefiles for each camera target area, buffer area and control area in the standard Pennsylvania south projected coordinate system. We will then retain an Excel spreadsheet with individual tabs identifying camera areas and a standard flat-file row/column database with monthly counts of crime frequency for the various crime types examined in this study (violent, property, disorder, all crime). Crime counts will be aggregated by count across all camera sites from 2004 to the end of the project. A simple numeric identifier will link crime frequency counts to shapefiles. This will enable external oversight and replication, while still retaining the project aims of simple retrieval.

Interview data will be retained as contemporaneous notes, redacted to remove any identifying information or personal identifiers. The only linking information will be an interviewee identifier that is in both final report and in the archived interview notes.

List of key personnel

Dr Jerry H. Ratcliffe

Professor, Department of Criminal Justice, Temple University, Philadelphia PA.

Dr Elizabeth Groff

Assistant Professor, Department of Criminal Justice, Temple University, Philadelphia, PA.

Résumés of key personnel

Jerry Ratcliffe

Dr Jerry Ratcliffe is Professor of Criminal Justice with the Department of Criminal Justice, Temple University, Philadelphia. In a previous life he was a police officer with the Metropolitan Police in London (UK) where he served for a number of years on patrol duties, in an intelligence and information unit, and as a member of the Diplomatic Protection Group. Due to a severe winter mountaineering accident while ice climbing in the Scottish Highlands, he left the police after 11 years of service. He completed a B.Sc. with honors in Geography and GIS at the University of Nottingham (UK) and has a Ph.D. from the same institution.

As a lecturer in policing (intelligence) with Charles Sturt University based at the New South Wales Police College in Australia, he ran graduate programs in criminal intelligence, and for a number of years coordinated Australia's National Strategic Intelligence Course. Dr Ratcliffe was also a senior research analyst with the Australian Institute of Criminology, where he conducted one of the first evaluations of an intelligence-led policing operation. In 2007, Dr Ratcliffe was awarded the Professional Service Award for outstanding contributions to criminal intelligence analysis by the International Association of Law Enforcement Intelligence Analysts (IALEIA).

He has published over 50 research articles and four books including: **'Strategic Thinking in Criminal Intelligence'** (Federation Press, 2004, second edition 2009); **'GIS and Crime Mapping'** (Wiley, 2005) and **'Policing Illegal Drug Markets'** (Criminal Justice Press, 2005). His most recent book, **'Intelligence-Led Policing'** was published by Willan Publishing in March 2008. Recent research articles have examined shooting patterns in Philadelphia, street corner drug dealing in Camden, NJ, and drug gang investigations by the New Jersey State Police.

Of particular relevance to this research project, is that Professor Ratcliffe is author of the (COPS Office) Center for Problem-Oriented Policing's response guide, **Video Surveillance of Public Spaces**. This report combined a meta-analysis of the available literature on CCTV with a practitioner's guide. The report-writing process identified a lack of quality CCTV evaluations, that this proposed project is an attempt to rectify.

A full resume with publications is available on request (but not included in this application as with publications and conference presentations it runs to more than 20 pages), or online at www.jratcliffe.net.

Elizabeth Groff

Dr Elizabeth Groff joined the Temple University Department of Criminal Justice in August 2007. Prior to joining the Criminal Justice Department, Dr. Groff was from 2002 to 2007 a Senior Research Associate at the Institute for Law and Justice (ILJ). From 1998-2002 she was a Social Science Analyst at the National Institute of Justice's Crime Mapping Research Center. She has

also been the GIS Coordinator for the Charlotte-Mecklenburg Police Department in Charlotte, NC. Dr. Groff received her B.S. and M.A. degrees in geography from the University of North Carolina at Charlotte and Ph.D. in geography from the University of Maryland at College Park. She also has an M.A. in criminology and criminal justice from the University of Maryland at College Park.

Dr. Groff's primary research interests are in crime and place; modeling geographical influences on human activity; agent-based modeling as a methodology; crime prevention; and policing. Her current research projects include: (1) a micro level longitudinal study of crime in Seattle, Washington with Dr. David Weisburd and Dr. Sue-Ming Yang; (2) exploring the use of simulation models for understanding street robbery and testing theory; (3) examining the impacts of technology acquisitions in law enforcement agencies with Dr. Tom McEwen; and (4) a micro level longitudinal study of the place characteristics related to where juveniles commit crime in Seattle, Washington with Dr. David Weisburd and Dr. Nancy Morris.

Journal Publications:

- Groff, E. R. (2008). Adding the Temporal and Spatial Aspects of Routine Activities: A Further Test of Routine Activity Theory. *Security Journal*, 21(1-2): 95-116.
- Groff, E. R. 2007. 'Situating' Simulation to Model Human Spatio-Temporal Interactions: An Example Using Crime Events. *Transactions in GIS*, 11(4):507-530.
- Groff, E. R. 2007. "Simulation for Theory Testing and Experimentation: An Example Using Routine Activity Theory and Street Robbery." *Journal of Quantitative Criminology* 23:75-103.
- Groff, E. R. and T. McEwen. 2007. "Integrating Distance Into Mobility Triangle Typologies." *Social Science Computer Review* 25:210-238.
- Groff, E.R., B. Kearley, P. Beatty, H. Fogg, H. Couture, and J. Wartell. 2005. "A Randomized Experimental Study of Sharing Crime Data with Citizens: Do Maps Produce More Fear?" *Journal of Experimental Criminology* 1:87-115.
- Beckman, K., L. Wyckoff, E.R. Groff, and P. Beatty. 2004. "Trends in Police Research: A Cross-sectional Analysis of the 2001 Literature," *Police Practice and Research* 5 (2): 165-189, 2004.
- Groff, E.R., and N.G. La Vigne. 2001. "Mapping an Opportunity Surface of Residential Burglary," *Journal of Research in Crime and Delinquency* 38 (3):257-278.

Book Chapters:

- Groff, E. R., D. Weisburd and N. Morris (Forthcoming 2008). Where the Action is at Places: Examining Spatio-Temporal Patterns of Juvenile Crime at Places Using Trajectory Analysis and GIS. In D. Weisburd, W. Bernasco and G. Bruinsma (eds), *Putting Crime in its Place: Units of Analysis in Spatial Crime Research*. Springer-Verlag.
- Groff, E. R. 2008. Characterizing the Spatio-Temporal Aspects of Routine Activities and the Geographic Distribution of Street Robbery. In L. Liu & J. Eck (Eds.), *Artificial Crime*

Analysis Systems: Using Computer Simulations and Geographic Information Systems.
Idea Group: Hershey, PA.

Groff, E.R., and T. McEwen. 2005. "Disaggregating the Journey to Homicide." In F. Wang (ed.),
Geographic Information Systems and Crime Analysis. Idea Group: Hershey, PA.

Groff, E.R., and N.G. LaVigne. 2002. "Forecasting the Future of Predictive Crime Mapping." In N.
Tilley (ed.), Analysis for Crime Prevention (Vol. 13, pp. 29-58). Criminal Justice Press:
Monsey, NY.

Groff, E.R., and N.G. La Vigne. 2001. "Evolution of Crime Mapping in the United States: From
the Descriptive to the Analytic." In A. Hirschfield and K. Bowers (eds), Mapping and
Analysing Crime Data: Lessons From Research And Practice (pp. 203-221). Taylor and
Francis: New York.

List of previous and current NIJ awards

Principal investigator, **Ratcliffe, JH**, "*A stand-alone application to detect the near repeat phenomenon in local and regional crime data*", National Institute of Justice 2006-07, grant number 2006-IJ-CX-K006, \$95,350.

Co-Principal investigator, Rengert, GF and **Ratcliffe, JH**, "*Geographic Tools to Improve Officer Safety in Correctional Institutions*". National Institute of Justice grant 2002-05, grant number 2002-MU-MU-0016, \$397,394.

Co-Principal Investigator, Weisburd, DL, **Groff, ER** and Jones, G, "*Smart Police Deployment: Evaluating the Use of Automated Vehicle Locator Technologies in Policing*." National Institute of Justice grant 2007-2009, grant number 2007-IJ-CX-K153, \$235,421.

Principal Investigator, **Groff, ER**, "*Modeling the Dynamics of Street Robbery to Inform Policy and Prevention*." National Institute of Justice grant 2005-2008, grant number 2005-IJ-CX-0015, \$141,163.

Co-Principal Investigator, Weisburd, DL, **Groff, ER**, "*Explaining Developmental Crime Trajectories at Places: A Study of 'Crime Waves' and 'Crime Drops' at Micro Units of Geography*." National Institute of Justice grant 2005 – 2008, grant number 2005-IJ-CX-0006, \$271,882.

Co-Principal Investigator, McEwen, T and **Groff, ER**, "*Distance to Crime: Analyzing and Mapping Violent Crime*." National Institute of Justice grant 2003 – 2006, grant number 2003-IJ-CX-0150, \$100,487.

Letter of cooperation/support from the Philadelphia Police Department

See next two pages



CITY OF PHILADELPHIA

POLICE DEPARTMENT
HEADQUARTERS, FRANKLIN SQUARE
PHILADELPHIA, PA 19106

CHARLES H. RAMSEY
Commissioner

U.S. Department of Justice
Office of Justice Programs
National Institute of Justice
810 Seventh Street NW
Washington D.C. 20531

March 31, 2009

The Philadelphia Police Department is delighted to strongly support and offers our full cooperation to the grant application from Dr Jerry Ratcliffe, titled 'A Micro-Spatial Evaluation of CCTV'. The city government's enthusiasm for an expansion of our pilot program has survived two administrations, and as a result we are now rolling out what we think is one of the biggest CCTV programs in the country. We are currently working to complete the implementation of our planned 220 cameras by the end of June 2009. We have also completed the construction of the CCTV monitoring location here at Police Headquarters, and have personnel currently operating in the room monitoring both the pilot cameras that were evaluated by Dr. Ratcliffe earlier last year as well as our expanding network of new cameras.

The pilot study conducted by Dr. Ratcliffe and his graduate student has been vital in providing an evidential base for moving forward with our camera expansion, however we are spending millions of dollars and the findings from this proposed project are essential in assessing the value or not of our continued investment in the program. I'm pleased to see that the proposed grant will not only evaluate crime, but also the on-the-ground conditions that could make-or-break the value of a CCTV camera. We are relatively new to CCTV cameras (like most of the country) so the proposal to interview camera operators and district personnel is an ideal way to determine how a camera system works in practice as opposed to in theory.

To confirm our commitment, we will provide:

- Geocoded point-specific crime data for all UCR part 1 and part 2 incidents in the city of Philadelphia from 2004 until the completion of the project timeline.
- We will work with Jerry Ratcliffe to identify street officers in each district where cameras operate to act as local liaison officers to the camera evaluation project, and we will provide access to the CCTV control room so that the research team can interview camera operators and work with them to get sightlines for cameras.

• With notice, we will make senior personnel available for interview at the close of the project so that the final report can include a senior team perspective on the camera project.

We do reserve the right to view and comment on any publications at least 14 days prior to submission to any external agency for publication, and a requirement of our cooperation is the continuation (revised where necessary) of the data protection agreement that is already in place between Dr Ratcliffe and Temple University, and the police department. We will allow our data to be archived for future research purposes; however we will only permit aggregate data to be released for archiving purposes, data that do not permit the identification of any crime victim or individual housing unit or location.

Sincerely Yours,


Deputy Police Commissioner

CLARIFICATION ON GRADUATE STUDENT TUITION

In the original application, we budgeted for \$43,176 of graduate student tuition to support our graduate research assistants. Since that time, Temple University has clarified the tuition rates for the forthcoming year. In light of that, our revised calculation is as follows:

Graduate student tuition per credit hour is set at \$590 for in-state students and \$861 for out of state (see College of Liberal Arts figures at <http://www.temple.edu/bursar/about/tuitionrates.htm>). We budgeted on the lower rate.

Temple graduate classes are three credit hours per class, therefore each class is $3 \times 590 = 1770$.

We support them up to three classes per semester, therefore each semester $3 \times 1770 = 5310$.

There are two semesters per year = $2 \times 5310 = 10,620$ per year per student.

There are two students allocated to the project therefore year 1 cost is $2 \times 10,620 = 21,240$.

We are unable to predict the likely increase in tuition given the current financial climate; however a conservative estimate of a 3% rise in tuition costs for the second year of the project would increase the year two tuition from $21,240 \times 1.03 = 21,877$.

Adding year one and the year two projection results in $21,240 + 21,877 = \mathbf{43,117}$.