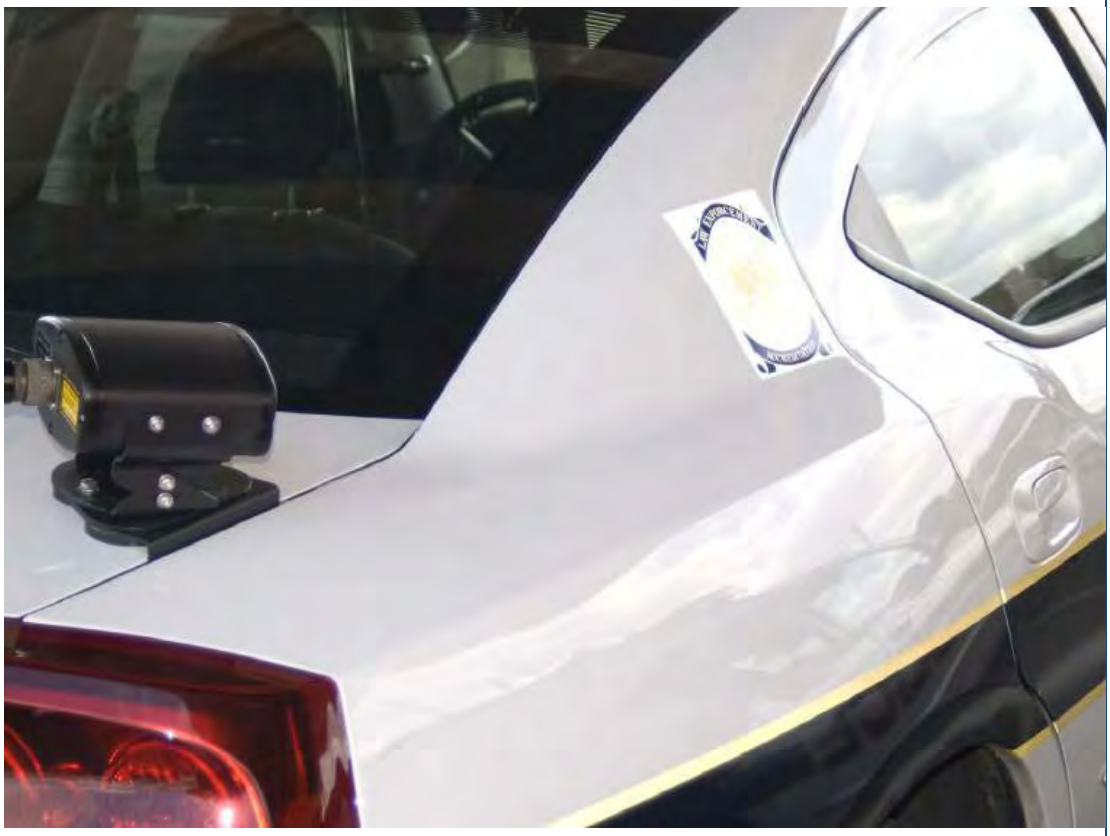
LICENSE PLATE RECOGNITION TECHNOLOGY (LPR)

IMPACT EVALUATION AND COMMUNITY ASSESSMENT



SPAWAR SYSTEMS CENTER ATLANTIC

GEORGE MASON UNIVERSITY

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FINAL REPORT

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LICENSE PLATE RECOGNITION TECHNOLOGY (LPR)

IMPACT EVALUATION AND COMMUNITY ASSESSMENT

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LICENSE PLATE RECOGNITION TECHNOLOGY PROJECT

The Project

George Mason University's Center for Evidence-Based Crime Policy was tasked by SPAWAR and the National Institute of Justice to carry out three tasks to strengthen the evidence base of license plate recognition (LPR) technology. These tasks included (1) determining the extent of LPR use across the United States, (2) evaluating the deterrent effect of LPR on crime, and (3) providing an understanding of LPR's potential impact on communities. Towards these goals, we conducted three studies for this project: (1) a random-sample survey of large and small law enforcement agencies across the U.S.; (2) a two-jurisdiction randomized controlled experiment evaluating the specific and general deterrent effects of LPR patrols on crime; and (3) a random-sample community experimental survey and legal assessment of the effects of LPR on citizen perceptions and beliefs about law enforcement's use of LPR.

The Locations of Study

The national survey included agencies across the United States. The locations used for the experimental studies were Alexandria City and Fairfax County, Virginia, two adjacent jurisdictions both located within the Washington DC Metropolitan area. The police agencies of each contributed their staff, expertise, and time to this project. Their collective experience and cooperation made this research project a success.

The Findings

The GMU Research Team discovered that LPR technology is rapidly diffusing into U.S. law enforcement. Over a third of large police agencies have already adopted LPR, and many are on their way to acquiring the technology. However, we also discovered this rapid adoption is occurring in a low-information environment; the evidence-base for the effectiveness and effects of LPR is weak. Indeed, only one other rigorous evaluation, conducted by colleagues at the Police Executive Research Forum (PERF) has ever been conducted on LPR technology, and very few agencies have engaged in any type of assessment of this technology. Further, we discovered a relative dearth of empirical information about the realities of community concerns with LPR.

Our randomized controlled experiment mirrored the findings from the PERF experiments in that the use of LPR in autotheft hot spots does not appear to result in a reduction of crime generally or autotheft specifically, during the period of time measured. This may be due to the intensity of the patrols during the experiment, which were limited by resources and shift constraints, or the base of data in which the LPR units accessed. However, the findings may also provide a true indication of the crime prevention effectiveness of LPR in crime

hot spots, and therefore, more testing of different applications and broader uses of data are warranted.

Finally, in our community assessment and legal analysis, we tested various perceptions and receptivity to uses of LPR by introducing a number of potential applications of the technology in searching for specific types of crime as well as collecting, storing, and sharing data. We discovered that concerns about LPR were not singular, but could vary depending upon the uses and connotations behind various uses. We suggest that exploring a *continuum of LPR use* may be a fruitful way for researchers to develop and test hypotheses about this and other police technologies.

The Products

Two major products were created from this study. The first is the Final Report, which includes four chapters that detail the process of our evaluations and assessments as well as the findings from each study.

In addition to this final report, we present to the law enforcement community the **LPR Web Portal**, located at http://gemini.gmu.edu/cebcp/LPR/index.html . The goal of the LPR Web Portal reflects the mission of the Center for Evidence-Based Crime Policy at GMU more generally: to provide law enforcement agencies and the communities they serve with information, research and analytic guidance about how LPR units can be deployed in more effective ***and*** legitimate ways. Various parts of this final report are deconstructed into the portal, and a variety of videos, deployment guides, and links to other evidence-based policing resources are provided. The portal is divided into sections specific to officer deployment, police leadership, community policing, crime analysis, and evaluation research.

The Team

The George Mason University LPR study was conducted by Dr. Cynthia Lum (Principal Investigator), Dr. Linda Merola (co-PI), Julie Willis and Breanne Cave (Research Assistants). Providing expertise to the team were the command and patrol staffs of the Alexandria and Fairfax County Police Departments, Matt Snyder and Joey Pomperada (SPAWAR), Dr. Bruce Taylor (National Opinion Research Center of the University of Chicago), Dr. Christopher Koper (Police Executive Research Forum), Dr. Devon Johnson and Ms. Naida Kuruvilla (George Mason University), Julie Wan (copyeditor), and Jason Lutjen (Slonky, Associates). For further information, please contact the CEBCP at cebcp@gmu.edu .

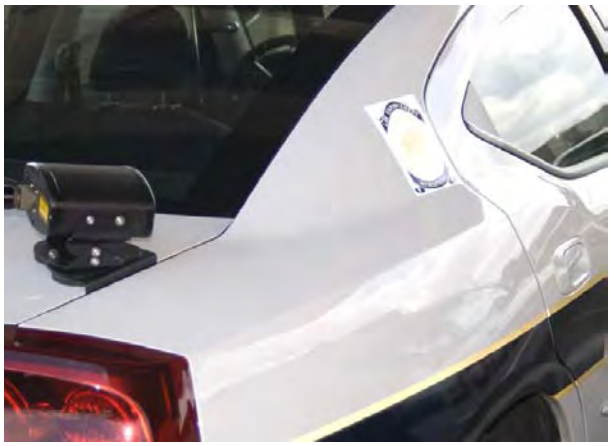
LICENSE PLATE RECOGNITION (LPR) TECHNOLOGY

IMPACT EVALUATION AND COMMUNITY ASSESSMENT FOR LAW ENFORCEMENT

1. DOES LICENSE PLATE TECHNOLOGY "WORK"?

Overview: *George Mason University's Center for Evidence-Based Crime Policy was tasked by SPAWAR and the National Institute of Justice to carry out three tasks to strengthen the evidence base of license plate recognition (LPR) technology. These tasks included (1) determining the extent of LPR use across the United States, (2) evaluating the deterrent effect of LPR on crime, and (3) providing an understanding of LPR's potential impact on communities. As an introduction, this chapter emphasizes the importance of building this evidence base and of the need for police departments to differentiate between "efficiency" and "effectiveness" in evaluating the capabilities of any technology to help reduce crime.*

LPR Technology

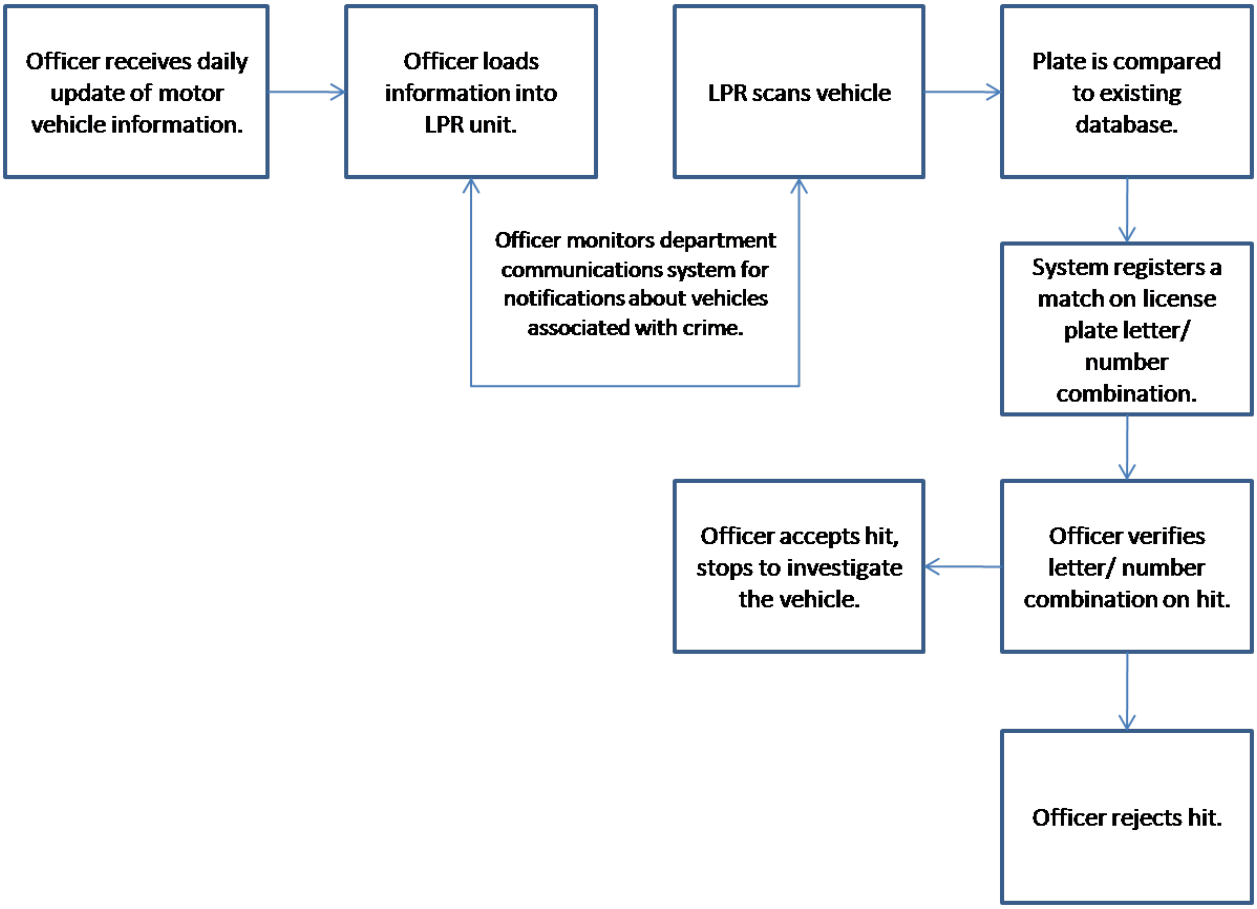


As an operational tool for law enforcement, the license plate reader is a straightforward and easily understood piece of sensory technology (Figure 1.1). LPRs scan the license plates of moving or parked vehicles and can do so while either mounted on a moving patrol car or attached to a fixed location, such as a toll plaza. Once a plate is scanned and its alphanumeric pattern is read by the LPR system, the technology compares the license plate against an existing database of plates that are of interest to law enforcement. Plates "of interest", for example, might include those on vehicles which have been recently stolen, or whose registered owners have open warrants. When a match is made, a signal alerts the officer to proceed with further confirmation, investigation and action. Hundreds of cars can be scanned and checked in very short periods of time.

LPR technology thereby automates a process that, in the past, was conducted manually, slowly, tag-by-tag, and with much discretion. In this manual approach, officers would see a car that appeared suspicious and provide the dispatcher with the plate number, who

would check the plate against a database such as National Crime Information Center (NCIC) to see whether the vehicle was stolen. The dispatcher would then radio the officer back with the status of the vehicle. LPRs replace this ad-hoc, tag-by-tag approach with an automated and speedy system.

Figure 1.1: Using License Plate Readers—A Simple Process



In addition to their quick scanning and matching capabilities, LPR is, in a broader sense, an information technology system. These systems can collect and store large amounts of data (plates, dates, times, and locations of vehicles) for future record management, analysis, and dataset linking. For example, license plates collected by a reader mounted on a toll plaza might be stored and then accessed in the future to confirm a suspect's alibi or whereabouts at a particular date and time. Data might also be used for predictive purposes. For instance, LPR units could be used to scan and record vehicular activity in front of high-risk locations. Unusual patterns of traffic by one or multiple vehicles that emerge from analyzing collected data might alert agencies to a heightened risk or concern. In theory, with enough saved LPR data, longitudinal information related to places and individuals could be constructed over time. In one case of a missing Alzheimer's

patient in the Washington DC area, police were able to locate the person using recent scans from LPR data of his vehicle. LPRs, as information technologies, also have the capability to encourage interagency data sharing.

Because of the sheer volume of tags that LPR can scan in minutes and because of its information technology capabilities, LPR, in theory, can act as a force multiplier to many crime prevention and homeland security efforts. However, the effective use of LPR is primarily limited by three factors: the system's ability to read license plates accurately, the quality and relevance of the data accessed by LPR to compare with scanned plates, and the way in which police departments deploy the machines. Thus, it follows that improvements and refinements in scanning, data access, and police deployment strategies could potentially improve LPR's effectiveness in controlling and preventing crime. At the same time, as with many other police tactics, advances in each of these functions can challenge other equally important facets of policing. These might include legal concerns about how long data can be stored, to what extent data might be mined, the balancing of values of privacy with security, and the broader concern of police legitimacy within communities.

The Current State of the Research Evidence on LPR Technology

Although a wide variety of agencies use license plate recognition technology, only one outcome evaluation measuring its effect on reducing crime has been conducted prior to this study. This evaluation was conducted by the Police Executive Research Forum (Taylor, Koper and Woods, 2010). The more common types of LPR research have focused on the function of the technology itself — its effectiveness in scanning license plates and detecting for stolen automobiles in various settings, such as highways, parking lots, or toll booths (e.g., see Maryland State Highway Authority 2005); comparisons of brands of LPR technology; or counts of misreads or other system errors. Nonetheless, as Bateson (2009) states and as Taylor et al. (2010) demonstrate, LPR technology is amenable to quantitative, experimental evaluation. LPR can serve a constructive function in finding stolen autos, which may lead to more frequent arrests of auto thieves and ultimately to deterrence of auto theft, if used with sufficient frequency.

The U.K. has been at the forefront of the funding, use, and evaluation of "ANPR" (automatic number plate recognition) technology in policing. From 2003 to 2007, a series of evaluations of ANPR were published by the Home Office and PA Consulting Group. These studies tracked the efficiency of LPR in increasing the recovery of stolen vehicles and goods, as well as increasing drug and weapon seizures. Results from the pilot and follow-up studies indicated that license plate readers significantly enhanced the ability of officers to make arrests, particularly when officers were dedicated specifically to a specially-designed ANPR unit, but any change in rates of crime that resulted from these increased

arrest rates was not documented (PA Consulting Group, 2003, 2004; Police Standards Unit, 2007).

"…despite the undisputed advantage of LPR being more efficient and perhaps even fairer than manual approaches, the question still remains as to whether this technology is more *effective* in reducing or preventing crime."

Three assessments of LPR technology in policing contexts have occurred in North America. In 2005, the Ohio State Highway Patrol conducted a four-month evaluation of plate reader technology to determine the effectiveness of LPR in the detection of stolen vehicles and stolen vehicle plates in highway and turnpike systems and to assist with development of Homeland Security programs (Ohio State Highway Patrol, 2005). In that study, the use of LPR increased stolen vehicle recoveries and arrests compared to the previous year. Another study analyzed data concerning the rates of "hits" (scanned plates that matched a hot list or database) for uninsured, prohibited, unlicensed, or stolen vehicle drivers (Cohen, Plecas, & McCormick, 2007). The research team found that no matter where LPR units were placed, more hits were associated with more scans per patrol.

Most recently, the Police Executive Research Forum (PERF) conducted the first rigorous evaluation of the crime reduction outcome effectiveness of license plate readers using a randomized controlled experiment in Mesa, Arizona (Taylor, Koper and Woods, 2010). The PERF researchers measured the effect of LPR systems on rates of vehicle theft along "hot routes" or traffic corridors that were suspected of having a high rate of auto theft traffic. The findings suggest that, while LPR technology significantly enhances rates of license plates "reads", the number of plates scanned in and of itself does not predict a reduction of vehicle theft rates.

Efficiency Does Not Equal Effectiveness

The existing research on LPRs, with the exception of the experimental evaluation conducted by PERF, assesses the *efficiency* of LPR units (speed in scanning and detecting), not necessarily its effectiveness in reducing crime. Indeed, increased stops, arrests, and recoveries related to vehicle crimes may not lead to measurable crime reduction effects, just as increases in drug or gun seizures, for example, may not lead to reduction in drug distribution/use or gun crimes. In police evaluation research, this distinction between implementation efficiencies and outcome effectiveness is crucial, precisely because the second does not naturally follow from the first.

For example, with regard to efficiency of scanning, while there may be differences across vendors, there is little question that license plate readers are more efficient than previous (and, in many cases, current) police practices for checking license plates. Two common approaches have included the officer "ad-hoc" investigation and the "look-out lists"

approach. The ad-hoc approach involves officers finding out more about the automobile and its driver by visually reading a plate from their patrol car or a fixed location and then calling dispatch on the radio, or else running the plate on their mobile terminals. The decision regarding which vehicles to investigate involves some combination of officer discretion, intuition, and memory of all-points-bulletins. Similarly, the "look-out lists" approach is one in which officers are given a list of recently stolen tags, automobiles, and other vehicles of interest and asked to "look out" for tags that appear on that list. Again, officer discretion is a major factor in this tactic; officers can choose when to look at the list and when to focus their attention on passing vehicles.

Both of these approaches stand in stark contrast to the more efficient and less discretion-oriented usage of LPR units. LPR can mimic these ad-hoc and lookout list approaches with greater speed, more efficiency and, perhaps most importantly, less reliance on individual discretion, which can be prone to bias. License plate readers can continuously scan hundreds of plates in minutes without the officer paying attention to vehicles passing by or taking up radio airtime that might be used for more pressing communications. Because of these efficiencies, LPR may contribute not only to reduced discrimination in traffic stops, but also to reduced distractions and accidents while driving.

"…the technology has often not been used in ways that could lead to effective crime reduction. The strong culture of reactivity and reliance upon case-by-case approaches in policing can act as a distorting filter thwarting the effective use of technological innovations…"

However, despite the undisputed advantages of LPR being more efficient and perhaps even fairer than manual approaches, the question still remains as to whether this technology is more *effective* in reducing, preventing, or even detecting crime. Especially with law enforcement technologies, efficiency is often mistakenly interpreted as effectiveness, which can perpetuate a false sense of security and a mythology that crime prevention or progress is occurring (Lum, 2010). Further, especially in the case of license plate readers, efficiency may not be significantly connected to effectiveness. The most accurate license plate readers might be used by law enforcement officials in ways that have no specific or general deterrent, preventative, or detection effect whatsoever. Some have even argued that if LPRs can at least reactively catch a car thief, then it does not matter what its crime deterrent effect might be. At $20,000 to $25,000 per unit, such assertions seem, at best, naïve and, at worst, very expensive.

The problems caused by equating efficiency and effectiveness in police technology cannot be overstated. Many advances in police technology have not been shown to be used effectively. More discouragingly, such "advances" have further solidified reactive, case-by-case, random, and ad-hoc policing approaches which do not facilitate crime

prevention. One example is computer-aided dispatch, or CAD/911 technologies. CAD/911 was widely adopted by police across the world to improve the police response to crime and, in turn, the satisfaction of the public. We now realize that, although 911 systems have improved police response time and the reporting of incidents, their use may not necessarily be connected to increased crime prevention or even improvements in police legitimacy[1] (National Research Council, 2004; Spelman & Brown, 1981; Sherman et al. 2002).

Another example of the confusion between efficiency and effectiveness is in the use of crime-mapping technology. Despite the rapid and recent diffusion of computerized crime mapping as a law-enforcement innovation (Weisburd & Lum, 2005) and despite the strong evidence that hot-spot policing using such maps will reduce crime (National Research Council, 2004; Sherman & Weisburd, 1995; Weisburd & Eck, 2004; Braga, 2005), police continue to allocate patrol in a manner unrelated to the concentration of crime at places (Weisburd, 2008). As with 911 and LPR, the efficiency of computerized crime-mapping over hand-mapping is clear. Yet, the technology has often not been used in ways that could lead to effective crime reduction. The strong culture of reactivity and reliance upon case-by-case approaches in policing can act as a distorting filter, thwarting the effective use of technological innovations (Lum, 2010).

This difference between efficiency and effectiveness has resulted in two types of evaluations of LPR technology, as mentioned previously. These include evaluations which assess (1) whether LPR physically and mechanically does what it is supposed to do (for example, how accurately and quickly it scans, reads, and matches license plates); and (2) whether the use of LPR actually results in greater detection and deterrence for preventing and reducing crime. The first is the more common technical research available on LPR (see Cohen, Plecas, & McCormick, 2007; Maryland State Highway Authority, 2005; Ohio State Highway Patrol, 2005; PA Consulting Group, 2003, 2004; Home Office, 2007). Outcomes measured might include the number of plates accurately scanned within an hour, the number of accurate "hits," or even the number of arrests made by LPR units. These and other internal assessments within police agencies are largely concerned with how accurate and quickly the technology works compared to the previous manual, tag-by-tag approach.

This type of evaluation also focuses on detections as an important crime measure of the success of LPR. However, what is often measured is the number of detections made, rather than whether an increase in detections had a preventative or deterrent effect. Arrests and detections using LPR may increase, but actual auto thefts might also increase and at greater rates. Placing LPRs in hot spots of crime may also lead to more detections, but the

[1] In fact, as Tyler (1990) and Tyler and Huo (2002) suggest, police legitimacy may be more successfully derived from procedural actions (how a person is treated, how a case is dealt with) than with more mechanical distributive justice as implicated by 911 systems (whether the case was responded to quickly or in a similar manner to other cases).

question then becomes, "as compared to what?" Placing a specialized unit in a hot spot may also increase detection rates without the use of LPR units, simply because the probability of detection is higher, no matter the mechanism used.

Unlike these assessments of LPR's efficiencies, there have been no evaluations of the effectiveness of LPR on crime outcomes until very recently. Currently, only one other study exists, which this project partially replicates. This is the experimental evaluation conducted by colleagues at the Police Executive Research Forum (see Taylor, Koper and Woods, 2010). In that randomized controlled trial, also funded by the National Institute of Justice, the authors examined both the efficiency of LPR units and their crime control effectiveness compared to other approaches. More on the PERF studies will be discussed in Chapter 3.

The Need for Evidence, Evaluation, and Leadership

The current George Mason University evaluation seeks to add to the evidence base regarding how LPRs, if used, can be more effectively deployed for crime prevention *and* without reducing police legitimacy. This effort is crucial, as LPR technology is rapidly diffusing into law enforcement without regard for the existence or need of such evidence. In 2007, even prior to any evidence of the effectiveness of LPR on crime, the International Association of Chiefs of Police set forth a resolution promoting the use of LPR and supporting its purchase through federal legislation and with federal funds. In 2008, the Department of Homeland Security Urban Area Security Initiative (UASI)[2] did just that, and, in Northern Virginia and the District of Columbia alone, $4.4 million was allocated for jurisdictions to acquire LPR (Virginia Department of Emergency Management, 2008). Our national random sample survey of police agencies, conducted for this project (Chapter 2), confirms this rapid adoption. Even before these trends in the United States, such diffusion had been seen in the United Kingdom (PA Consulting Group, 2004; Home Office, 2007).

This rapid diffusion within an environment of little information, yet complex and competing agendas regarding its use, necessitates a leadership role for both early adopters and entities such as the National Institute of Justice. The determination of ways in which this technology may be used to detect and reduce crime effectively, cost-effectively, and fairly are core concerns in democratic policing. The National Institute of Justice, and those who conduct research for it, can provide structured information to law enforcement agencies with regard to addressing and promoting discourse and awareness about common challenges and concerns about LPR systems, as well as guiding agencies toward more optimal crime control implementation of these systems. Currently, such guidance is coming from vendors themselves, who tend to focus on the efficiencies of LPR rather than

[2] In a recent report by *USA Today*, a spokesperson for ELSAG, one of the major manufacturers of LPR systems, estimated that approximately 40 agencies in the DC metropolitan are using LPR systems (see Hughes, 2010).

operational effectiveness and its effects on communities. However, law enforcement agencies need the following information to optimize their use and decisions regarding LPR:

- empirical knowledge about effective policing tactics and strategies generally, and for LPR technology, specifically,
- knowledge that is derived from high quality field experiments, action research and demonstrations, and
- a mechanism by which such information can be translated and disseminated, such as the GMU LPR web portal (see http://gemini.gmu.edu/cebcp/LPR/index.html).

Building the Evidence-Base for LPR Technology

The goal of this project is to add to and strengthen the evidence base for LPR in these ways. Building this evidence base requires more rigorous impact evaluations, such as field experiments. Such evaluations have two positive effects. The first and most obvious is an increased understanding of the connection between LPR use and crime control. Related to this, these studies will also provide law enforcement officials with better information regarding *how and where* technologies like LPRs should be deployed in order to optimize the prevention of crime.

In building this evidence base, a number of issues should be considered. First, the deterrent effect of LPR on crime depends on the data that is loaded into LPR units. If the data is limited only to license plates connected to auto thefts or within a specific jurisdiction, then LPR's deterrent capability will likely also be limited to this particular crime or area. If the data is only updated once a day (as opposed to automatically), then the crime control effect of LPR is limited to those autos that were reported stolen prior to the last update (the previous night). When the source of data used by the LPR is expanded and connected to other types of information about individuals (such as open warrants, court orders, sex offender registries, repeat offender databases, and the like) the deterrent effects of LPR technology may increase. However, this expansion may also lead to heightened concerns about the legality of LPR use and also the effect its use has on police legitimacy in the eyes of the community (see Chapter 4). All of these questions can be tested empirically.

In addition to the quality and quantity of data used by LPR systems, the effectiveness of LPR also depends on how the technology is deployed. Field experiments and evaluation

tests of various deployment approaches can illuminate the tactics that optimize the effective use of LPR. For example, we know from the Evidence-Based Policing Matrix (Lum, Koper and Telep, 2009)[3] that targeted efforts at very small geographic units using proactive and focused strategies based on data analysis are much more effective than reactive strategies that focus on individuals. A number of studies have already discovered that crime concentrates at small places (see Sherman et al., 1989; Sherman and Weisburd, 1995; Weisburd et al., 2004). Further, the concentration of auto theft has also been repeatedly shown (Henry and Bryan, 2000; Kennedy 1980; Plouffe and Sampson, 2004; Rengert, 1996; Rice and Smith, 2002). Thus, an evidence-based strategy for the most effective use of LPR systems is one in which LPRs are deployed in locations where the probability of passing a stolen automobile or wanted individual connected to a license plate is very high.

Additionally, hot spots deployment can be enhanced by the Koper Curve Principle. Koper (1995) found that the returns on deterrence could begin diminishing after a short period of time (e.g., 15 minutes). Thus, the deployment of LPR units in crime hot spots for long periods of time may be less effective than moving LPR units around to randomly selected hot spots every 15 to 30 minutes. Further, as Weisburd and Eck (2004) and Lum, Koper, and Telep (forthcoming) both suggest, more tailored approaches at crime hot spots may be more fruitful than vague, general approaches. Again, this may suggest that the optimal use of LPR units in crime hot spots for the short time they are there should involve highly tailored and structured deployment. Finally, LPR can also have a more general deterrent effect (see Sherman and Weisburd, 1995; Sherman, et. al., 1995). Potential thieves may see or know about the LPR patrol units and be deterred because of the presence of the technology, rather than its application.

Although these assertions are based on existing evaluation evidence, they remain hypotheses until empirically and rigorously tested in the context of LPR specifically. Early testing has already been conducted by the Police Executive Research Forum. Using randomized, controlled experiment of the effects of LPR in Mesa, Arizona, researchers discovered that LPR use at hot spots of crime leads to more positive scans for auto theft and stolen plates, as well as to more stolen vehicle recoveries, than a manual approach (Taylor, Koper, & Woods, 2010). However, when comparing the deterrent effect of a specialized unit manually checking plates versus using LPR, the manual checking was associated with lower auto theft rates than both the LPR use group and the control ("business as usual") group (though the effects of the manual plate checks were short-lived). Nor did LPR use deter auto theft relative to the control condition. In the PERF study, no crime reduction impact was found from LPR use on auto theft in hot spots. But further testing of different types, intensities, and breadth of data of LPR use must be examined to

[3] See http://gemini.gmu.edu/cebcp/matrix.html

see if these are ways that LPR can be effectively deployed. Such a goal is important given that some agencies have already invested in them.

Despite the nuances to think about when evaluating LPR, the value of an evidence-based perspective in deploying LPR is clear. It forces us to move beyond the efficiencies and the mechanics of the technology itself to begin using it in ways that reflect our knowledge about the prevention mechanisms that work best in patrol deployment. And, aside from telling agencies to "use it," it provides ideas on how best to deploy the technology in the framework of deployment schemes that we already know are successful in reducing crime (based on existing scientific research).

Additional Knowledge-Building: Legality and Legitimacy

In addition to building the evidence base on LPR's crime control effectiveness, there is also a lack of empirical evidence regarding the legal and legitimacy concerns that could arise with LPR use. To this point, a small number of legal analyses have been published (see IACP 2009), each dealing with different aspects of the potential legal implications of LPR. Generally, claims and guesses about community concerns fall under a number of categories, from general "big brother" worries that the government is monitoring citizens to very specific cares about the security of information collected and saved by the police. Yet, at this point, discussion of these issues is mere speculation about what is important to the community and how these concerns might alter views of police effectiveness and legitimacy. Evidence-based testing can challenge preexisting notions of privacy and legitimacy, just as it can with assertions of "effectiveness," by rigorously assessing the extent and nature of the concerns.

These questions become particularly relevant in the case of LPR, as various uses of LPR require access to and retention of different types of data. As more data becomes associated with license plate records, police gain an investigatory tool that can allow immediate access to a broad range of information on individuals whose plates are scanned by the system. Additionally, this investigatory tool may become more potent (and the potential legitimacy concerns more severe) as the ability for police departments to save past LPR data expands through technological upgrades. The legitimacy questions associated with LPR technology are therefore nuanced and cannot be answered by addressing the legitimacy of the system in general — varying applications of this technology challenge the police and its community in different ways. Consequently, a second goal of this study is to begin to develop an evidence base with respect to the legitimacy questions associated with various applications of LPR. (Chapter 4)

The George Mason University Study

The George Mason University (GMU) Center for Evidence-Based Crime Policy was commissioned by SPAWAR, as part of the National Institute of Justice's Science and Technology Information Led Policing portfolio, to add to the existing evidence base related to the use of license plate readers by law enforcement. We depart from existing evaluations of the efficiency, speed, and accuracy of LPR units and focus on the relationship between LPRs and crime control, as well as legitimacy outcomes. Toward this goal, the GMU research team completed four tasks:

(1) We conducted the **first random-sample national survey** of police agencies, assessing not only the extent and nature of LPR use, but also the concerns and challenges agencies face prior to and after acquiring LPR. This is currently the only random-sample study assessing LPR use across U.S. law enforcement agencies and is presented in Chapter 2.

(2) Then, following the experimental model of the Police Executive Research Forum's (PERF) current experimental evaluation in Mesa (AZ), we add the **first adjacent-jurisdiction, randomized controlled experiment** on the impact of LPR on crime. This is partially a replication of the PERF experiments, with a number of differentiating caveats. Working with our law enforcement partners, the Alexandria (VA) Police Department and Fairfax County (VA) Police Department, we report our findings of this randomized controlled trial involving auto crime hot spots across two jurisdictions that share a border. Our goal in using two jurisdictions sharing a common border was to emphasize that boundaries often matter little to criminal offending and to compare effects within and across boundaries. To do this, we randomly allocated LPR deployment in half of all hot spots across two jurisdictions to test whether LPR use yields a specific deterrent effect on auto thefts and a more general deterrent effect on crimes. These results are presented in Chapter 3, along with a shorter, supplemental document in the LPR Web Portal (see below) that provides police departments with policy recommendations on using LPR.

(3) We also conducted the **first random-sample community survey-experiment related to LPR** in Fairfax, Virginia, in which we sampled 2,000 residents to assess their receptivity to LPR use by their police agency. Not only did we incorporate general police legitimacy questions in the survey, but we also asked people to react separately to various types of LPR use. The presentation of these scenarios of LPR use was varied randomly across respondents, providing an experimental test of how various applications of LPR technology impact citizens' perceptions of police legitimacy. The results of this survey are presented in

Chapter 4, along with a "continuum of LPR use" to aid in the consideration of legal/legitimacy issues and the further testing of legal and legitimacy claims.

(4) Finally, the research team created **a unique evidence-based LPR Web Portal** to aid police in using LPR technology. The web portal translates research information for dissemination to five communities: police officers, police leaders, community members, researchers, and crime analysts. The processes and findings from this project and others are summarized in the portal, and videos, policy guides, and suggestions are also included. The web portal can be accessed at http://gemini.gmu.edu/cebcp/LPR/index.html).

2. LAW ENFORCEMENT TRENDS IN LPR USE

A NATIONAL SURVEY

Overview: *To add to the evidence-base of license plate recognition technologies, we begin with a national survey of LPR use in the United States. We randomly sampled law enforcement agencies to determine their use, concerns, and challenges in using LPR. We also explore both issues of effectiveness of LPR as a crime control intervention and the potential effects of LPR on police legitimacy and legal concerns. This survey is the first random sample national survey of agencies to gauge these issues.*

A National Assessment of LPR Use

The research team's first task was to gain a sense of the extent and nature of LPR use across the United States. This exercise makes tangible the extent of the diffusion of this innovation and provides agencies knowledge of what to expect prior to and after they adopt LPR. National surveys are important, as they provide agencies a benchmark for comparison, and a platform for sharing concerns about tactics and technologies. A random-sample survey is also important since surveys of agencies based on convenience or membership in professional organizations may bias results to the characteristics of those specific memberships.

Although no national assessment that is focused on LPR currently exists, two surveys provide a useful start. The first— the most recent (2007) Law Enforcement Management Administrative Survey (LEMAS)[4] asks a single question about whether agencies used LPR in 2007. As of the printing of this report, the 2007 LEMAS results have yet to be released. The second was a broader survey on many types of technologies conducted by the Police Executive Research Forum of its membership[5] (Koper et al., 2009). In that study, Koper et al. found that over one-third of the PERF membership agencies had adopted LPR, with a large majority finding the technology useful. Of those who had not adopted LPR, the majority anticipated acquiring it sometime in the future.

[4] See the Bureau of Justice Statistics, http://bjs.ojp.usdoj.gov/index.cfm?ty=dcdetail&iid=248. The LEMAS surveys all agencies with 100 or more officers and a representative sample of smaller U.S. agencies.
[5] The PERF membership consists of self-selected police executives from various agencies in the United States. The membership is not representative of the population of law enforcement agencies and tends toward larger, more progressive departments.

The PERF study suggests a rapid diffusion of LPR technology at least among large agencies. Understanding the extent of this diffusion across departments of various sizes and documenting their concerns is an important start to building an evidence-base on the use of license plate readers.

Specifically, our survey had three objectives:

(1) Given LPR's rapid diffusion indicated in the PERF study, we sought to measure the prevalence of the use of license plate readers in police agencies in the United States: roughly, what proportion of large and small agencies currently used license plate reader systems and how many agencies were planning to acquire the system in the future.

(2) Given our interest in evaluating the effectiveness of license plate readers, we sought to identify how LPR was being used: for what purpose, by whom, and how frequently.

(3) Given the challenges that LPR might pose with respect to information privacy and, therefore, the relationship between police and communities, we wanted to understand from the police perspective their concerns about how LPR might affect their legitimacy with the community. We later gauge the community's perspective through our citizen survey in Chapter 4.

The Survey Sample

To select our random sample, we used the most recently available Law Enforcement Management and Administrative Statistics (LEMAS) Data—the 2003 survey.[6] The LEMAS is a relatively current and complete compilation of state, county, and local law enforcement agencies in the United States. It surveys all agencies with 100 or more (herein, "large") sworn officers and a representative sample of agencies with fewer than 100 officers (herein, "small") (see Bureau of Justice Statistics, 2009). The LEMAS also enjoys a high response rate: In 2003, 95% of large and 89% of small agencies responded. Because adoption of LPR and many other technologies occurs more often in larger agencies, we decided to over-sample from the population of large agencies collected by the LEMAS. Thus, we selected a random sample of 200 agencies from the LEMAS agencies. These samples included a random sample of 100 "large" agencies and a random sample of 100 smaller agencies.

[6] We used the LEMAS 2003 data because we wanted to connect information about organizations from the LEMAS to our sample, especially information about technology uses in those agencies. As of the completion of this survey in 2010, the 2007 LEMAS data, including the agencies sampled, was not yet to be made available.

There are limits to this sampling approach, which should be considered in the interpretation of the results below. First, we used the LEMAS 2003 data because we wanted to connect information about technological traits of organizations to our sample, which are only found in the LEMAS. However, because the 2007 LEMAS was still unavailable at the time of conducting this study, the sample is drawn from an older survey. The information presented below in table 2.4, for example, should be interpreted as traits agencies that have and do not have LPR now, had in 2003. More explanation is given below. Second, given the limited resources for this portion of this project, we limited our sample size target to 200 agencies. However, given that there are approximately 18,000 law enforcement agencies in the U.S. (over 1,000 with 100 or more sworn officers), the statistical power of our test is limited as the confidence intervals are large. Caution should therefore be taken in the interpretation of these results.

As compared to the overall LEMAS large and small agency populations, our selected sample showed no significant differences in terms of agency size, population served, or type of agency. Table 2.1 depicts the mean agency size and jurisdiction population in our selected sample of agencies as compared to the overall LEMAS populations divided into the large and small agency groupings.[7]

Table 2.1: Mean number of sworn officers and population served in agencies samples

	SMALL		LARGE*	
	Agency size	**Population served**	**Agency size**	**Population served**
Our sample	27	17,032	416	343,126
LEMAS	27	24,768	432	413,731

* The differences between small and large agencies were non-significant at the .05 level using a two-tailed t-test.

Table 2.2 depicts the types of agencies (large and small) in our sample compared to the LEMAS. Our small agency sample contained a larger proportion of municipal police agencies and a smaller proportion of sheriff's agencies than the LEMAS small agency sample, and this difference was statistically significant at the .05 level. In our sampling of agencies, we excluded those sheriff's agencies that did not have law enforcement functions that would necessitate the use of license plate readers, which may have caused

[7] A note to the reader: In our random sampling, we happened to select the New York City Police Department (NYPD), which is significantly larger than all other agencies in LEMAS. However, whether we include or exclude NYPD in our comparisons, the differences between our sample and the overall LEMAS data remained non-significant.

these differences. No significant differences were found between our sample and LEMAS in the large agency category.

Table 2.2: Comparison of large and small agencies in LEMAS and sample

	SMALL		LARGE	
	Our sample	**LEMAS**	**Our sample**	**LEMAS**
Municipal Police	80 (80%)**	1,363 (69.3%)	63 (63%)	526 (59%)
Sheriff	19 (19%) **	582 (29.6%)	33 (33%)	281 (31.5%)
Tribal Police	1 (1%)	15 (.8%)	0 (0%)	2 (.2%)
State Agency	0 (0%)	0 (0%)	2 (2%)	49 (5.5%)
County Police	0 (0%)	6 (.3%)	2 (2%)	33 (3.7%)
Regional Police	0 (0%)	2 (.1%)	0 (0%)	0 (0%)

**Differences in proportions are significant at the .05 level.

The Survey Instrument and Data Collection Methodology

The survey instrument is included as Appendix A and consists of two sections, both of which were given to all selected agencies. If agencies did not use LPR technology at the time of the survey, they were instructed to complete only the first section, which consisted of two questions: (1) whether the agency was interested in acquiring the systems, and (2) the types of concerns that the agency associated with the purchase and use of LPR. Agencies were offered a range of answer choices reflecting potential concerns, including the cost of the system, the availability of data for the system, the operational demands of the system, and the legitimacy concerns associated with the system.

If agencies did use LPR systems, they were instructed to answer only the second section of the survey. This section had 10 questions: five related to the operational uses of LPR and five related to legitimacy concerns associated with the system. Questions related to the use of LPR addressed the agency's funding source for the system, the number of LPR units the agency had acquired, the system's vendor, the types of uses (including operator, place of use, platform for the device, and amount of time during the day that the system was used), and whether or not the agency had conducted an evaluation of the system's effectiveness. Questions related to the legitimacy of the system addressed the agency's preparations for the use of the system, the agency's concerns regarding potential legal challenges related

to the system, the public's concerns about the use of the system (if any had been expressed to the agency), and any legal challenges experienced by the agency regarding its use of LPR.

To maximize our response rate, we used multiple survey methods to contact agencies, to distribute the survey, and to obtain responses. These included email, telephone, fax, regular U.S. postal service, and an online submission system. Our initial contact occurred on July 14, 2009 and by September 20, 2009, four rounds of contact efforts were conducted. We began by contacting the chief, commissioner, or other chief executive officer of the agency; this individual either answered the survey him/herself (29% of our surveys were directly answered by the head of an agency) or passed it along to an individual familiar with the agency's LPR, patrol, or traffic enforcement functions. The response rate for this survey at the time of this report was 84.5% (n=169). Roughly, the same proportion of small (82%) and large agencies (87%) responded to our survey.[8]

The Survey Results

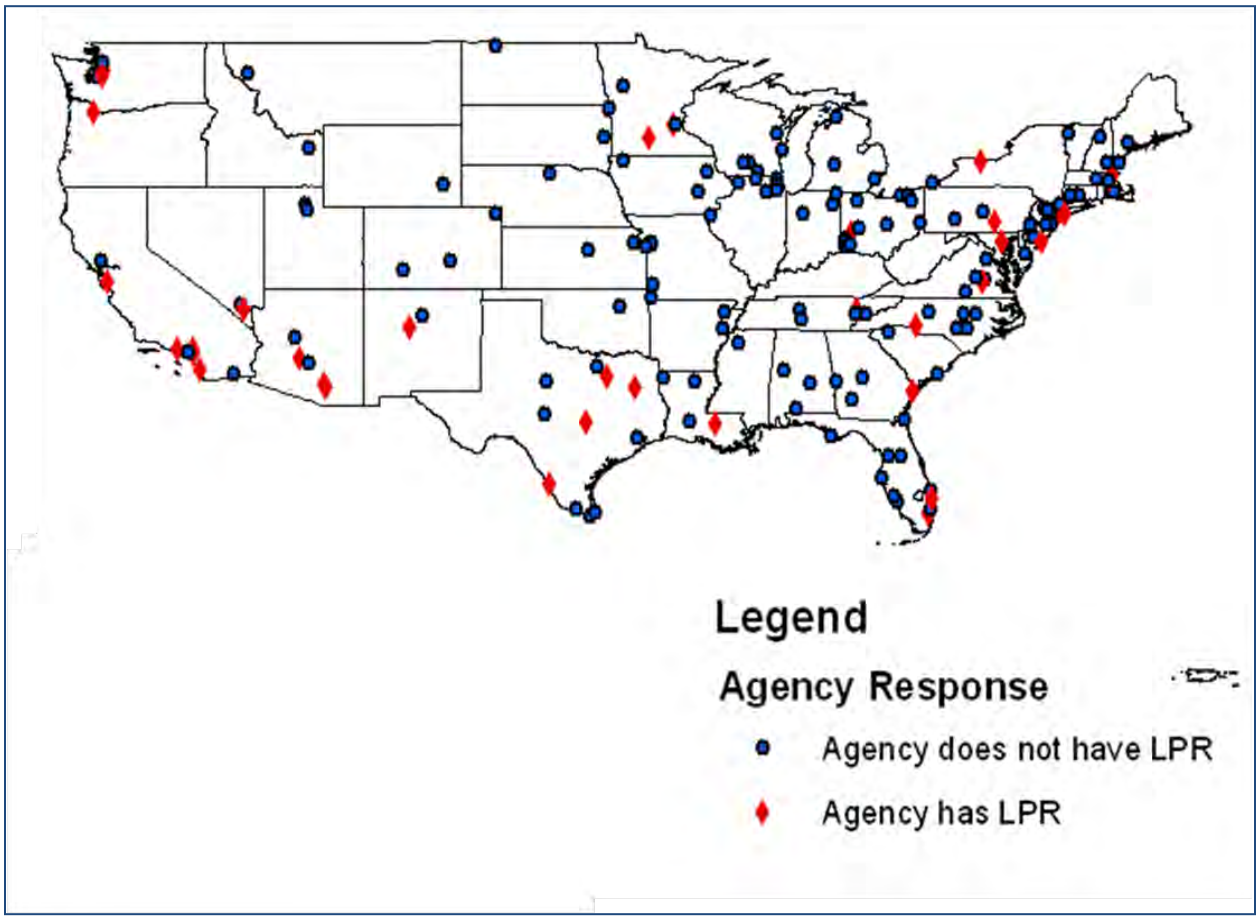
PREVALENCE AND FREQUENCY OF LPR USE IN THE UNITED STATES

Figure 2.1 shows the geographic distribution of the respondents, coded by LPR use.[9] The geographic location of responding and non-responding agencies was fairly dispersed; no particular region had a significantly higher or lower rate of response than the average response rate of the sample. When comparing agency size and population served between those who responded and those who did not respond, no significant differences were noted.

[8] Interestingly, although the non-response proportion of our sample from small agencies and large agencies was similar, the relative size of agencies that did not respond within each grouping tended to be larger.

[9] No police agency in Hawaii or the District of Columbia was randomly selected during the sampling process.

Figure 2.1: Geographic distribution of survey responses



*Anchorage, Alaska, Police Department had just acquired LPR and responded as an agency that did not use LPR.

Table 2.3 shows the distribution of LPR use between small and large agencies who responded to our survey. The larger agencies were more likely to have access to and use LPR systems than the smaller ones (37% of large agencies as compared with less than 4% of smaller agencies). This was consistent with the PERF technology study, which found a similar prevalence of LPR use (38.1%) among member agencies with 100 or more sworn officers (see Koper et al., 2009). Additionally, our survey discovered a significant interest in license plate reader technology among agencies more generally, speaking to the possibility of its further rapid diffusion. Twenty-one non-use agencies (16 of which were large agencies) that responded that they did not have LPR indicated that they planned to obtain this technology in the next 12 months. Thus, by the time of the printing of this report, over 50% of large agencies, and almost 10% of small departments are estimated to have acquired LPR or have access to it.

Table 2.3: Distribution of LPR use among large and small police agencies

	Small Agencies (n=82)	Large Agencies (n=87)
Use LPR	3 (3.7%)	32 (36.8%)
Do not use LPR	79 (96.3%)	55 (63.2%)

Of the 35 agencies in our sample that responded that they currently use LPR, the vast majority (85.7%) used four or fewer LPR devices. Most of these agencies received funding for LPR systems through state or federal grant programs, although a significant number (10 agencies) used asset forfeiture funds, resources from private vehicle insurance companies, and other non-grant or agency budgetary sources to purchase LPR systems. It is clear the diffusion of this technology seems supported by external funding sources.

This technological diffusion strengthens the case for more scientific evaluations of the effect of LPR and other police technologies. Like many police-adopted technologies, acquiring LPR has been based less on scientific research about its connection to crime reduction and more on other factors and assumptions. But rapid diffusion into a low-information environment can also contribute to misuse and waste. Thus, ***this rapid diffusion should not be interpreted as making the case for continued acquisition of LPR, but rather, as establishing a more pressing need for more information about the effects and effectiveness of LPR.***

CHARACTERISTICS OF LARGE AGENCIES BY LPR USAGE

Because only three agencies within our small agency sample responded that they used LPR, we focus this section on the differences between organizational and jurisdictional aspects of large agencies that do and do not use license plate readers. Table 2.4 depicts characteristics of large agencies in the sample according to their LPR use and their various organizational characteristics from the 2003 LEMAS. We included a number of agency characteristics that might indicate a level of technological sophistication that may support LPR systems. These include mobile computer units, computerized crime mapping/analysis, or the access to motor vehicle records and interagency information systems.

Table 2.4: Characteristics of large agencies (≥ 100) with and without LPR[10]

	Use LPR (n=30)	Do not use LPR (n=53)	t test
Mean size of agency	498	211	**2.968****
Mean population served	287,269	187,645	**2.175****
% with crime analysis	80%	68%	1.176
% that have any mobile computer units	87%	79%	.838
% with computerized crime mapping	63%	56%	.593
% that do hot spot identification	53%	42%	1.033
Have access to motor vehicle records	73%	75%	-.213
Have access to inter-agency information system	37%	53%	-1.418
Surveyed public satisfaction with police services	50%	43%	.716
Did not survey public	47%	51%	-0.228

*p<.05

As previously mentioned, it is important to interpret this information as the traits that an agency had in 2003 who have (or do not have) LPR *today*. Some of variables are likely to be similar now (such as size of agency and mean population served). But with regards to technological traits that change rapidly, the information here should be interpreted within a diffusion of innovations context (see Rogers, 1995; Weisburd and Lum, 2005). For example, LPR as a mobile computer technology might rely on the prior implementation (as reflected in the 2003 LEMAS) of other technologies to make easier the acceptance and use of LPR today. Because the Bureau of Justice Statistics has not made available the results of the LEMAS 2007, this perspective should be taken with Table 2.4.

Table 2.4 indicates that agency size matters. This makes sense given that larger agencies are likely to exist in places with greater traffic related responsibilities and auto-related crimes. Larger agencies can more likely afford the maintenance and support of this

[10] The NYPD, which has adopted LPR, was excluded from this analysis, as it is an outlier. Further, in 2007, the LEMAS survey asked agencies if they had specialized auto theft units. Had this data been available in 2003, it would have been a useful addition to this table, as we discovered a large proportion of agencies that used LPR had specialized units that employed them. Anchorage PD and two state police departments were excluded for response type (Anchorage PD has LPR but responded as if it did not), and the lack of comparability in population served (the two state police departments' "population served" was the entire population of the state).

technology or more readily articulate needs when LPR proposals are solicited by federal grant providers. Although these differences were not statistically significant, agencies with LPR were more likely to use mobile computer technology and crime analysis, both which can be used to support LPR use.

However, agencies that currently use or do not use LPR did not differ on other traits in 2003. Both types of agencies were similar in terms of computerized crime mapping use and hot spot identification. They were equally likely to have high levels of access to motor vehicle records and lower levels of access to interagency information sharing systems. LPR and non-LPR agencies were also similar in their survey outreach to the public.

HOW LPR SYSTEMS ARE USED

For those agencies in our sample that used LPR (n=35), the most common function of LPR was detecting stolen motor vehicles and license plates (91%) and also motor vehicle violations (40%) as Table 2.5 indicates. We previously labeled this type of data connection to LPR as "primary" (see also the "continuum of uses" in Chapter 4) because it involves scanning vehicle plates directly and comparing them to a single database concerning the status of those plates (and the cars attached to them).

Table 2.5: Types of Uses for LPR

	%
Detect stolen vehicles or tags	91.4%
Detect motor vehicle violations (expired registration, unpaid tickets, etc.)	40.0%
Connect licenses to a secondary database (sex offender registry, child support, warrants) for further investigation	40.0%
Monitor or record vehicles entering high-crime locations	22.9%
Monitor security in high-risk locations (government buildings, key infrastructure)	17.1%
Other	11.4%

"Secondary" data connection with LPR—i.e., connecting license plates to non-vehicular data to alert officers to other types of offenses or risks of the owners of vehicles—was also employed by 40% of agencies. It should be noted that this was a common practice prior to LPR use and involved officers calling into the dispatch or typing a tag into their mobile computer units, finding the name of its registered owner, and then running that name against another database. These might include connecting registered owners to their

open warrants, violations of child support, convicted sex offender registries, or those found guilty of selling drugs around schools. Between 17 and 23 percent of agencies using LPR also noted that they use readers for other purposes, including monitoring of high risk/crime locations.

The frequency of LPR use varies, with 40% of agencies turning them on and off for a few hours or for a shift. However, in a quarter of the agencies that use LPR, at least one device is left on at all times (Table 2.6).

Table 2.6: Daily frequency of use

	%
Devices are turned on and off during the shift for a few hours	40.0%
At least one device is always in operation 24 hours a day, 7 days a week	25.7%
Devices are turned on at an ad-hoc basis for specific operational purposes	22.9%
Other	25.7%

Tables 2.7 and 2.8 show that the primary user of LPR systems is a uniformed patrol officer in a marked patrol unit. The vast majority of agencies who use LPR do not use them in an undercover capacity. Agencies most frequently mounted systems on marked police vehicles (83%) and then on unmarked vehicles (40%). The use of fixed LPR systems or LPR systems integrated into a suite of electronic surveillance systems was relatively rare.

Table 2.7: Location of LPR Unit

	%
Devices are mounted on marked police vehicles	82.9%
Devices are mounted on unmarked vehicles	40.0%
Devices are mounted at fixed positions along highways or other traffic areas	5.7%

Table 2.8: Operator of LPR Unit

	%
Uniformed officers in general patrol	77.1%
Officers who are a part of a LPR-dedicated or specialized unit	34.3%
Civilian and non-sworn agency employees	0.5%
Personnel in a command center	0.5%
Other	2.0%

DO POLICE AGENCIES EVALUATE THEIR LPR USE?

It is uncommon for police agencies to conduct outcome evaluations of their operations using rigorous evaluation methods. The same is even truer of police technologies like LPR. Lum, Koper and Telep (ONLINE FIRST, 2010), in their Matrix on policing evaluations show no evaluations or police technology with respect to crime outcomes prior to the PERF and GMU studies. Most agencies only evaluate the process of tactics or the efficiency of technologies, concluding "success" if an arrest is made or if the technology works faster. Of the 35 agencies that use LPR, only five (four large and one small) conducted any type of assessment of LPR use, and none conducted impact evaluations.

LAW ENFORCEMENT CONCERNS ASSOCIATED WITH LPR

Our literature review revealed at least some degree of public discourse and concern about license plate reader systems. Because such technologies can quickly connect a visible identification number (license plate) with information about the vehicle and the driver, these systems have provoked debates and discussions about data security and privacy. Therefore, understanding the concerns of citizens may assist law enforcement agencies in their decision to adopt this technology.

For those agencies that already use license plate reader technology, we gauged concerns about system legitimacy in two ways. First, we asked agencies how they prepared themselves to obtain and use LPR. This question allowed us to understand the process of planning to use LPR in terms of both technical preparation and preparation for concerns that citizen or community groups might raise. Second, we asked agencies to indicate their concerns with acquiring LPR. Table 2.9 reports the types of preparations carried out by agencies using LPR.

Table 2.9: Agencies With LPR: Preparations for LPR technology

	%
Reviewed research on LPR technology	**77.1%**
Attended a demonstration of the technology by the manufacturer or vendor	**77.1%**
Consulted with another police agency regarding the use of LPR or attended an LPR training session hosted by another agency	**60.0%**
Announced the use of the technology through press release or other media campaign	**42.9%**
Upgraded computer / information technology to accommodate LPR technology needs	**42.9%**
Consulted with the agency's attorney or researched the legal implications of the technology	**42.9%**
Created standard operating procedures for the use of LPR	**40.0%**
Created or collected the data to be used by the LPR system	**20.0%**
Consulted with community leaders on the implementation of the technology	**14.3%**
Conducted a needs assessment for the use of LPR	**5.7%**
Other	**2.8%**

Most of the preparation for the acquisition of license plate readers focused on understanding the technology through reviewing the literature and attending demonstrations by manufacturers. Consultation with other agencies was also a regular practice, which adds salience to Weisburd and Lum's (2005) finding regarding the influence of early adopters in the diffusion of police technologies. Upgrading existing technology to accommodate LPR was also somewhat important to technology acquisition, as was creating standard operating procedures for how to use them.

Interestingly, preparing for legal or community-based ramifications was less of a concern for police agencies. The most common type of preparation with the community was in the form of media releases or campaigns to inform the community of LPR acquisition. Approximately 43% agencies consulted the agency attorney regarding possible legal challenges to the use of the system or conducted some sort of research on the legal implications of LPR use. Agencies less frequently consulted with community leaders (14%), and only 6% of agencies who responded conducted a needs assessment on the technology itself.

Table 2.10 shows the results of the concerns that agencies, regardless of whether they used LPR, had with license plate readers more generally (agencies were asked to check all which applied). Table 2.10 indicates the proportion of agencies that checked the specific concern listed. As the survey in Appendix A indicates, we asked slightly different sets of questions to those who did and who did not have LPR, which is why just the proportions are listed here, rather than testing for differences between those with and without LPR. The "N/A" denotes those questions that were relevant to one group and not the other.

Table 2.10: Agency concerns related to LPR

	Use LPR	Do not use LPR
Cost of technology or ongoing maintenance	54.3%	29.9%
Concerns about technological problems with LPR systems	22.9%	4.5%
Potential for legal or privacy concerns	17.1%	1.5%
Concerns about vandalism of LPR units	11.4%	N/A
Lack of familiarity with LPR systems	11.4%	23.9%
Concerns about driver distraction when using LPR in police vehicles	8.6%	5.2%
Not enough information on the benefits or best practices associated with LPR technology	5.7%	20.1%
Concerns about misuse or hacking of data stored in LPR database	5.7%	3.7%
Concerns about complaints from citizens or community groups	5.7%	3.0%
Other	0.0%	12.7%
Lack of outside funding available to purchase LPR systems	N/A	46.3%
Agency is focused on other priorities	N/A	37.3%
Data files or downloads are not available to support LPR technology	N/A	9.0%

Cost of the technology and its ongoing maintenance was one of the concerns most frequently cited by agencies in our sample that already acquired LPR. This result is

mirrored in the sample of agencies without LPR in terms of concerns about maintenance costs and funding the purchase of LPR systems. The responses in Table 10 also indicate a tendency for both types of agencies to be concerned with technological problems, lack of familiarity with the system, and lack of information about its effectiveness and use/best practices, which is mirrored in the evaluation literature as well (the lack of an evidence-base for LPRs).

Finally, of interest in these findings is that agencies that do not use LPR are less concerned about privacy or legal issues related to LPR systems than those that do use the system. Even more interesting is that many more agencies identified concerns related to privacy and legality as more significant than concerns about complaints from citizens or community groups. When we asked agencies if they had received complaints from citizens or community groups about LPR, seven of the agencies surveyed had experienced some sort of challenge to their use of LPR, either by voiced concerns by citizen groups (five agencies) or by legal challenges to the use of the system (two agencies). Neither of the two agencies who faced legal challenges had made legal preparations prior to beginning to use LPR technology. Overall, however, the vast majority of agencies did not indicate concerns regarding either legal/privacy issues or community issues. Even when one potential privacy issue was framed in a slightly different manner—as a potential concern about "misuse or hacking of data"—very few agencies responded that this was a concern.

Conclusions

Given that our sample of 200 agencies is small compared to the total population of small and large police agencies in the U.S., these findings should be taken cautiously. However, the findings do suggest important considerations for the study, acquisition, and use of LPR technology. LPRs are rapidly diffusing to police agencies throughout the United States. We estimate from our study that over a third of all large police agencies already use LPR systems and that at least 30% of the large agencies that don't have LPR now will be acquiring this technology within the next 12 months. The primary use of LPR systems has been exactly what they were initially intended for—to detect and reduce auto theft. Because of this, it is not surprising that while agencies are sometimes concerned with privacy or community complaints regarding the use of this technology, it appears the greatest concerns center on costs and mechanical maintenance problems.

However, the national survey also reveals interesting nuances about the prevalence, use, and concerns associated with license plate readers. First, there is a disconnect between the rapid diffusion of this innovation and the lack of concern about its outcome effectiveness. Very few agencies have actually assessed LPR and none has conducted even a moderately rigorous impact evaluation of its use. Furthermore, we learned the primary use of LPR is with mobile, uniformed patrol. This finding is important when building operational policies about its use. We now turn to the next section, which will explore this issue.

3. THE IMPACT EVALUATION

A TWO-JURISDICTION RANDOMIZED CONTROLLED EXPERIMENT

Overview: *In this chapter, we present the methodology and results of a randomized controlled experiment evaluating the general and specific deterrent effects of license plate reader hot-spot patrol on levels of crime in hot spots. These experiments were conducted in partnership with the Alexandria Police Department (APD) and the Fairfax County Police Department (FCPD), two Northern Virginia Police Departments in the Washington, DC, metropolitan region. This study adds to the first LPR experiments by the Police Executive Research Forum (PERF) in two ways: First, this experiment provides the opportunity to compare 15 randomly selected hot spots that received LPR patrol across two border-sharing jurisdictions with 15 hot spots that did not. Second, we used an intervention that combines a tailored approach with the Koper Curve timing principle (see Koper, 1995). Findings, lessons learned, and advice to agencies are detailed.*

Evaluating the Effectiveness of License Plate Readers

Law enforcement agencies and their chief executives are becoming more and more responsible for proactively *reducing* and *preventing* crime, not just detecting and reactively responding to 911 calls. Thus, outcome measures of deterrence and prevention, rather than arrest or response time, have become just as, if not more, important performance measures for the police. The effectiveness of LPRs relies not only on detecting and responding to auto thefts but also on its ability to prevent and deter those crimes (and others) more generally.

In Section 1, we emphasized the difference between assessing the efficiency and effectiveness of license plate readers: LPR may be more efficient and faster in scanning plates and matching them to a database, but without outcome evaluations we do not know whether this scanning technology is more effective in reducing and preventing crime. This is a key distinction for law enforcement agencies seeking to optimize the effectiveness of LPR (or any technology) use. *Even if more arrests are made*, the most accurate LPR systems can lead to little change in crime problems if they target places with low probability of crime, if there is limited reference data for the LPR unit to scan plates against, or if they are not used in ways that maximize their effects.

The effectiveness of LPR is also important when considering whether to invest in the technology. Readers can range from between $20,000 to $25,000 per unit, representing a significant burden to agency budgets. Additionally, there are costs for training, maintenance, and adapting existing information and technology to the units. Consequently, agencies with LPR units but without matching crime reduction or prevention effects may fail

"Even if more arrests are made, the most accurate LPR systems can lead to little change in crime problems if they target places with low probability of crime, if there is limited reference data for the LPR unit to scan plates against, or if they are not used in ways that maximize their effects."

to convince either government funders or the public of the need for such technology for their agency.

The results of the national survey in Section 2 emphasized the importance of considering effectiveness and costs. LPR is rapidly diffusing into a "low-information environment." There is little evidence on whether readers are effective in preventing crime or on the nature of LPR's impact on police legitimacy with the community. However, our agency survey indicates that police executives are very much concerned with not only the impact of LPR use on crime, but on citizen privacy and police legitimacy.

Given these concerns, in this chapter we report on our evaluation of the crime prevention effects of LPR, and in the next chapter, our findings about community concerns. Similar to and with the consultation of the PERF team (see Taylor, Koper and Woods, 2010), we examine the crime control impact of license plate readers on crime using the "gold standard" of evaluation research—a randomized controlled field experiment. We replicated PERF's efforts in Mesa, AZ, with some similarities and some differences. First, we test for the specific deterrent effects that LPR deployment has on vehicle theft, theft from auto, and other auto-related crimes (i.e., driving while intoxicated and reckless driving) as well as LPR's general deterrence effects on crime and disorder. To do this, we identified hot spots of auto theft in both jurisdictions and then randomly allocated a specific type of LPR deployment (discussed in detail below) in half of all hot spots across two jurisdictions in order to test whether that deployment yields a deterrent effect.

This study is a randomized controlled trial of the effects of LPR use at auto crime hot spots in two adjacent jurisdictions in the Washington, D.C. area. Crime, especially car theft, moves seamlessly across boundaries in the Washington, DC, metropolitan region; it is common for cars to be stolen and recovered in two separate states, counties, or cities. By conducting a multi-jurisdiction approach, we wanted to determine if such an operation could be conducted, both in research and in practice. We also used an intervention that included a combination of "sweeping" hot spots by the LPR

unit and then "sitting" at key areas after the initial sweep. We asked officers to follow the Koper Curve principle by reducing the time officers were asked to stay in one hot spot to 30 minutes.[11]

While results show no statistically significant reductions on crime in experimental hot spots, we hypothesize this could be due to the weak intensity of the intervention, given the availability of LPR units for our study. However, this may also be due to a lack of effect. For example, compared with other manual, non-LPR hot-spot approaches, the PERF research team in Taylor et al. (2010) also did not discover significant reductions in crime in experimental hot spots. We detail how future assessments might be conducted given enough resources and provide ideas about evidence-based deployment strategies using existing LPR technologies. We encourage officers, first-line supervisors, and command staff to visit the George Mason University LPR Web Portal,[12] where we convert much of this and other information into usable deployment guides, including tips by officers and command staff from our partner police agencies, video demonstrations, slide shows, and links to other agencies that are also studying and providing useful information (e.g., PERF, IACP, and the National Policing Improvement Agency [NPIA] in the United Kingdom). Given what seems to be the inevitable adoption of LPRs by at least medium to large jurisdictions, finding the right and legitimate way of using LPRs to yield a crime prevention advantage is an important goal for this study.

The Tested Intervention: What is the Optimal Deployment of LPR?

Although police technologies can be evaluated in many ways, action research is most useful and valid when the strongest methods of evaluation are used to test the most optimal deployment of that technology. Concerning methods, testing LPR on comparable places with and without the intervention is needed in order to ensure that results are believable (and not due to chance, selection bias, or other coincidences). With regard to optimal deployment, we should test the effects of LPR in places with high probability of crime in ways that reflect the most likely user and that use the most effective tactics. Further, researchers also have to consider the resources available for evaluation; using those resources wisely is important in the researcher-practitioner relationship.

At the same time, there is a lack of an evidence base for LPR technology that presents guidance on what is the most effective deployment of LPR units as we discussed in Chapter 1. In the absence of such information, the next-best option is to look at the evidence base of police practices more generally. This evidence base may provide clues to the best possible approach for deployment that will likely lead to the most positive results *based on scientific research and evidence* as opposed to best guesses, hunches, or hopes (Lum, 2009; Sherman, 1998). An evidence-based approach is an alternative to a "best practices" one,

[11] In the PERF experiments, officers stayed in hot spots for about 1 hour.
[12] See http://gemini.gmu.edu/cebcp/LPR/index.html

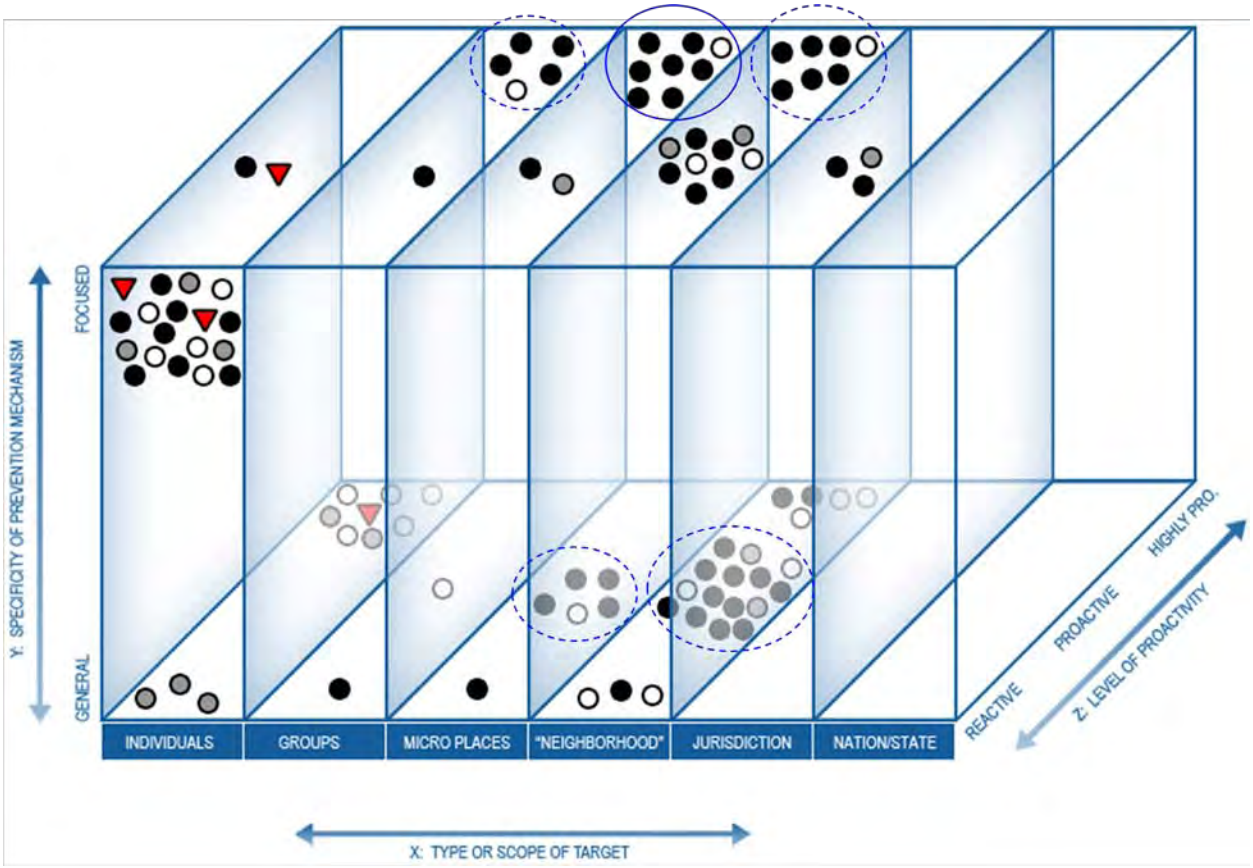
which is based on an experience or consensus rather than on evaluation and systematically collected and analyzed information.

Fortunately, there is existing evidence concerning many police tactics and strategies (see reviews of this research by the National Research Council, 2004; Sherman et al., 1997; Sherman et al., 2002; Weisburd and Eck, 2004). Further, there have also been a number of Campbell systematic reviews and meta-analyses[13] of law enforcement strategies and tactics that guide police agencies on what works to reduce crime. These have included hot-spot policing, neighborhood patrol, second-responder policing, policing guns, counterterrorism, drug enforcement, and problem-oriented policing (see Bennett et al. 2008; Braga 2007; Davis et al. 2008; Koper and Mayo-Wilson 2006; Lum et al. 2006; Mazerolle et al. 2007; Weisburd et al. 2008).

Recently, Lum, Koper, and Telep (2009; ONLINE FIRST, 2010) have developed a translation tool for this entire field of rigorous police research. It is known as the ***Evidence-Based Policing Matrix*** shown in Figure 3.1 and is available online.[14] As defined by its creators, the Matrix "is a research-to-practice translation tool that categorizes and visualizes all experimental and quasi-experimental research on police and crime reduction according to three common dimensions of crime prevention—the nature of the target, the extent to which the strategy is proactive or reactive, and the specificity or generality of the strategy. This categorization and visualization of policing evaluation studies reveals three-dimensional clusters of effective studies, which we refer to as 'realms of effectiveness.' These realms of effectiveness provide insights into the nature and commonalities of effective police strategies and can be used by police agencies to guide various aspects of their operations." The Matrix currently houses all rigorous to highly rigorous police research through December 31, 2009, and is updated biannually.

[13] See http://www.campbellcollaboration.org/crime_and_justice/
[14] The Matrix is available for free at http://gemini.gmu.edu/cebcp/matrix.html

Figure 3.1: The Evidence-Based Policing Matrix (Lum, Koper, and Telep, 2009)



How is the Matrix applicable to designing LPR deployment? When police agencies deploy a new technology in patrol, they want to optimize the potential that technology will have by using it in the manner most likely to reduce crime. The Matrix shows clustering of effective studies, or "realms of effectiveness," at the intersection of three types of tactical approaches that show positive effects:

(1) tactics that target places, specifically, small areas of high concentrations of crime or "hot spots";

(2) tactics that are more proactive in nature, which use data and information to develop strategies to anticipate and prevent future crimes, or to address underlying causes of crime; and

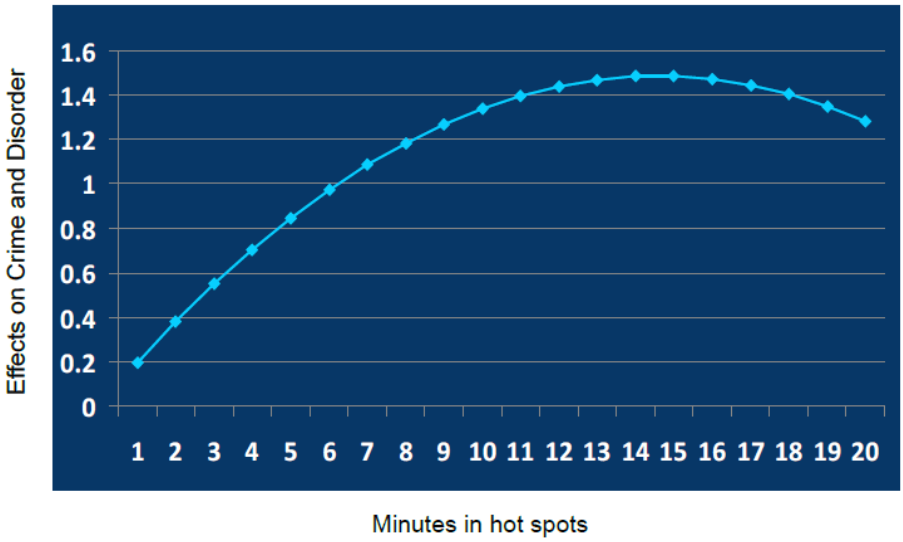
(3) tactics that are more specific in their prevention mechanisms or more tailored to the problem at hand.

Thus, for LPR deployment, the current evidence in the Matrix suggests that the most optimal use of this technology would be to deploy it in small and clearly delineated crime hot spots, to use crime analysis and crime data to develop those hot spots, and to tailor a

proactive approach (and also clearly articulate and supervise that approach) within these hot spots for the task at hand.

Existing research also provides clues on the ideal duration and extent of these deployment activities. The Koper Curve Principle as illustrated in Figure 3.2 (see Koper, 1995) states that the deterrent effect of hot spots policing is maximized when officers do not stay in hot spots for long periods of time. Not only can officers become bored and unmotivated by staying in a small hot spot for hours, but as Koper's research illustrates, there are diminishing marginal deterrence effects for each minute that an officer lingers in a hot spot after 12–15 minutes. In other words, to maximize the effectiveness of a hot-spot policing approach, officers should not stay in hot spots all day but rather move from hot spot to hot spot in a completely random fashion, staying for only a very short period of time.

Figure 3.2: The Koper Curve



The existing evidence also provides guidance about the type of tactics and strategies that might lead to greater crime prevention effects. For example, positive evaluations in the Matrix indicate that tailored, focused, and analytical approaches seem to have a greater effect on crime reduction and prevention than vague, general approaches (Weisburd and Eck, 2004). This could suggest that officers respond better to clear directives or tactics that are supported by tangible analysis.[15] With LPR, we hypothesized this type of tailored

[15] This stands in contrast to an intuitive approach to policing that is reliant on hunches and experience (see Bittner and Bayley, 1984; Sherman, 1984). These and other scholars, notably Goldstein (1979), advocate for more information and analysis to support officer discretion.

approach would be to "sweep" the small hot spot at least once for parked and moving vehicles that may create an alert and then, depending on the place, allow for an officer to exercise discretion to do what he or she felt worked best for that location. This approach was also used in the PERF experiment. In our study, this often meant strategically positioning officers' vehicles in certain locations in which the probability of a stolen vehicle passing by would be greatest (such as a busy intersection or a frequently used car park). We often called this combined approach a "sweep and sit" scheme, which is contrasted from just a "fixed location" use of LPR or a completely mobile use of LPR.

Thus, to test the effectiveness of LPR on crime, we created an intervention for our experimental hot spots that best reflected the existing evidence. ***Specifically, we randomly assigned dedicated officers to experimental hot spots to conduct the sweep-and-discretion LPR intervention described above. During each shift, officers were also assigned multiple hot spots using a random allocation scheme. They were required to leave the hot spot after 30 minutes had elapsed and to move on to the next randomly allocated hot spot.***

Identifying Hot Spots for the Experiment

The adjacent jurisdictions used for this evaluation were Alexandria City and Fairfax County, Virginia. Fairfax County is one of the larger Northern Virginia suburban counties outside of Washington, D.C., where many individuals who work in the metropolitan D.C. area reside. According to the U.S. Census, it has a population of approximately 969,600 persons; approximately 59% are Caucasian, 10% are African American, 15% are Hispanic, and 17% are Asian. The County spans almost 400 square miles, with a population density of about 2,450 persons per square mile. The police department consists of approximately 1,370 sworn officers serving a well-educated community (over 50% of residents have a college education) with high home ownership rate (70%).

Alexandria City is a denser city immediately adjacent to the Washington, D.C.'s Southwest border. According to the U.S. Census, it has a population of approximately 150,000; approximately 56% are Caucasian, 22% are African American, 14% are Hispanic, and 5% are Asian. The City covers about 15 square miles, with a population density of about 8,552 persons per square mile. The police department consists of about 320 sworn officers serving a community that is very well educated (54% have a bachelor's degree or higher).

Figure 3.3: Northern Virginia Map

We used a two-step process to derive the hot spots used to test the effectiveness of LPR. These steps reflect both principles and theories of crime at places as well as practical crime prevention concerns. With regard to criminological theory, we wanted to create **hot spots that were small in size**. A number of place-based criminologists—notably, Sherman et al. (1989), Sherman and Weisburd (1995), Weisburd (2002; 2008), and Weisburd, Bernasco, & Bruinsma (2009)—have argued that the size of hot spots matter for both theory and practice. Specifically, there can be discernible patterns of crime – as well as areas without crime – within neighborhoods believed to be "dangerous". Patrolling larger geographic areas may actually be less efficacious in accurately targeting crime hot spots. Further, Weisburd, Bushway, Lum and Yang (2004) found that crime trends at very small and specific places are stable and often drive an entire city's crime rates. These findings have been supplemented by empirical evidence, which has strongly supported that when

police direct their patrol to small, "micro" places of crime, they can have a significant crime prevention effect (Weisburd and Eck, 2004).

From a more practical, crime prevention standpoint (and in addition to empirical findings on hot spot policing), we also wanted to derive **hot spots which were environmentally meaningful.** It is not enough to rely only on geographic information systems to create hot spots based on crime data, even if we generate small hot spots. Once concentrations of crime are mapped, hot spots need to be individually inspected to reflect the goals of our intervention and the realities of policing. If computer-generated hot spots are too large, for example, a sweep-and-sit, Koper curve method may not be accomplished in 30 minutes or less. If computer-generated hot spot boundaries are not clearly delineated, officers may not know the exact location in which to patrol. Finally, computer-generated hot spots may not make environmental sense. Hot spots may be cut by rivers or train tracks or be blocked by geographic attributes that would make patrolling such an area difficult.

Below, we detail how we created our final hot spots for testing in this field experiment. By using GIS and statistical analysis to develop the hot spots, and then working with officers to refine the boundaries of the hot spots, we were better able to ensure the feasibility and meaningfulness of the intervention to officers and researchers.

STEP I: USING GIS TO IDENTIFY CRIME CONCENTRATIONS

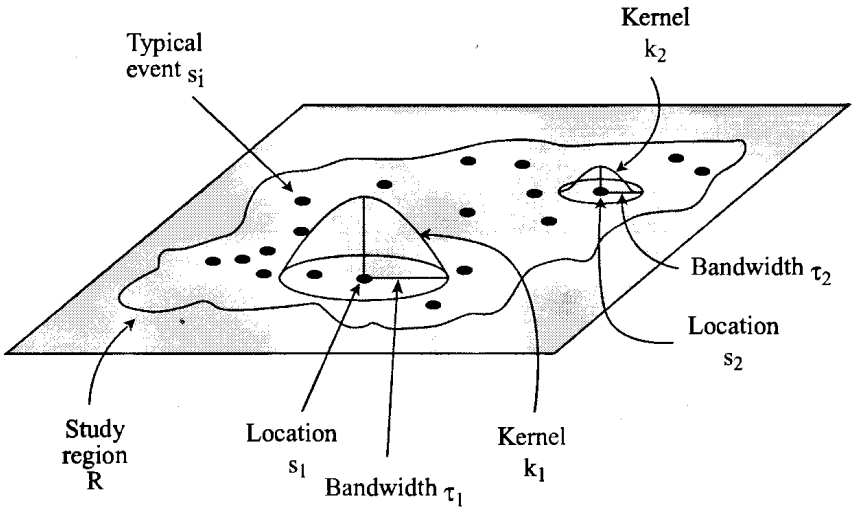
To identify concentrations of crime to create our hot spots, we used ArcGIS,[16] a geographic information systems software, to map automobile theft data from both jurisdictions. ArcGIS uses a process called "geocoding" to convert the address field of each crime database into numerical latitude ("x") and longitude ("y") coordinates. Because crime data has many entry errors, such as spelling, spacing, or format, we used an interactive and recursive process of database cleaning and computerized mapping, so as to maximize the ability of ArcGIS to geocode as much of the crime data as possible. Each of the agencies involved had crime analysis units that assisted with the initial downloading and preliminary cleaning of this data. The final geocoding match rate of crime data addresses to x-y coordinates was 91.6% for FCPD and 99.5% for APD.[17]

Once crimes were geocoded, exploratory spatial analysis was then run to develop hot spots. Exploratory spatial data analysis uses numerical coordinates to generate and analyze distributions of distances between crimes in a defined space. It includes point pattern analysis, such as kernel density analysis, and spatial statistical approaches such as nearest-neighbor analysis (Anselin et al., 2000). To develop our initial hot spots, we used kernel-density analysis, which creates both visualizations and associated descriptives about the crime density surrounding a point. Figure 3.4 shows a kernel density illustration

[16] ArcGIS is a product of the ESRI Corporation (see www.esri.com).
[17] The lower match rate for FCPD could reflect a number of factors, although we suspect it is due to FCPD's relative newness to crime analysis, mapping, and a new records management system. It may also be due to the varied and expanded geographic terrain of Fairfax County compared with Alexandria City.

(Bailey & Gatrell, 1995). Such visualizations are essentially statistical distributions of the concentration of points within the area starting from a point on a map to a distance or radius. These radii are called "bandwidths" and can be determined by ArcGIS default or manually adjusted by the analyst.

Figure 3.4: Kernel Density Illustration
(from Bailey and Gatrell, 1995)



Source: Adapted from Bailey and Gatrell (1995).

To confirm hot spot diagnosis via Kernel Density results, we also created STAC hot spots through CrimeStat.[18] STAC hot spots were created for all crimes, auto thefts and theft from auto for both Alexandria City and Fairfax County. STAC analysis was run with settings of three, five, and 10 incidents per ¼, ½, and 1 mile. Thus, nine different STAC simulations were run for each study site in order to get the best picture of hot-spot distributions.

At this point, we then decided to narrow our study area to include all of Alexandria City and only the eastern portion of Fairfax County for several reasons. First, the auto theft and theft from auto incidents had high densities and clustering at the border areas of the two jurisdictions. Additionally, most of the auto-related incidents in Fairfax County fall within the Eastern half of the county, close to its border with Alexandria City. Last, by narrowing the focus of our study area, we were able to fine-tune our STAC and kernel density settings and analysis to better identify smaller, more micro-level auto-incident-

[18] CrimeStat is a free spatial analysis program available through the National Institute of Justice and the Inter-university Consortium for Political and Social Research (ICPSR). See http://www.icpsr.umich.edu/icpsrweb/CRIMESTAT/ for details on the program.

related hot spots for our experiment. We also decided to use only auto theft to identify the hot spots for LPR deployment in our final maps.[19]

After deciding on the new study area and types of crime to map, we merged the two jurisdictions into a single geographic database that represented our new dual-jurisdiction area. We then reran the kernel-density simulations using a search radius of 251.91 feet, and the STAC simulations (at ¼, ½, and 1 mile distances). Overall, reducing the total search area for hot spots resulted in much better representations of hot spots. What emerged is shown in Figure 3.5. The area delineated with the yellow border in the northeast corner of this map is Alexandria City, which is bordered to the west and south by Fairfax County.

Figure 3.5: Kernel Density Analysis of Auto Theft for January 1, 2008 Through September 15, 2009

[19] We did not include auto theft recovery data for either location, given that this information was not readily available for one of the two jurisdictions.

STEP 2: HOT-SPOT ADJUSTMENT WITH OFFICERS

Even with accurate mapping of clusters of crime using GIS, the problems with relying on these initial maps to deploy officers for hot-spot policing are many. First, the boundaries of hot spots are still vague, no matter what software (ArcGIS or STAC) is used. Spots may make statistical sense, such that number of crimes or the density of population within each area chosen are similar, but the hot spots may not make operational or environmental sense. For example, a hot spot can be divided by an environmental barrier (e.g., river, park, railway, business area) that is difficult to cross by either offenders or officers. Second, the hot spots have to be small enough for our intervention to be administered within 30 minutes, following the Koper Curve Principle.

More practically, if police delineate large areas that encompass both hot and cold areas, this could lead to not only an unnecessary spreading out of scarce resources but also a watering down of the effects in these areas. On the other hand, if departments are too specific in their hot spot identification, resources may also be used inefficiently, and officers can get bored with a hot-spot approach, especially if they are driving around the same small place. Hot-spot policing that is operationally meaningful must therefore be informed by not only place-based theories and spatial analysis but also environmental considerations and operational meaningfulness.

To strike this balance, we met with officers and supervisors from each agency who were familiar with these areas and readjusted each of the 40 identified hot spot by hand on paper maps. Once new boundaries were demarcated, they were digitally transferred back to ArcGIS so that the deployment and outcome measures within them could be detailed. The readjustment was based on three criteria:

1. hot spots had to be clearly delineated;

2. hot spots had to be small enough so that the sweep-and-sit approach could occur within 30 minutes; and

3. hot spots had to be environmentally "friendly," meaning that they could be crossed easily without major barriers that would obstruct officer movement and tactics.

Take, for example, Figures 3.6a and b. Figure 3.6a reflects an early hot spot that researchers identified from the GIS analysis. Boundaries were vague, cutting across streets and large intersections. While the spot seemed small and manageable, when we presented this hot spot to officers familiar with this area, this was believed not to be the case. Because of environmental barriers and density of cars in this area, the readjustment by officers, according to our deployment criteria, became two smaller and more specifically defined areas, shown in Figure 3.6b.

Figure 3.6a: Initial Hot Spot

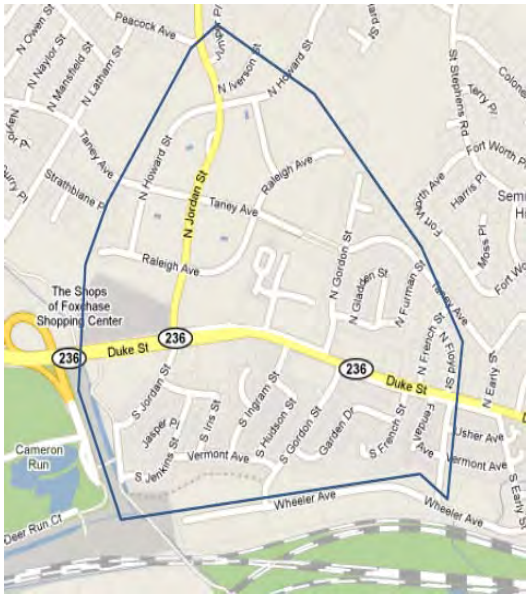
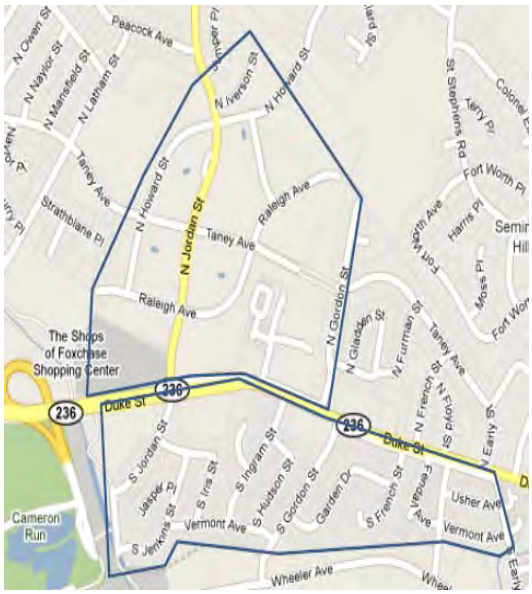
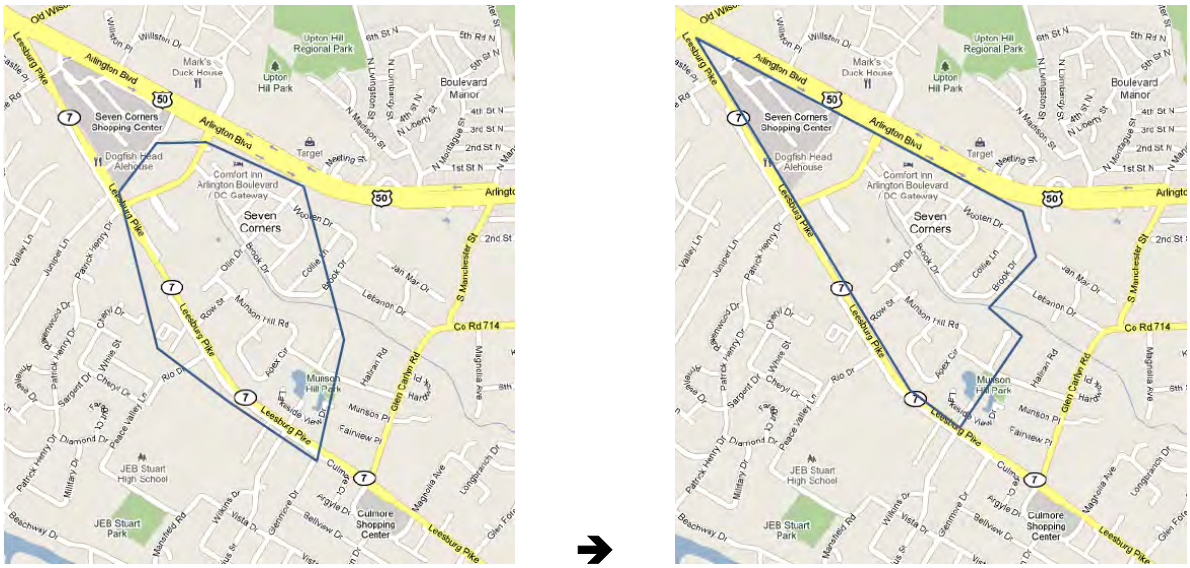


Figure 3.6b: The New Hot Spots



Officers argued that by splitting the hot spot in this way, they could carry out a "sweep-and-sit" technique within the 30 minutes allotted. The amount of sweeping and sitting time could vary at hot spots, and the GMU team did not set rigid requirements given the diversity of the hot spots developed. Another adjustment example can be seen in Figure 3.7.

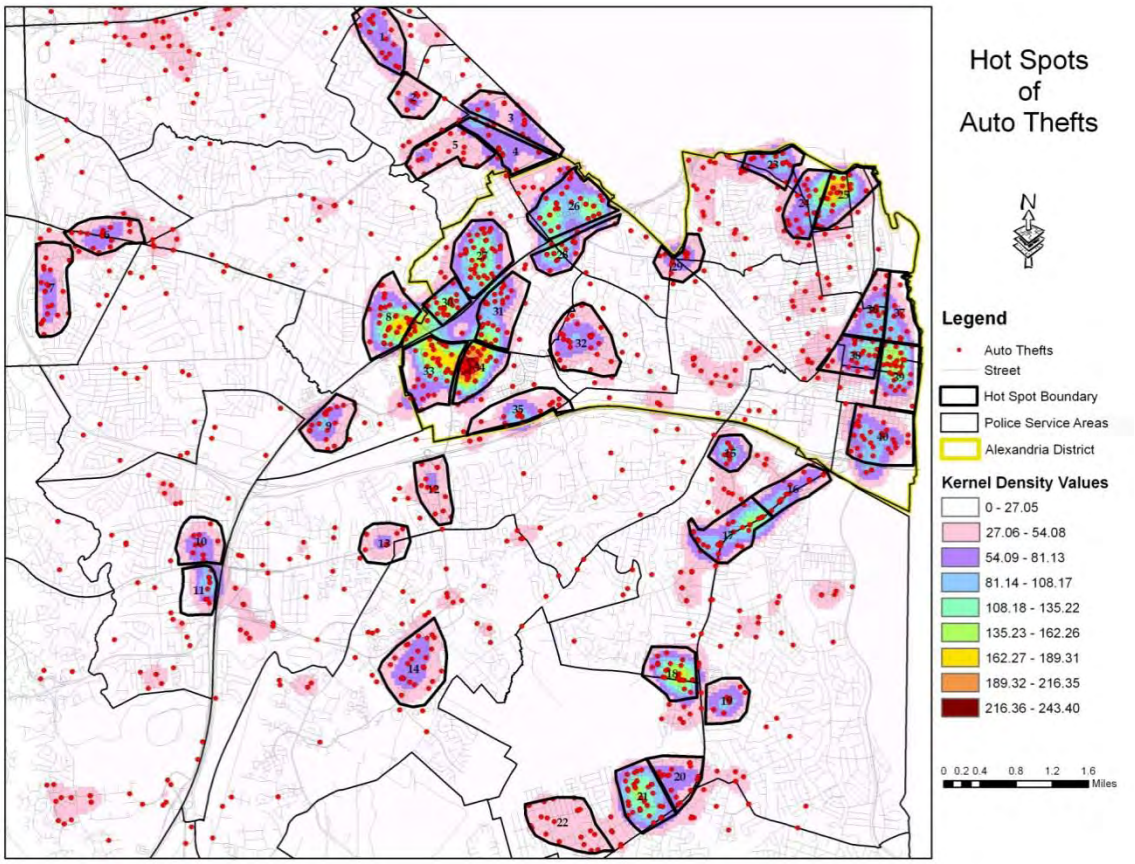
Figure 3.7: Another Readjustment Example



This mixed method of combining statistical approaches with officer adjustments became very important to the research team, because it meant that it combined a statistical analytic exercise—the generation of hot spots—with the realities of the operational units in order to come up with hot spots that were generated from a combination of research and experience. This type of interaction between the research team and operational units not only brings operational meaning to the implementation of research studies but better builds collaboration and understanding between researchers and agencies.

Thus, our initial 40 hot spots became 45 hot spots. One further adjustment was also made. Because the human resources available for this project from each agency was minimal (two officers from each agency were dedicated to this project), it would be impossible, given the time period allotted for these four officers, within the confines of their shift work and other responsibilities, to cover all hot spots in the areas we initially defined. To alleviate this issue, we removed the easternmost sector of the Alexandria Police Department from this project, as well as some western and southernmost hot spots from the Fairfax County police agency. Thus, in the end, we reduced our field of hot spots to 30 for this experiment, which are delineated by black borders in Figure 3.8.

Figure 3.8: Final Hot Spots for the GMU Experiment



The average number of auto thefts in these hot spots varied from five to 41 incidents (as calculated from the data we had available from January 2008 through September 2009), with an average in each hot spot of 20.23 incidents and a standard deviation of 9.412. The average area of the hot spots selected for this study varied in size from 0.06 square miles to 0.5 square miles, with an average of 0.238 square miles and standard deviation of 0.105 square miles. Some hot spots were on or close to the border between Alexandria City and Fairfax County, while others were not, creating an excellent and unique opportunity for a multi-jurisdiction study.

Randomization and Experimental Design

Field experiments establish validity through randomization in order to isolate the effects of treatment from other factors that may contribute to group differences. Randomized controlled trials are considered the "gold standard" in evaluation research and help to ensure that there is no systematic bias that divides subjects into experimental and control groups (Campbell and Stanley, 1963; Farrington and Petrosino, 2001; Weisburd, 2003). Specifically, random allocation provides an appropriate counterfactual in the control group, indicating what would happen had treatment not been administered (Cook, 2003). We use a place-based randomized control design in this study, as it is regarded as highly effective in contributing to believable results when examining the effectiveness of patrol crime prevention strategies (Boruch et al., 2000; Cook, 2003; Weisburd 2000).

"Of the 30 hot spots, 15 were randomly assigned to receive the LPR deployment intervention, while the other 15 were not. The assignment was not revealed to the officers involved."

Of the 30 hot spots, 15 were randomly assigned to receive the LPR deployment intervention as described previously, while the other 15 received "business as usual" policing (no change in the existing police activities in that area). The assignment was not revealed to the officers involved. To randomize hot spots, each was numbered 1–30 from the northernmost to the southernmost hot spot. To select approximately equal number of hot spots from each jurisdiction (13 of the hot spots fell in APD's jurisdiction and 17 in FCPD's jurisdiction), we block-randomized by jurisdiction, randomly selecting seven from Alexandria City and eight from Fairfax County.

The experiment was designed to last 30 officer working days for each officer (recall, there were two officers assigned within each jurisdiction for this experiment). For each working day for each officer, we also randomly selected five of the experimental hot spots per officer per day so that multiple hot spots per shift could be visited for 30-minute periods. Thus, there was a chance that officers would sometimes visit similar hot spots in

consecutive working days. Each of the five randomly selected experimental hot spots were printed onto a hot spot assignment sheet (see Appendix C), and placed into a sealed envelope with an instruction sheet (see Appendix B). The instructions sheet repeated the training that each officer received prior to the start of the experiment, which we describe below. We provided 30 sealed envelopes to the supervisors of each officer, for a total of 60 envelopes per police agency. These were given one by one to the officers for the 30 consecutive working days that the officers were available for the experiment.[20]

On each of the hot spot assignment sheets we provided an area where officers would record the number of reads, hits, and strategy used each time they went into and out of a designated hot spot. They also recorded the time that they entered and exited the hot spot so that the research team could measure how well the officers adhered to the 30 minute rule. Research team cell phone numbers were also provided on each map so that any questions from officers could be fielded at any time throughout the duration of the experiment. Once officers were done with their shifts, they would place their five maps, with recorded information, back into the envelop, seal and sign the envelop and return the packet to their supervisor.

Implementing the Experiment

TRAINING: Two officers in the Fairfax County Police Department (FCPD) and two officers from the Alexandria Police Department (APD) were dedicated to participate in the experiment and were not required to answer calls for service (unless in emergency or back-up situations). In order to insure the experiment was implemented well, we trained each officer with his or her supervisor on the entire experiment and gave each of them specific instructions about what to do with the daily envelopes. We include the transcripts of training materials in Appendix D, which provides a useful summary to agencies and researchers interested in replicating this experiment.

ASSIGNMENTS AND SUPERVISION: After training each officer and supervisor, we implemented the experiment on February 22, 2010, for each police department.[21] The FCPD ended its experiment on April 20, 2010, while the APD ended its experiment on June 1, 2010. In the Fairfax County Police Department (FCPD), the experiment was implemented by a marked auto theft specialized unit, consisting of one detective from that unit and one patrol officer on detail assigned to this project. Each officer had his own LPR vehicle and was assigned to work during the day. Hence, it could have been possible that

[20] There were days during the experimental period in which officers were not available, which extended both experiments in each jurisdiction further than anticipated.

[21] The start date of the experiment was delayed due to the historic 2010 Washington D.C. area snowstorm. Although most of the snow and ice had been cleared from the roads before the evaluation started, road salt and debris did affect the effectiveness of the plate readers, and snow banks blocked officer access to some parts of hot spots during the first few days of the evaluation. Another factor in the delay was the transition to a new records management system in one of agencies.

both officers worked on the same day and times. Limited resources and shift constraints did not allow the researchers to determine exactly when officers would patrol, although they generally did so during the daylight hours.

The implementation in the Alexandria Police Department (APD) was conducted by two patrol officers in District 3, or the Western half of the city. Because of resource scarcity, only one officer at a time could be allocated to the LPR unit per shift, so a system of two officers, switching off daily, was used. Additionally, APD officers are assigned to 11.5-hour shifts, which meant that they only work 3–4 days per week. This led to the APD experiment taking longer. For the vast majority of the experiment, the officers were able to maintain the experiment and its instructions, including following directions if they were unable to complete their daily assignments. In only one case, due to an unavoidable personal situation, did one officer not complete his 30-day assignment. It should be noted that this officer could have completed this assignment, but due to the time restrictions of this project, the GMU team decided to stop the experiment on this officer's 26th experimental day.

To ensure that the experiment was implemented correctly, supervisors were assigned by each agency command to oversee these officers. The research team also visited each agency after approximately 7 working days of the start of the experiment and then subsequently every 10 days or so to pick up folders and make sure the experiment was going as planned. The fidelity of the experiment was greatly increased by initial training, supervision, and detailed instructions included in each daily assignment packet.

IMPLEMENTATION FIDELITY: The daily logs for each patrol sheet indicate that the experiment was implemented fairly well and that the 30-minute rule was strictly followed. In the Fairfax County Police Department, of the 300 patrols assigned (five hot spots per day for 30 days for two officers), officers were unable to complete only 20 assignments. Of those 280 assignments completed, almost all (272) stayed 20–40 minutes within a hot spot, with 237 very close to exactly following the 30-minute rule. In APD, officers were also assigned to 300 total patrols and did not complete 44, since the experiment was ended earlier for one of the two officers. Of these 256 completed assignments, officers spent 20–40 minutes in 248 of them and followed the 30-minute time-in-hot-spot rule strictly in 236 hot spot assignments.

Responding to crimes, traffic stops, and family emergencies accounted for many of the missed assignments. Although officers were instructed to stay within the hot spot and to regard scanning vehicles with the LPR system as their priority during patrol, it was well

understood that backup calls, crime occurring within the hotspot, and similar events would be a higher priority for officers than experiment implementation.

PLATE SCANNING: The data within the LPR units consisted of downloaded stolen automobiles and license plates from the Virginia State Police, as well as any additional license plates entered into the LPR system manually by officers. This data was then compared to scanned plates. The average number of plate scans within hot spots per 30-minute visit in Fairfax County was 450. The mean number of plates scanned during a full patrol period ranged from a low of 324 to a high of 601. In Alexandria, the average number of plates scanned within hot spots was 689, ranging from 87 to 1068.[22] The variation between the number of plate scans can be explained in part by the characteristics of different hotspots—the presence of a busy street near or in the hot spot, the number of cars that are routinely parked in the area, and so on. The difference in the mean number of plate scans in hot spots was not statistically significant.

In total, there were 19 "accepted" hits in Fairfax during the experiment. Of these, there were three stolen vehicles found, one lost vehicle, and one set of stolen plates recovered in the hot spots during the experiment. The remaining hits were from terrorist/gang (13)[23], or sex offender watch lists (1). In Alexandria, there were 14 "accepted" hits, four of which were for stolen vehicles, and two of which were stolen tags. The remaining hits were from terrorist watch lists (4) or a mistaken or already recovered vehicle in the database (4).

From these data, it is difficult to draw any strong conclusions about the relationship between the number of plates scanned and the number of auto theft recoveries, which were both infrequent. However, the reader should recall that this experiment focuses on measuring the impact on LPR's ability to deter crime, not only the number of hits received by the LPR units.

The Outcomes Measured

In our experiment, we measure both the specific and general deterrent effect of LPR deployment (see Nagin, 1998; Sherman 1990). We define a general deterrent effect of LPR on crimes as measured by examining the trends of many different categories of crime and disorder in hot spots. The reason for measuring a general deterrent effect is that even if autothefts are not reduced, having a marked patrol unit in these locations may deter other crimes, as evidenced in previous hot spot patrol studies. In our study, we measured general deterrence using counts of reports of crimes and disorders, including crimes

[22] One of the two LPR officers in Alexandria failed to stop the LPR in-between hot spots and reported plate read numbers that were unusually high. Although we had the start and end number for reads for the day, we could not be sure that the LPR was not used outside of the hot spots (i.e., plates read in between hot spots). Thus, the average for the number of plates scanned in Alexandria was calculated using only one officer's reported numbers.

[23] Officers did not distinguish between terrorist and gang watch lists in accepted hits.

against persons and property (which included auto related crimes), weapon-related crimes, disorders, and drug activity. To give the reader a sense of the distributions of these crimes, we present Table 3.1. Table 3.1 provides the counts, for the entire Fairfax County and Alexandria City during the period we implemented the experiment for each jurisdiction, respectively.

Table 3.1. General Crime Distributions for the Two Jurisdictions

Crime Type	FCPD	% of Total Crimes	APD	% of Total Crimes
Person	1225	11.7%	508	15.9%
Property	4503	43.0%	1761	55.0%
Disorder	3959	37.8%	742	23.2%
Drugs and Vice	667	6.4%	173	5.4%
Weapons	99	1.0%	19	0.6%
TOTAL CRIMES	10453	100.0%	3203	100.0%

We also measured the deterrent effect of LPR on auto theft/theft from auto, as well as auto related crimes (auto theft, theft from auto, and other auto-related offenses such as driving under the influence and reckless driving). We chose these types of crimes, given that the types of data entered into the LPR units in these agencies primarily reflect these crime categories. While we use these measures for a "specific" deterrent effect, we note that a specific deterrent effect of LPR does not have to be measured with auto-related crimes. Whatever the specific type of crime(s) targeted with the devices would be this measure. Further, the term "specific deterrent effect" might also point to the effect of and LPR arrest on an individual's offending and recidivism. This is not measured in this study, but are important considerations nonetheless. Table 3.2 shows these distributions.

Table 3.2. Auto-Related Crime Distributions for the Two Jurisdictions

Crime Type	FCPD	% of Total Crimes	APD	% of Total Crimes
All Auto Related	2250	21.5%	655	20.4%
Auto Theft and Theft from Auto	1018	9.7%	437	13.6%

Percentages shown are of total crimes per jurisdiction.

Thus, we collected three measures for each of our hot spots: all crimes (persons, property, disorder, drugs and vice, and weapons), auto-related crimes (auto theft, theft from auto, and other auto-related offenses), and just auto theft/theft from auto. These counts were collected for five periods:

- **PRE-INTERVENTION PERIOD**: The period of days, equivalent to the intervention period, before the start date (February 22). For the Alexandria Police Department, this period included November 15, 2009, through February 21, 2010—for a total of 99 days. For the Fairfax City Police Department, we recorded crime information

from December 26, 2009, through February 21, 2010, matching the 58 intervention period days for FCPD.

- **INTERVENTION PERIOD**: The time period during the intervention. For the Alexandria Police Department, the intervention lasted from February 22 through May 31, 2010—a total of 99 days. For the Fairfax County Police Department, the intervention lasted from February 22 through April 20, 2010—a total of 58 days.

- **POST-INTERVENTION PERIOD**: We also collected crime data for 30 days after the intervention stopped for each jurisdiction. For the APD, this time period went from June 1 through June 30, 2010, and for the FCPD, this time period went from April 21 through May 20, 2010.

- **SEASONAL LAG OF INTERVENTION PERIOD**: To capture a seasonal effect of the intervention period, we recorded crime counts in the same time period of the intervention in the previous year. For the Alexandria Police Department, this was from February 22 through May 31, 2009, and for the Fairfax County Police Department, from February 22 through April 20, 2009.

- **SEASONAL POST-INTERVENTION PERIOD**: To capture a seasonal control for the post-intervention period, we recorded crime for the same 30-day period of the post-intervention period, but for the previous year. For the APD, this time period went from June 1 through June 30, 2009, and for the FCPD, this time period went from April 21 through May 20, 2009.

Statistical Approach and Models

Using a randomized controlled experiment, we applied the LPR patrols to our 15 experimental hot spots. Each of our three crime categories – all crimes, auto-related crimes, and auto thefts/theft from auto, were then recorded for each of the five periods above for each of the 30 hot spots. Of interest were differences between treatment and control hot spots for two dependent variables: crimes during the intervention period and in the post-30-day period immediately following the intervention. The control hot spots reflect the most appropriate counterfactual to the experimental units in a randomized controlled experiment. This makes the comparison of crime counts for each an adequate analytic approach. However, to better specify our model, we also incorporated three further controls: the pre-intervention levels of crime and the levels of crime in the same during- and after (3)-treatment periods the year prior.

Choosing the most appropriate statistical model to examine the effects of the intervention depends on the distribution of the dependent variables. While the distribution of all crimes during the intervention period appears normal, the distributions of auto-related crimes and auto theft/theft from auto were not, as Figure 3.9 (a – c) indicates. In particular, auto

crimes were skewed to zero or one crime per hot spot. This suggested that linear regression would not be an appropriate statistical approach for each of these models, but that perhaps a generalized linear model (Poisson or negative binomial) would be more useful, especially to model specific deterrence.

Figure 3.9a. Distribution of All Crimes Within Hot Spots During the Intervention Period

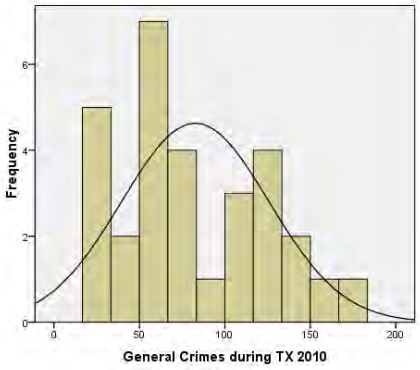


Figure 3.9b. Distribution of Auto Thefts and Thefts from Auto Within Hot Spots During the Intervention Period

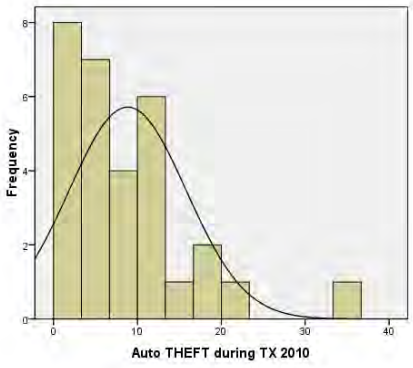
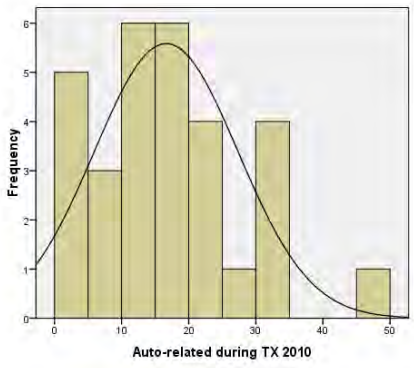


Figure 3.9c. Distribution of Auto-Related Crimes Within Hot Spots During the Intervention Period



Because there was evidence of over-dispersion in these low crime counts for auto-related crimes, the negative binomial generalized linear model was preferred over the Poisson distribution model for auto-related and autotheft/theft from auto categories (although we did conduct Poisson and found similar findings). We ran two models: First, we modeled the counts of these different categories of crime in the intervention period compared to the

pre-intervention period. Second, we modeled the counts of these different categories of crime in the post-intervention period compared to the pre-intervention period. The models specified were:[24]

ALL CRIMES:

Model 1: Modeling the Intervention Period

$$Y(Tx) = \beta_0 + \beta_1(x^{tx}) + \beta_2(x^{pre}) + \beta_3(x^{seasonTx}) + \beta_4(x^{ju}) + \beta_5(x^{juINT})$$

Model 2: Modeling the Post-Intervention Period

$$Y(POST) = \beta_0 + \beta_1(x^{tx}) + \beta_2(x^{pre}) + \beta_3(x^{seasonPOST}) + \beta_4(x^{ju}) + \beta_5(x^{juINT})$$

where: β_0 = Intercept

x^{Tx} = Intervention (experiment = 1, control = 0)

x^{pre} = Crime levels during pre-intervention period

$x^{seasonTx}$ or $x^{seasonPOST}$ = Seasonal covariate; indicates crime levels in the same period of dependent variable, but one year prior. The addition of "*Tx*" or "*POST*" matches the dependent variable being measured.

x^{ju} = A dummy variable for the jurisdiction (APD = 1, FCPD = 0)

x^{juINT} = A variable representing the possible interaction effect between location of the hot spot (Alexandria or Fairfax) and whether or not the hot spot was an experimental or control unit (Experiment x Jurisdiction)

In addition, for auto-related and autotheft/theft from auto crimes, the variable names remain the same as above. Here we also included in the model the natural log of an "offset" or exposure variable, ln(*offset*). The offset variable indicates the number of days (99 or 58) that a hot spot was exposed to the intervention:

AUTO-RELATED AND AUTO THEFT/THEFT FROM AUTO ONLY:

Model 1: Modeling the Intervention Period

$$Y(Tx) = \exp[\beta_0 + \beta_1(x^{Tx}) + \beta_2(x^{pre}) + \beta_3(x^{seasonTx}) + \beta_4(x^{ju}) + \beta_5(x^{juINT})] + \ln(offset)$$

Model 2: Modeling the Post-Intervention Period

$$Y(POST) = \exp[\beta_0 + \beta_1(x^{Tx}) + \beta_2(x^{pre}) + \beta_3(x^{POST}) + \beta_4(x^{ju}) + \beta_5(x^{juINT})] + \ln(offset)$$

[24] These models were developed in consultation with Dr. Christopher Koper of the Police Executive Research Forum, and reflect Taylor et al. (2010).

Experimental Results

MEAN COUNTS OF CRIME

Table 3.3 shows the counts for the hot spots per jurisdiction for each crime categorization and for each time period measured.

Table 3.3. Mean Counts of Crimes for Hot Spots by Jurisdiction and Measure

	Mean	Std. Deviation	Mean	Std. Deviation
	FCPD (17 hot spots)		APD (13 hot spots)	
ALL CRIMES				
Pre-Intervention	52.24	24.004	71.31	45.644
During Intervention	86.41	41.384	77.77	46.494
Post-Intervention	41.12	20.068	17.85	12.233
Seasonal Intervention (2009)	82.65	43.190	66.00	37.076
Seasonal Post-Intervention (2009)	44.53	24.567	25.38	15.570
AUTO RELATED*				
Pre-Intervention	12.82	6.635	17.00	13.916
During Intervention	16.71	9.835	16.54	12.190
Post-Intervention	6.88	3.295	3.77	3.059
Seasonal Intervention (2009)	9.06	5.309	13.15	7.679
Seasonal Post-Intervention (2009)	7.94	4.981	6.69	5.407
AUTO THEFT/THEFT FROM AUTO				
Pre-Intervention	7.12	3.407	14.62	13.035
During Intervention	6.24	3.882	12.23	8.691
Post-Intervention	2.76	2.223	2.69	2.689
Seasonal Intervention (2009)	4.94	2.817	9.77	6.698
Seasonal Post-Intervention (2009)	2.71	1.312	4.62	2.755

* Recall, "auto-related" means auto theft, theft from auto, and other auto-related offenses such as driving under the influence and reckless driving.

Table 3.4 then displays the mean values across the 30 hot spots of the experiments in the pre-, during, and post-intervention periods.

Table 3.4 Mean Counts of Crime in the Control and Experimental Group Combined by Time Period Measured

	Control or Experiment	Mean	Std. Dev.	Std. Error	Min	Max
ALL CRIMES						
Pre-Intervention	Control	60.87	39.379	10.168	15	149
	Experiment	60.13	32.935	8.504	12	151
	Total	60.50	35.671	6.513	12	151
During Intervention	Control	79.67	48.153	12.433	19	164
	Experiment	85.67	38.878	10.038	28	170
	Total	82.67	43.109	7.871	19	170
Post-Intervention	Control	32.40	23.591	6.091	3	91
	Experiment	29.67	17.690	4.568	5	60
	Total	31.03	20.535	3.749	3	91
AUTO-RELATED CRIMES						
Pre-Intervention	Control	13.80	8.402	2.169	3	28
	Experiment	15.47	12.386	3.198	4	54
	Total	14.63	10.434	1.905	3	54
During Intervention	Control	15.33	9.788	2.527	3	32
	Experiment	17.93	11.768	3.039	4	49
	Total	16.63	10.717	1.957	3	49
Post-Intervention	Control	5.47	3.758	.970	0	12
	Experiment	5.60	3.376	.872	0	12
	Total	5.53	3.511	.641	0	12
AUTO THEFT/THEFT FROM AUTO						
Pre-Intervention	Control	9.60	6.833	1.764	3	23
	Experiment	11.13	11.855	3.061	2	50
	Total	10.37	9.539	1.742	2	50
During Intervention	Control	8.07	5.298	1.368	3	20
	Experiment	9.60	8.458	2.184	2	35
	Total	8.83	6.978	1.274	2	35
Post-Intervention	Control	2.47	2.642	.682	0	8
	Experiment	3.00	2.171	.561	0	8
	Total	2.73	2.392	.437	0	8

GENERAL DETERRENCE OF ALL CRIMES

In applying the models when examining the general deterrent effect of LPR patrol, there appeared to be no discernible difference in the levels of crime during or after the intervention period between experimental and control hot spots (Table 3.5). We discuss

shortly why this may have occurred, from weakness of intensity of intervention to the possibility of a real lack of effect of LPR.

Table 3.5 Linear Regression Results for General Deterrent Effect of LPR

	MODEL 1 **Y(Crime Levels During Tx)**	**MODEL 2** **Y(Crime POST Intervention)**
Constant	8.46 (7.600)	10.19 * (4.730)
Intervention Effect **(Experiment=1)**	10.19 (7.998)	-.26 (4.486)
Pre-Intervention Crime Levels	.71 *** (.152)	.06 (.073)
Seasonal Effect **(either Tx or POST in 2009)**	.44 ** (.132)	.62 *** (.121)
Jurisdiction Effect	-8.33 (9.174)	-12.803* (5.772)
Interaction Effect **(Intervention x Jurisdiction)**	-13.28 (11.866)	.44 (6.861)
Adjusted R^2	.87 (15.722)	.62 (12.713)

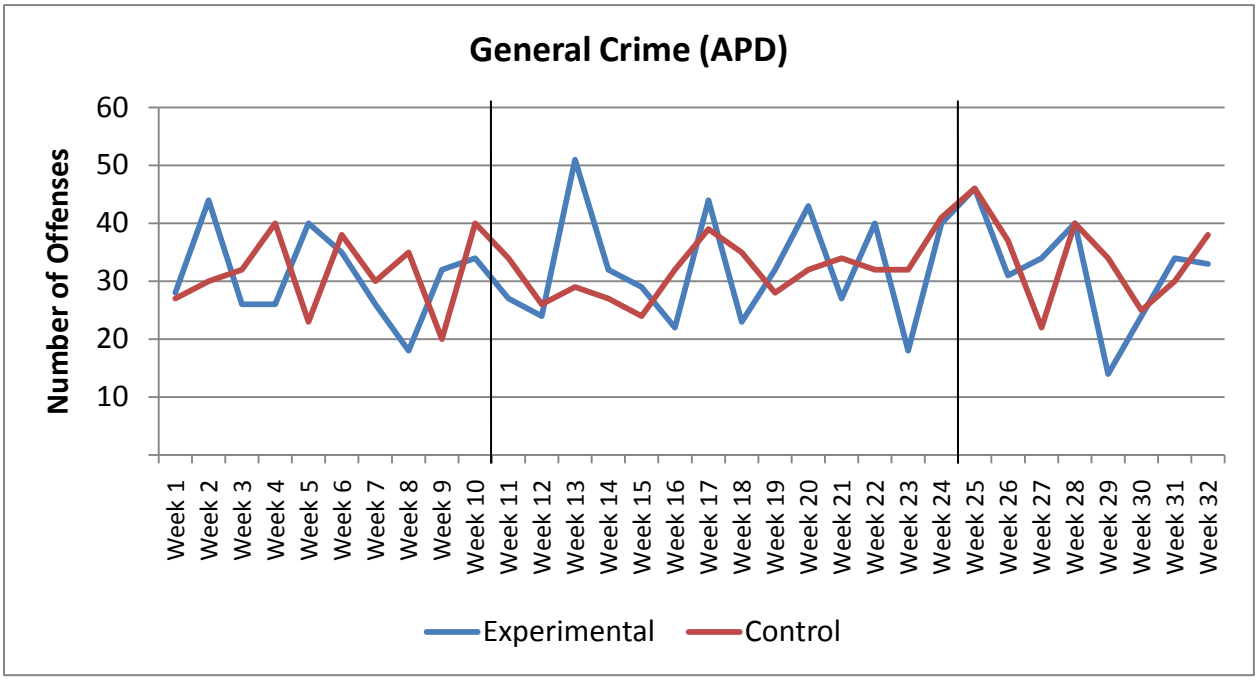
Unstandardized β coefficients reported, with standard errors in parentheses.
* p<.05, ** p<.01, *** p<.001

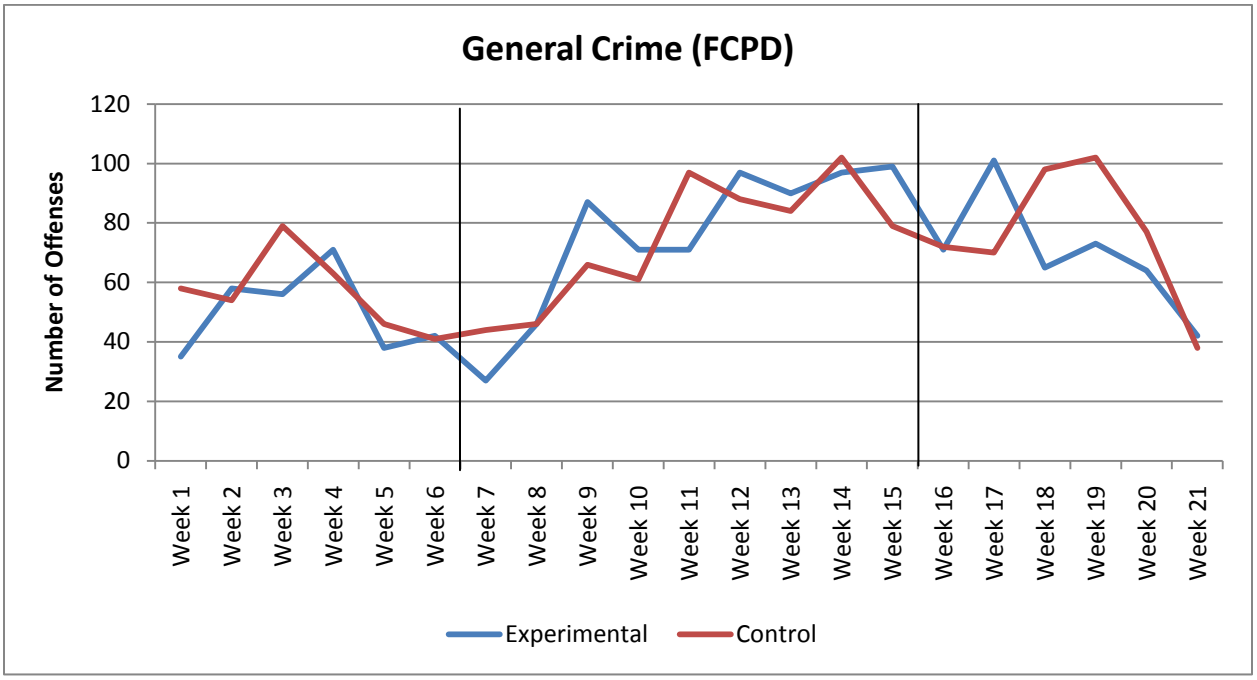
It appears that crime levels during the treatment period were best predicted by crime levels in the same time period before treatment and during the same time period a year prior (the "seasonal effect"). Although crime levels in the post-intervention period were not significantly influenced by crime levels prior to treatment, a seasonal effect was also found. It appears that hot spots in Alexandria city had significantly less crimes compared to Fairfax County in the post treatment period, although this was found in both treatment and control groups. The interaction effect indicates that the effects of the intervention did not differ across the two jurisdictions.

Figure 3.10 shows the weekly counts of all crimes for Alexandria Police Department (APD) and Fairfax County Police Department (FCPD) during the pre-intervention, intervention, and post-intervention periods. The experimental period is delineated by the vertical lines

for each jurisdiction respectively.[25] No clear pattern emerges from these visualizations between control and experimental groups.

Figure 3.10. Weekly trends of all crimes for Alexandria City and Fairfax County





[25] Weekly trends of all crimes for Alexandria from the week of November 15, 2009 ("Week 1") through the week of June 30, 2010 ("Week 32") and for Fairfax County from the week of December 26, 2009 ("Week 1") through the week of May 20, 2010 ("Week 21").

SPECIFIC DETERRENCE OF AUTO THEFT AND AUTO-RELATED CRIMES

Similarly, we did not discover a statistically significant specific deterrence effect of LPR deployment in hot spots on auto theft or auto-related crimes (Table 3.6). And, as with all crimes above, the effects of the intervention did not differ across the two jurisdictions.

Table 3.6. Negative Binomial Results for Specific Deterrent Effect of LPR

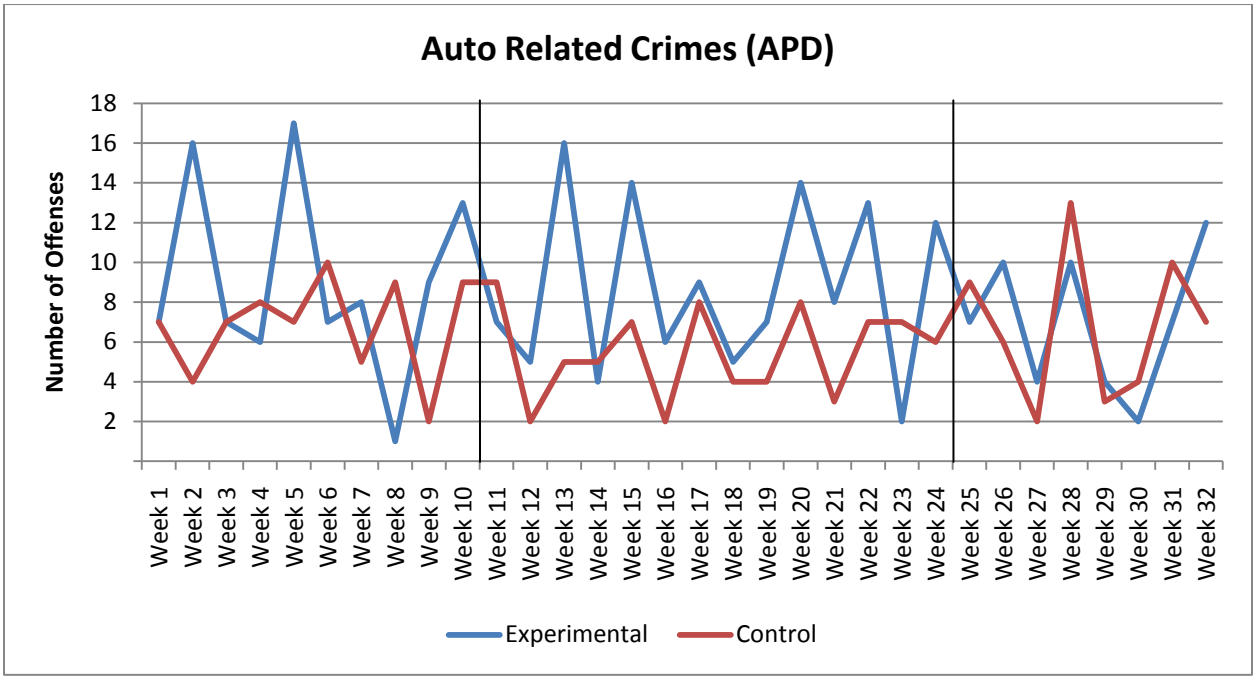
	Auto-Related Model 1 Y(Tx)	Auto-Related Model 2 Y(POST)	Auto-THEFT Model 1 Y(Tx)	Auto-THEFT Model 2 Y(POST)
Intercept	-2.39 *** (.544)	-3.03 *** (.556)	-2.76 *** (.448)	-3.90 *** (.561)
Intervention Effect **(Experiment=1)**	.37 (.532)	.32 (.557)	.03 (.525)	.60 (.577)
Pre-Intervention Crime Levels	.04 (.023)	.03 (.030)	.04 (.022)	.04 (.030)
Seasonal Effect **(either Tx or POST in 2009)**	.04 (.041)	.04 (.053)	.05 (.045)	.08 (.120)
Jurisdiction Effect	-.70 (.550)	-1.03 (.641)	-.52 (.615)	-.70 (.689)
Interaction Effect **(Intervention x Jurisdiction)**	-.49 (.817)	-.50 (.852)	-.07 (.796)	-.96 (.894)
Chi-Squared (df=24)	4.031	7.495	6.108	12.715
Log-Likelihood	-111.145	-80.677	-93.096	-62.902

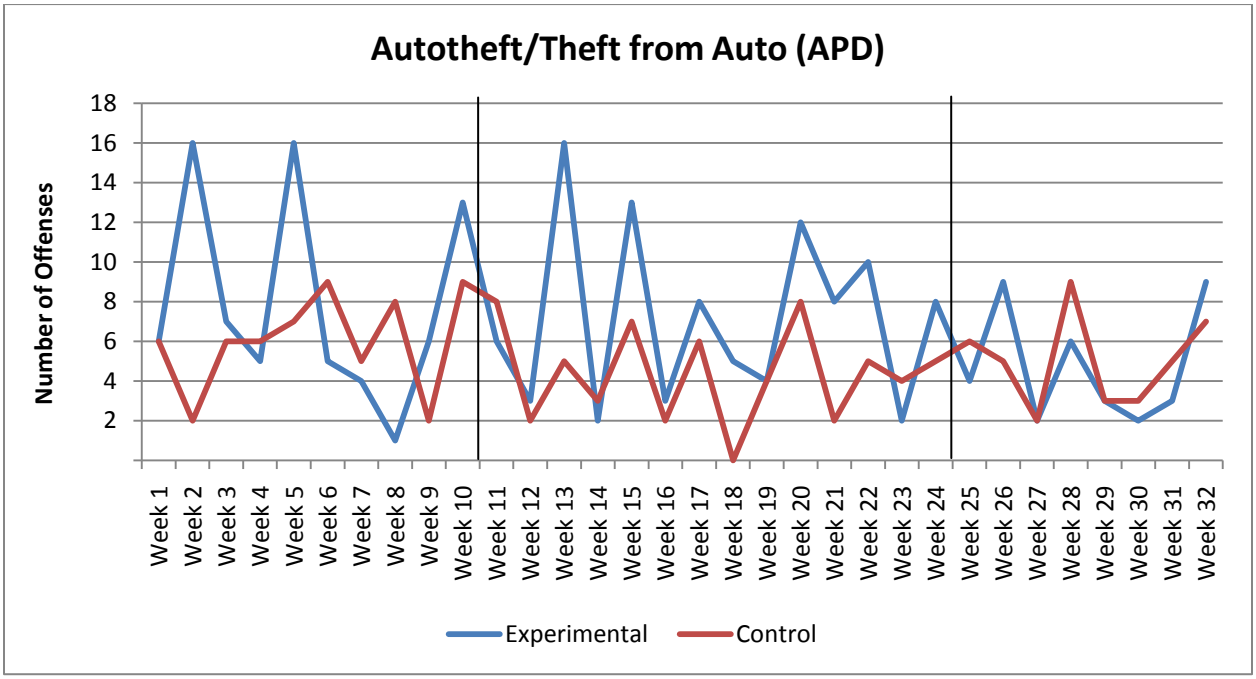
Unstandardized β coefficients reported, with standard errors in parentheses
* p<.05, ** p<.01, *** p<.001

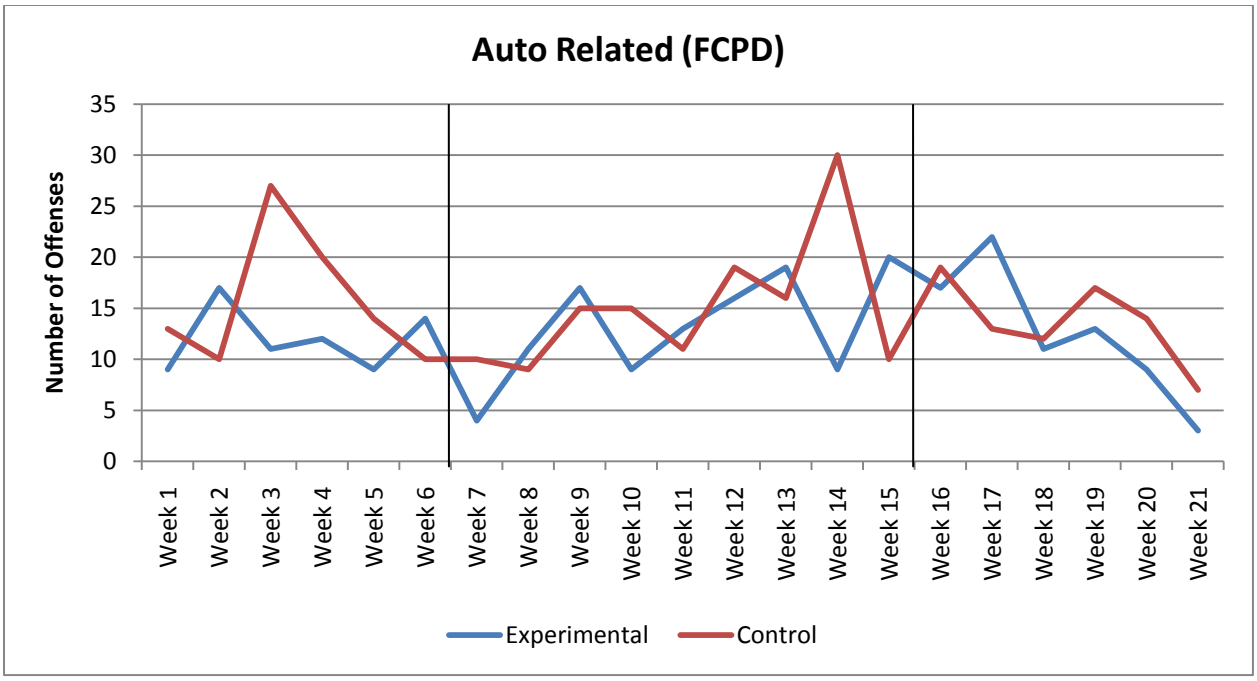
Figure 3.11 shows the weekly counts of auto-related crimes and auto theft/theft from auto for Alexandria Police Department (APD) and Fairfax County Police Department (FCPD) during the pre-intervention, intervention, and post-intervention periods for each jurisdiction respectively.[26] No clear pattern emerges from these visualizations between control and experimental groups.

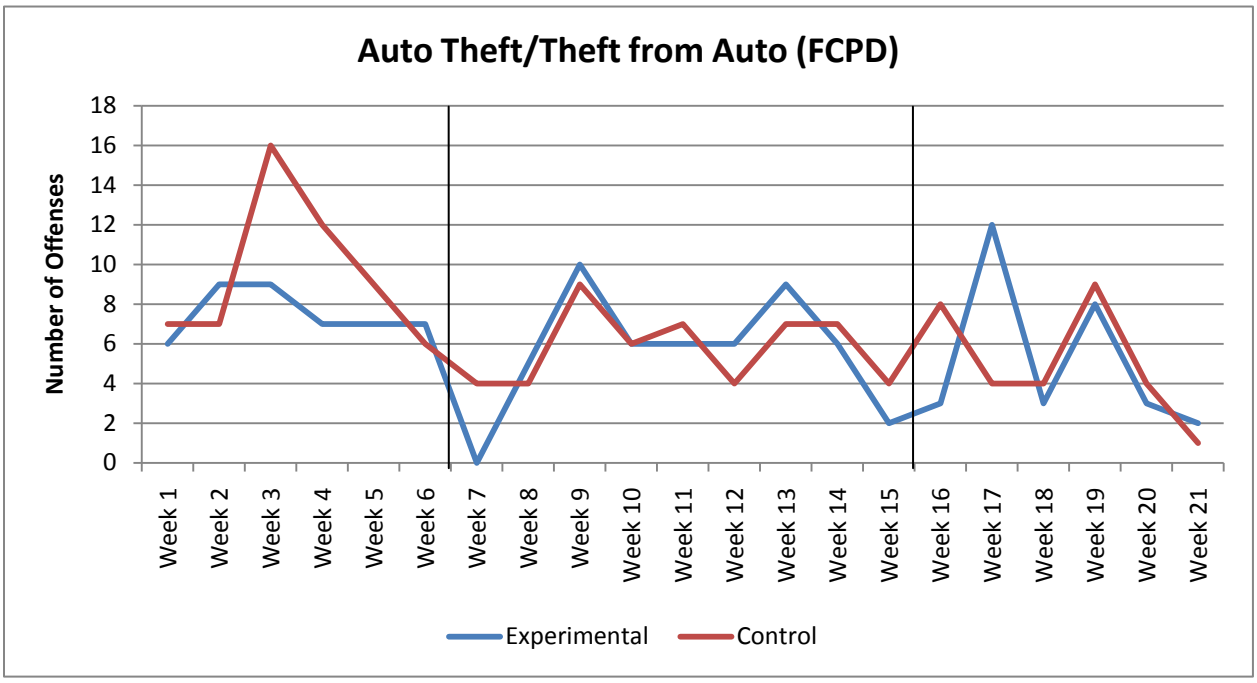
[26] Again, weekly trends of all crimes for Alexandria are from the week of November 15, 2009 ("Week 1") through the week of June 30, 2010 ("Week 32") and for Fairfax County from the week of December 26, 2009 ("Week 1") through the week of May 20, 2010 ("Week 21").

Figure 3.11. Weekly trends of auto-related crimes and auto thefts/thefts for Alexandria City and Fairfax County









A NOTE ON SENSITIVITY TESTS FOR DISPLACEMENT AND DIFFUSION

This study was not designed to specifically measure displacement of crime and diffusion of benefits (see Clarke and Weisburd, 1994; Weisburd et al., 2006), primarily because of the small number of hot spots and adjacency between some hot spots. Although the individual re-mapping of hot-spot boundaries helped to define areas that were more

environmentally distinct, there may be the possibility of displacement of crime and diffusion of benefits to adjacent control hot spots from experimental ones. The limitation on the number of hot spots in these two jurisdictions did not allow for the creation of clearly distinct and separated hot spot locations with non-overlapping buffer zones to measure displacement.

However, to consider the possibility of displacement and diffusion, we ran sensitivity tests for each of our models, controlling for possible effects of the intervention from experimental to control hot spots. To do this, we created a dummy variable to control for the presence of an adjacent experimental hot spot to a control area. This allowed us to detect whether any differences created by the intervention in an experimental hot spot was the result of displacement or diffusion. The inclusion of this factor in each of the models described above did not significantly affect any of the effects shown.

Possible Explanations for Non-Significant Findings

The findings may simply indicate that LPR patrols, even when used in ways that reflect the evidence, do not have a general or specific deterrent effect on crimes as measured by crime levels during and after the intervention. Indeed, the PERF findings (Taylor et al., 2010) were similar. That research team also found that hot spots in which LPR was used did not see the same significant reductions in crime compared to hot spots in which an autotheft specialized unit did manual-checking (although the LPR patrols had more detections of stolen automobiles). From these findings, any blanket-statement supporting agency purchase or government funding of LPR devices should be viewed cautiously.

There are two important caveats to the meaning of both the GMU and PERF findings. First, as we learned in Chapter 2, LPR is rapidly diffusing into American law enforcement, especially among agencies with 100 or more sworn officers. This rapid technological diffusion is occurring with or without the evidence about the effectiveness or effects of LPR. Secondly, accepting these findings assumes that the intervention within the experiment reflects the correct way to deploy LPR units.

"From these findings, any blanket-statement supporting agency purchase or government funding of LPR devices should be viewed cautiously."

The first caveat has important implications for the second. No matter the evidence, police agencies and federal and state governments have already invested in LPR technology. Finding the way to get the most out of LPR units already in use will be the next stage of evaluation. We suggest that three factors should be considered in improving the effects that LPR might have on crime generally or on auto theft (or other crimes) more specifically. These factors are:

1. **Intensity and frequency of deployment:** One possible reason for the lack of significant difference between treatment and control hot spots in this experiment is the weakness in the intensity of the intervention in our experiment. Because of very limited resources in both APD and FCPD, there was likely only a single vehicle involved in an experiment hot spot at any given time. This intensity differs drastically from other hot spot experiments conducted by Sherman, Weisburd, and Mazerolle, in which saturation of patrol and an "all-hands-on-deck" approach is employed.

   On the other hand, this limited resource availability of LPR is likely to reflect the normal situation in many agencies that use LPR. One or a few units might be available for even larger agencies, as our national survey found. Given the PERF findings, we suggest that a combination of LPR units and manual auto-theft tactical approaches (running tags on mobile terminals or through dispatch) in hot spots may be more useful in a situation of limited resources. We also hypothesize (although further testing is needed) that a Koper Curve approach in hot spots is more economical in terms of hot-spot coverage.

2. **Limited database of LPR units:** Discussed extensively in Chapter 4, this is the notion of improving the base of data imported into LPR units. As emphasized in Chapter 1, LPR is an information technology system and therefore relies on the availability of data from which the system can compare scanned tags. If data is outdated, limited in size or scope, or not connected to other pieces of data, this will limit the abilities of LPR. These are limits reflected in this experiment. However, expanding the source and connectivity of data that LPR units access as well as the analysis conducted on data that LPR units collect can have consequences on citizen privacy and also police agency legitimacy.

3. **The use of LPR may reduce the deterrent effect of patrol:** It may be the case that LPR use alone by uniformed vehicle patrol reduces the deterrent effect of that patrol unit. For example, if an officer is sitting in a fixed location scanning cars passing by, he or she may provide less general coverage of a hot spot, even within 30 minutes, than a roaming car might provide. Or, an officer focusing on LPR "hits" and positioning his or her vehicle to scan cars may miss seeing disorders and crimes because of the distraction. On the other hand, LPR frees the officer from constantly running tags on his or her mobile unit. One option that officers might consider is to view LPR as a background-scanning device but focus on activities that evidence indicates are effective (problem solving and proactive patrol in very small hot spots).

Should we just focus on arrest as our outcome measure?

During one presentation of these findings, an individual suggested that the non-significant findings simply reinforced the notion that the performance measure used for LPR should not be crime rates but rather arrests and license plates scanned. We disagree. Police scholarship has made significant inroads into moving police away from only considering reactive, police-initiated performance measures such as numbers of arrest. Indeed, arrest rates can increase with no effect on crime or calls for service. Rates of crime or calls for service could even increase during periods of more arrests.

Further, one would be hard-pressed to justify a $20,000 purchase of an LPR unit with an increase in one, five, or even 10 arrests without a decrease in crime (unless, perhaps those arrests could show a decrease in crime over the long term). We also disagree with regard to the "number of scans" or "number of positive hits" benchmark for successful deployment. Most obviously, an officer can obtain the same number of scans in one area compared to another, but with different positive hit rates. With regard to hit rates, the argument about arrests, above, is similarly applied.

What needs to be more generally emphasized is that technology will ultimately always lead to faster processing. But as Lum (2010) emphasizes, efficiency does not equal effectiveness, especially in policing. Technologies are not used in a vacuum but are filtered through the organizational, strategic, and tactical cultures of police agencies. Such cultural filtering may lead to accepting a technology, because it seems obviously

"Technologies are not used in a vacuum but are filtered through the organizational, strategic, and tactical cultures of police agencies. Such cultural filtering may lead to accepting a technology, because it seems obviously efficient given past practices, or makes sense given the current mentality of the police. Both of these are predicated on the belief that past and current practices, traditions, and cultures, as well as organizational structures are the most optimal for police decision making."

efficient given past practices, or makes sense given the current mentality of the police. Both of these are predicated on the belief that past and current practices, traditions, and cultures, as well as organizational structures, are the most optimal for police decision making. Indeed, recent reforms such as community policing, problem-solving, evidence-based approaches, information-led policing and management, and other paradigm shifts have challenged these beliefs.

Officer Experiences with LPR and the Experiment

We end this chapter with a final section on officer experiences with the experiment. Toward the end of the experiment, we conducted semi-structured interviews with each officer and his or her supervisor (the questions are included in Appendix E). Many of these are reflected in our deployment guides, officer and supervisor tips, and video demonstrations at our LPR web portal, http://gemini.gmu.edu/cebcp/LPR/index.html and may help others better understand both research and implementation concerns.

OFFICER EXPERIENCE WITH THE LPR TECHNOLOGY

All of the officers agreed that the LPR technology was relatively easy to learn. One officer remarked that he had been taught to use the system in 15 minutes and found that the interface was straightforward. There were a few minor issues with the software and cameras; for instance, officers remarked that having the LPR system running increased the lag time of the in-car computer system. The ability of the cameras to function was sometimes hampered severely by rain and foggy conditions, which meant that the images of license plates that officers were attempting to verify could become difficult to interpret. The officers also remarked that some of the older systems seemed to have a narrower field of vision, and readjusting the unit on the vehicles could increase the number of reads that the system produced.

OFFICER EXPERIENCES WITH IMPLEMENTING THE EXPERIMENT

The officers expressed a number of challenges and common themes concerning the successes and difficulties of the implementation of the experiment. First, although officers were not entirely clear about the purposes of the experiment, what was apparent was that straightforward and direct deployment commands work best in both experimentation and everyday deployment of tactical interventions. What made this portion of the experiment lucid was clearly delineated hot spots, proper training, straightforward instructions, and supervision on what to do in the event of deviation or distraction from the experiment, as well as clear information on how to record their activities.

The experiment, however, affected officer attitudes and flexibility, although all of the officers generally remained positive about their overall experience with the study. First, long-term involvement in hot-spot patrol became tedious, and some of the officers cited

boredom as one of the negative aspects of the experiment. Because there were relatively few hot spots selected for the experiment group, officers would routinely go to the same area on consecutive patrol days and commented that the experience became repetitive. Officers also noted that using LPR in these same hot spots meant that many of the same vehicles were scanned each day.

Secondly, the daily hot spot randomization scheme required officers to patrol hot spots in a particular order, which meant that they sometimes had to drive relatively long distances through traffic in order to reach the assigned hotspots. This was particularly problematic in Fairfax, which is a large area (over 407 square miles) that experiences heavy commuter traffic throughout the day. Officers attempted to adjust their patrol times in order to avoid the heaviest traffic, but the combination of the randomization scheme and the density of traffic meant that officers occasionally could not complete their assigned days of patrol. Although the researchers decided to limit the hot spots in the experiment-and-control group to a relatively small area of Fairfax County, it still took officers sometimes up to 2 hours to move from one hot spot area to another.

Finally, aspects of shift work also affected implementation. There were two departments and three immediate supervisors involved with coordinating the patrols. Although the police fully supported implementation throughout the RCE, occasional emergencies, calls for backing up other officers, and personnel shortages did require officers to break from the experiment. Also, officers who began the patrol day later and had less flexibility in their schedules noted that they were less successful at implementation on any given day.

OFFICER EXPERIENCES IN IMPLEMENTING THE DEPLOYMENT MODEL

The process of patrolling was relatively straightforward to officers. Within the confines of the hot spots, officers would attempt to maximize the number of hits to increase their chances of finding a stolen vehicle. After sweeping the area, officers were given some discretion as to their efforts, but they tended to prefer stationary patrol (hence the "sweep-and-sit" intervention that marked this experiment). The stationary approach was preferred for two reasons—one, operating the patrol vehicle while checking plates was an awkward process and sometimes required the officer to back the patrol vehicle up to ensure that they had scanned all of the plates in an area. Secondly, officers perceived that they would be able to scan more vehicles in stationary patrol, especially in areas with high vehicle traffic, such as a busy intersection or a road with a median to track vehicle traffic in both directions.

Although the primary use for LPR was scanning plates for comparison against the database of stolen vehicles, officers did note that the system was useful in other contexts. For instance, officers sometimes received an all-points-bulletin about a vehicle that was involved with a crime. When this information also involved a license plate of a vehicle, officers would load the plate information into their vehicle database so that the LPR

scanned for it in addition to the existing database of vehicles. One officer involved with the study recovered a stolen vehicle in this way. In addition, the LPR system saves records of scanned vehicles so officers could use lookout information to see if the LPR had ever scanned a particular plate. Information on another stolen vehicle was found by an officer involved in the study using this method.

We also asked officers to contrast LPR patrol in hot spots with the traditional approach to identifying and responding to auto-theft problems. Officers commented that traditionally, the identification of and response to auto-theft problems depended on the sector where the problems were occurring. In some locations, crime analysis was used to identify problem areas; in others, officers relied on their experiences to patrol. One officer spoke of the experience: "I ran tags all the time the normal way and never found any stolen vehicles or tags. I never found anything. Before [using LPR in this way], when I was on patrol I'd go to places where I thought there were stolen cars and run the tags. I would go through places and run all of the cars on the road."

OFFICER GENERAL EXPERIENCE WITH EVALUATION RESEARCH

Although there were a number of frustrations and initial negative reactions with the experiment as aforementioned, officers and their supervisors responded that they would be willing to participate in an evaluation with researchers again. Also, some officers commented that the experiment was beneficial to them in several ways—it forced them to become more proficient with their equipment, it made them significantly more familiar with their patrol areas, and they liked the fact that the researchers were relatively unobtrusive during the experiment. Implementing the experiment made the officers of Fairfax County (which is 26 times the size of the City of Alexandria) learn new travel paths, traffic patterns, and ways to get into and out of patrol areas. Interestingly, one of the sergeants involved in the experiment commented that he would be better able to explain the need for participation in RCEs in general because of this experience.

Officers frequently commented that the success of the implementation of this experiment did not rely on the researchers as much as on allocating the labor and equipment needed to implement the experiment appropriately, which in turn required the direct intervention of supervisors. In one department, patrol officers remained on duty during the implementation of the experiment and continued to respond to calls when not actually conducting patrols with the LPR in their assigned hot spots. Alerting dispatch of the special assignment to LPR patrols was also important. Further, one sergeant remarked on the

importance of leadership to convey the significance and purpose of working with researchers with whom officers involved.

Although researchers made an effort to meet with officers before beginning the experiment to explain the rationale of the LPR evaluation, other personnel issues, such as officer turnover and shortages of workers, meant that not all officers had the same introduction to the experiment. This initially led some officers to regard experimenting as "just an assignment" that interfered with regular work. In one department, the process of implementation was further complicated by a change in the car computer system software. These issues seem to indicate that attention to the individual officers who are implementing experiments is an important priority for researchers, and engagement with police at all levels of command—chiefs and commanders, immediate supervisors, and the individual officers—is important throughout the research process.

Final Thoughts

This and the PERF LPR experiments represent two of the first experimental evaluations of a police technology and their effects on crime. We summarize our findings with five important take-away-points:

- Measuring the effectiveness of LPR requires more than just assessing the technology's efficiency in scanning and detecting. It requires rigorous evaluation, in which crime prevention, control, and deterrence outcomes are used. This and PERF's experiments indicate that police technology can be tested using randomized controlled experimentation, and that more testing is needed of various uses to determine in what way LPR can be most effective.

- LPR is rapidly diffusing into police agencies, especially among those departments with over 100 sworn officers. Although the specific test of LPR in this experiment did not yield significant results, this rapid diffusion of a very expensive technology means that continued testing of LPR deployment is needed to seek out ways in which LPR's use can be optimized.

- The totality of policing evidence from the Evidence-Based Policing Matrix indicates that the best use of LPR is proactive patrols in crime hot spots and using the Koper Curve principle. However, the specific findings here indicate that weak intensity of deployment, as well as limited data underlying LPR systems, can possibly dampen effectiveness. Thus, agencies with LPR should draw lessons from the implementation here and consider more intensive deployment or expanding the database underlying LPR systems. Of course, expanding database systems may yield other concerns, which are examined more deeply in the next chapter.

- Our interviews with officers indicate that officer support and first-line supervision are key in implementing any innovative strategy. Incorporating clearly defined strategies to increase officer engagement and transformational leadership can assist in creating the infrastructure necessary for implementing new deployment models.
- Finally, it is possible that the results here could indicate that LPR deployment does not lead to measurable crime-reduction effects. We strongly urge agencies and researchers to consider further testing police technologies and their effects on crime before coming to that conclusion.

The George Mason University research team thanks the Alexandria and Fairfax County Police Departments for their exceptional efforts in carrying out this experimental evaluation.

4. LEGAL ANALYSIS AND THE COMMUNITY SURVEY

POLICE LEGITIMACY, CITIZEN PRIVACY, AND LEGAL ISSUES[27]

***Overview**: In addition to surveying police organizations and evaluating the impact of LPR on crime, the GMU research team also sought to examine community views of License Plate Recognition technology (LPR). Toward this end, we conducted the first random-sample community survey-experiment related to the technology. The goal of the survey-experiment was to provide an understanding of LPR's potential impact on communities and the effect of LPR use on police legitimacy and job approval. This chapter develops a continuum of LPR uses in order to provide a framework for understanding the legal and legitimacy issues related to LPR and in order to aid policy development. Following this, a review and integration of existing legal analyses of LPR is conducted. Finally, results from the community survey-experiment are discussed and are targeted to various points on the LPR continuum. The community survey-experiment finds that the community is generally supportive of LPR use. However, despite the high levels of support and high levels of police legitimacy in this community, the survey-experiment also detected slippage in opinions about the police, as well as in police legitimacy, once the use of LPR was discussed.*

Challenges and Concerns about LPR Use

License plate recognition technology is rapidly diffusing in policing. In our national survey of police agencies, we found that 37 percent of large agencies already use LPR and that, as of September 2009, nearly one-third of large agencies not currently using LPR plan to acquire it within one year. It is also clear from our study that technical capacities for the storage of LPR data, as well as the ability to link this data with other databases, are similarly expanding. Our national survey further reveals that 81% of large law enforcement agencies routinely use laptop computers within their patrol cars, suggesting that many officers have become accustomed to working with technology while on patrol. Presumably, these and other technological innovations will continue to support the rapid diffusion of LPR and other technologies into U.S. police agencies.

Within this climate of rapid adoption, however, speculation exists over the legal and legitimacy implications of LPR use. Yet, despite the pressing need for answers to these questions, few agencies or researchers have examined these concerns. In fact, our national survey of police agencies indicates that only 28.5% of agencies researched the legal implications of the technology before adopting LPR. Furthermore, these assessments seem to be informal, and little has been written about the concerns of LPR in general.

[27] The authors would like to thank Dr. Devon Johnson for her helpful comments during the creation of this survey.

The few articles and reports that have been written have examined the potential legal issues related to LPR (Hubbard, 2008; International Association of Chiefs of Police [IACP], 2009). However, while strictly legal evaluations provide a useful starting point for agencies, they are meant to acquaint readers with potential issues and hypotheses rather than to provide empirical analyses about the extent to which concerns are salient. Social science research can provide guidance to agencies in assessing questions of LPR impact on police legitimacy, job approval, and agency-community relations.

To aid in the construction of an evidence base for LPR, we utilize a community survey-experiment to test potential legal and legitimacy issues. A "community survey-experiment" is a type of survey (in our case, a random sample survey of 2000 residents in one community) that also includes randomized controlled experiments embedded within it. These experiments manipulate or add survey wording in order to test the impact of these changes on the answers of respondents. Experimental surveys, as compared to control surveys, may also alter the ordering of questions for the same purposes. For example, in a control survey, one might ask respondents about their feelings regarding LPR use. In comparison, in experimental surveys, respondents might be asked the same questions following questions about privacy or crime. In this way, the survey-experiment can provide tangible results regarding individuals' reactions to the primary uses of LPR and what might trigger negative or positive reactions to the technology under different controlled conditions.

To begin, this chapter introduces a *continuum of LPR* uses. Understanding the range of LPR uses can help to hypothesize and test the salience of the variety of concerns that may arise from various uses. Currently, no such framework exists; rather, previous analyses have often treated the uses of LPR as equivalent in their implications. Following discussion of this continuum, the legal issues surrounding LPR use are briefly reviewed prior to a detailed discussion of the community survey-experiment.

The Continuum of LPR Uses as a Framework for Analysis

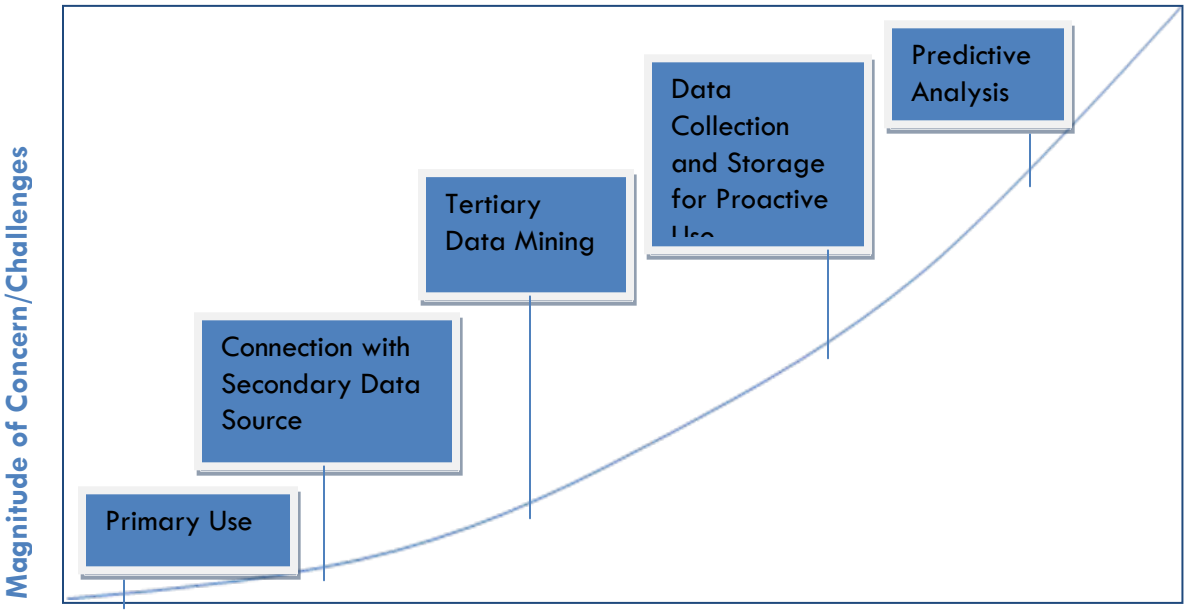
As indicated in prior chapters, license plate readers have a range of functions; these include the scanning of passing cars to check if they are stolen and the storage of data about vehicular movement to access locations of vehicles at a later date. As suggested by our national survey, most agencies currently use LPRs for the former function, but not the latter. Many agencies do not have the data storage capacity to save LPR data for long periods of time, nor the infrastructure to allow LPR data to be connected to other sources of information, such as other databases. It is likely, however, that the frequency and variety of LPR uses will expand quickly as greater diffusion occurs.

To the extent that researchers and agencies have studied the impacts of LPR, the analyses have focused mainly on the primary use of this technology—retrieving stolen vehicles. However, each potential type of LPR use may be associated with distinct benefits (such as

deterrence and crime prevention) and distinct costs. Costs might include legal challenges or a reduction in the community's view of the police legitimacy. Since legal and legitimacy issues may be contingent upon the type of LPR use, potential benefits and costs need to be categorized in a way that can match uses with potential implications. As emphasized in Chapter 1, this step is all the more crucial because agencies are currently acquiring LPR units quickly and at a substantial per unit cost, and they are promulgating policy in a low-information environment. In this way, developing a continuum of uses for LPR can provide a tangible framework for aiding agencies as they consider adopting and deploying LPR readers. In the future, such a framework may also be used to advance rigorous testing of potential benefits and their associated costs, in terms of both finances and agency legitimacy.

Figure 1 presents one possible continuum of LPR use. Each category (or space on the continuum) represents a type of LPR use, as described below. As one moves farther to the right of the continuum, additional legal and legitimacy concerns may be raised by the uses of LPR located there. Moreover, the intensity of these concerns may increase exponentially as uses become more predictive in nature.

Figure 4.1. Continuum of LPR Uses



Points Along the Continuum

1) PRIMARY USE: AUTOTHEFT AND CARS OF INTEREST

This use of LPR involves an immediate check of a motorist's license plate in order to detect whether that vehicle or license plate has been stolen or whether the particular vehicle is

the subject of a search related to an investigation. We characterize this scenario as an "immediate" or "primary" use of LPR because existing data that already identifies stolen vehicles is accessed, and the data collected from the LPR reader need not be stored for any length of time in order to perform this function. Currently, this represents the most frequent use of license plate readers by law enforcement agencies, including the two departments examined in this study. In fact, according to our agency survey, 91.4% of agencies with LPR use the technology for this purpose. It also seems reasonable to hypothesize that this use might raise the least legal concerns or challenges to police legitimacy, although we test this hypothesis specifically in this chapter. Indeed, some law enforcement agencies have asserted that the technology merely automates a process that was previously (and legitimately) conducted manually by police officers—that of searching for or "calling in" stolen vehicles to discern if they are stolen (IACP, 2009, p. 12). In this view, LPR adoption simply renders this process more efficient and less costly, enhancing an already existing police service likely supported by the community.

However, the argument may also be made that the deployment of LPR represents more than simple automation or mere efficiency gains. Rather, the technology allows law enforcement to accomplish acts outside of human capabilities (Hubbard, 2008; Reiman 1995). For example, the use of LPR allows officers to check license plates when it might be too dark outside for the human eye to see, or it might allow officers to check license plates on the freeway when passing cars are going too fast for the human eye to register a license plate number (Hubbard, 2008; Stroud, 2006). The discussion of these points—and their potential legal and legitimacy implications—is conducted in greater detail in the "Review of Legal Issues" section of this chapter.

2) CONNECTION OF LPR DATA WITH A SECONDARY DATA SOURCE

We increase the complexity of LPR use when moving to the right of the continuum. The next likely use of LPR is the connection of scanned license plates to a secondary data source associated with those plates. This step on the continuum involves the linking of LPR data (for our purposes, the time, date, location of vehicle observation, and plate number)[28] with records from a state's Department of Motor Vehicles. Therefore, at this step in the continuum, information from the LPR readers is connected for the first time to the registered owner of the vehicle and then to a portion of that owner's motor vehicle record. Unpaid parking tickets, lack of insurance, and other traffic-related delinquencies might be

[28] In writing about LPR, some of the sources that we discovered have considered LPR systems that also record digital images of distinguishing vehicle features (such as damage to the vehicle or bumper stickers) or a digital image of the vehicle's driver and passengers (International Association of Chiefs of Police, 2009). It is important to note that these possibilities may raise additional legal or constitutional implications not explicitly discussed here. For example, a digital image of a driver's face alone might be considered personally identifiable information, so these types of pictures might require even more stringent protection of the stored images (IACP, 2009).

accessed. This connection may implicate issues of data and personal security for the individual involved and certainly raises questions about the need for stringent standards for data handling. In their report on privacy, the IACP compared data connected to a registered owner of a vehicle (step 2 on the continuum) with the collection of LPR data alone (step 1 on the continuum) and concluded that unconnected LPR data should not be considered "personally identifying information" (IACP, 2009, pp. 7–11). Since "a license plate number identifies a specific vehicle, not a specific person," the IACP concluded that the collection of license plate data alone does not rise to the level of personally identifying information (IACP, p. 10). However, even at space 1 on the continuum, the IACP noted the sensitive nature of this data and recommended that it be considered "For Official Use Only" (IACP, p. 11).

In contrast, at step 2 on the continuum, officers must access state DMV databases in order to link a vehicle to a registered owner and, therefore, an individual has been identified. Once this link has taken place, the information may be considered personally identifying (IACP, p. 8). Personally identifying information may also consist of multiple pieces of non-personal information to which one individual has access, for example, through different databases (IACP, p. 8). If these databases may be accessed by the same individual or if they are stored on the same system, these pieces of non-personal information may become the equivalent of personally identifiable information (IACP, pp. 8–9). Potential legal and legitimacy issues may increase if this data is stored for long periods of time (as discussed below).

Practically speaking, this step on the continuum also begins to implicate substantial issues of personal security for individuals in the community. Yet, it is currently a common police investigatory practice to access DMV data. Prior to LPR systems, manual approaches often required motor vehicle records to be accessed by the police in the investigation of traffic and other offenses. Red light and speeding cameras, as well as toll-booth violations, are some further examples of this type of use. These approaches, however, have not previously involved the storage of large amounts of data by police (as discussed below).

3) TERTIARY DATA MINING

This location on the continuum involves connecting LPR data with "tertiary" databases by using motor vehicle information to identify persons of interest. Again, this type of investigation was done by the police prior to LPR and commonly involved the police running a tag for the registered owner and then running the owner for the existence of an open warrant. LPR accelerates and automates this function.

LPR is not limited to checks for open warrants. Rather, the uses of license plate readers that fall into this category can vary widely. For example, data that might be uploaded into LPR systems include the license plates of vehicles owned by registered sex offenders, those delinquent on child support payments, recently released violent offenders, or individuals arrested for selling drugs around schools or public parks. An example of this type of use might be LPR patrol around schools and parks for parked vehicles of registered sex offenders or drug dealers. All of these LPR uses involve the connection of LPR data to other data sources through motor vehicle information but for law enforcement purposes unrelated to motor vehicles or vehicular enforcement.

Similar to the second stage of the continuum, however, this step does not necessitate prolonged data storage of LPR scans (although the criminal data accessed may have been stored for some time). Despite this, novel legitimacy issues may still arise because the police have departed from using LPRs for vehicle-related law enforcement, which may seem its most obvious use. These uses of the technology are conceptually distinct from the previous step on the continuum for this reason. Since LPR is not being used as a technological tool for traffic or vehicular enforcement at this space on the continuum, people could view these uses as promoting more generalized surveillance. We could hypothesize that these uses may heighten the likelihood that LPR adoption will impact police legitimacy, job approval, and police-community relations. However, this hypothesis remains untested.

Even within this category, different uses may evoke varying responses. For example, members of the community may view sex offenses as grave enough to warrant the use of LPR to prevent sex offenders from entering school zones. Yet, the community might not tolerate other uses where the perceived benefits are too few or the perceived intrusion into the personal lives of community members seems too great (for example, using LPR to detect parents who don't pay child support). Though some authors writing on this topic have suggested hypotheses about the likelihood that some uses might be accepted over others, the only true way to gain an indication of community sentiment is through rigorous testing of the type conducted in this study.

4) USING LPR UNITS FOR DATA COLLECTION AND STORAGE FOR PROACTIVE USE

This step on the continuum involves the long-term storage of data from LPR readers themselves (most frequently, the location, date, time, and vehicle license plate) and its preservation for investigative purposes. For example, when attempting to view the last known locations of a wanted suspect, information saved from a LPR reader might demonstrate that a suspect's vehicle traveled to a certain location. Alibis of suspects might

also be corroborated or challenged from the information captured by LPR units placed at toll roads or near locations where an individual claimed to be. Such information applies not only to suspects. In a recent case, an Alzheimer's patient was located with the help of a license plate reader, which had detected his vehicle at a particular location. However, some have argued that this type of data retention may also prejudice the investigatory process against an individual, since LPR information may be presumed to be correct even in instances when the data may be misleading. For example, if an LPR unit records the presence of a vehicle at a particular location, this does not mean that the registered owner of the vehicle or even a particular suspect was driving the vehicle at the time. It may also be difficult for an individual to combat an assumption that the data presents an accurate picture of daily activities, since individuals do not normally keep detailed records of their day-to-day routines.

The IACP has identified a need to "establish a set of guidelines, including standard criteria, to assist law enforcement agencies in their development of retention policies for LPR data" (IACP, 2009, p. 3). Currently, however, "there is no formula for determining how long data should be retained" (p. 3), and no court has examined the issue of LPR data retention as of the writing of this report. In addition to the development of data retention policies, the IACP has also called for police agencies using LPR to undertake "regular and systematic audits [to] help ensure that the quality of data contained in a LPR system remains high." (p. 4) These audits are required because saved LPR data may become the basis for investigations.

As mentioned previously, data storage raises even more serious potential for abuse through either hacking or misuse; as a result, rigorous testing of policy in this area of the continuum is critical. Moreover, members of the community may also hold very strong opinions regarding whether or not this information should be considered private and also if data of this type should be collected and maintained by the police. The survey-experiment discussed below provides evidence regarding one community's response to these questions.

5) PREDICTIVE ANALYSIS

While proactive use of stored LPR data might apply to ongoing investigations and searches for individuals or their alibis, LPR data may also be used for more predictive analysis, an extension of this proactive use. Predictive analysis involves the analysis of collected data to determine patterns of behavior and movements in order to anticipate and prevent crime. One example might be the decision to place LPR units at locations around an arena prior to a major event. Unusual vehicular activity or multiple hits of particular vehicles in front of a location may be found by analyzing the saved data. Proactive investigations might then be generated. Similar to #1–#4 above, vehicles might also be scanned for connection to other databases in order to anticipate problems for prevention purposes.

This type of analysis may offer special challenges to the legitimacy and legality of police actions. On the one hand, large amounts of data, combining information from many incidents and individuals, would be examined for overall patterns of behavior. This type of procedure is commonly used in intelligence analysis, where patterns within what may seem like large amounts of mundane data may be found. However, such processes may also result in access to individual data and may turn the scrutiny of law enforcement toward individuals who may not pose any threat. Any type of predictive analysis runs the risk of false positives. Anticipating and reducing the negative impact of false positives is an important crime prevention goal of democratic police agencies. Again, predictive analysis utilizing LPR data may be undertaken in many different contexts, and the reaction of the community may be dependent upon the context of such use. It is useful to gauge how such deployment of LPR units might be received by the community, something we do in our survey-experiment below.

Each of these uses of LPR across the continuum can provide varying benefits and concerns for law enforcement agencies. The point that we emphasize here is that, prior to this study, hypotheses about LPR have too often remained unsupported by evidence. However, the extent to which these concerns matter and the impact that using LPR will have on police legitimacy are important empirical questions in understanding the effectiveness of license plate readers and any other police technology. In addition to secondary uses not contemplated by the community or by department policy, agencies must also consider whether or not they might be compelled to disclose information by courts presiding over civil matters wherein an individual's location is at issue. Community members may also fear that a law enforcement agency may share LPR data with other government or private entities. As Solove (2006) argues, when data is collected and stored, "the potential for secondary use generates fear and uncertainty over how one's information will be used in the future, creating a sense of powerlessness and vulnerability" (p. 522). The survey-experiment discussed below also includes information with respect to opinions about data sharing.

Also, it bears repeating that at all steps on the continuum, it is important for agencies to consider the potential for improper disclosure of saved LPR information, either by authorized users or through hacking. Improper disclosure implicates individuals' privacy and poses potentially very serious obstacles to police legitimacy. Improper disclosure may also result in serious physical harm to members of the community. Security safeguards or audits may help lessen some concerns (IACP, 2009, p. 17), but these have not been rigorously evaluated at this point.

Review of Legal Issues and Their application to the LPR Continuum

As the LPR continuum indicates, various uses can present different legal and legitimacy challenges to the police. However, as noted above, few analyses of the legal issues

related to LPR have been published, and there are no tests of LPR (or any other police technology) on police legitimacy. Additionally, only a small number of courts have adjudicated cases involving LPR use, and those that have done so are state trial courts (*New York v. Davila*, 2010; *Machado v. City of New Haven*, 2006). Though much of the judicial business in a state is handled at the trial court level, these opinions represent first attempts by courts to grapple with situations where police have utilized LPR and cannot be regarded as either exhaustive or as binding precedent. Other courts may view these issues differently, and new questions will arise over time. Additionally, even in instances where state trial courts have authored opinions referencing LPR use, there are limitations to the guidance that can be obtained from those opinions. This is primarily because only a limited number of issues have been raised by litigants at the current time. Practically, this means that it will take some time for the law enforcement community to receive a more definitive answer to the legal questions related to LPR use.

In addition to a lack of definitive guidance from the courts for agencies considering LPR adoption, few scholarly legal analyses of LPR have been published to date. Two notable exceptions are found in the IACP's *Privacy Impact Assessment Report for the Utilization of License Plate Readers* (2009) and in the article published by Hubbard (2008). Both sources provide analyses of the privacy implications of LPR, though with some similar and some disparate results. In addition to a number of differences in issue coverage, some of the variation results from the fact that these analyses cannot rely upon a single case but must craft a discussion of the implications of LPR from prior court cases and scholarly work related either to other technologies or to privacy more generally.

This section will provide a brief review of some of the existing evidence base with respect to the constitutionality of LPR. At present, this evidence base is necessarily underdeveloped, and this review will require bringing potential legal arguments together from various sources, some specifically related to LPR and some not. The articles and court cases discussed within this section may inform an agency's decision to adopt LPR but cannot predict with complete accuracy how courts will rule once faced with LPR cases. However, one advance that can be accomplished at this time is to categorize and relate the existing legal evidence base to the continuum of LPR uses presented above. In addition to providing a useful foundation for future testing, the continuum of uses should supply a tangible way to think about the legal issues involved in LPR use.

The chief concern about LPR stems from LPR's implications for individual privacy. Though the U.S. Constitution does not explicitly guarantee a "right to privacy," the Fourth Amendment states, "[t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated...." (U.S. Const. art. IV). This provision of the Fourth Amendment is made applicable to actions of the states through the Due Process Clause of the 14th Amendment. Though the U.S. Supreme Court has not examined the constitutionality of LPR use specifically, some other Fourth Amendment cases can help to provide a foundation for our inquiry. We shall also discuss cases dealing with manual license plate checks to get a sense of what courts might decide with respect to LPR.

Though the U.S. Supreme Court has not specifically adjudicated the issue of license plate privacy in the face of manual checks, numerous courts (including several U.S. Courts of Appeals) have resolved this issue. Time and again, these courts have found manual checks of license plates by police to be constitutionally permissible (*U.S. v. Ellison*, 2006; *U.S. v. Walraven*, 1989; *U.S. v. Matthews*, 1980). These cases have relied upon the standard set forth by the U.S. Supreme Court in *Katz v. U.S.* (1967). The *Katz* test makes clear that no Fourth Amendment violation may occur unless there exists a "constitutionally protected reasonable expectation of privacy" (*Katz v. U.S.*, 1967, p. 360). In order for such an expectation to exist, "there is a twofold requirement, first that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as 'reasonable'" (*Katz v. U.S.*, 1967, p. 361). In this way, the expectation of privacy must be both "subjective" and "objective" in order to merit protection by the Fourth Amendment.

These requirements are difficult to satisfy with respect to license plates. Driving is not a private activity but rather an activity that one engages in while out in public. While on the road, the vehicle and, most importantly, the license plate, remain in public view (*U.S. v. Diaz-Castaneda*, 2007, pp. 1150–1151; *U.S. v. Ellison*, 2006, pp. 561–562; *Olabisiomotosho v. City of Houston*, 1999, p. 529; *U.S. v. Walraven*, 1989, p. 974). The state has a legitimate interest in motor vehicle and highway safety (*Delaware v. Prouse*, 1979) and, as a result, can properly require that license plates remain unobstructed. It is not surprising, then, that these arguments have resolved the question of an individual's privacy interest in his/her license plates for the courts that have examined the issue of manual checks. At first glance, these arguments might also seem to resolve the constitutional issues related to privacy and the use of LPR.

Moreover, while the U.S. Supreme Court has not examined license plates per se, it has examined whether or not a vehicle's VIN number is to be considered private. In the case of *New York v. Class* (1986, p. 87), the Court was asked to decide whether or not a police officer had conducted an unreasonable search when he reached into a private car and moved some papers so that he could see the car's VIN number. Much like the other courts'

holdings with respect to license plates, the Supreme Court decided that this act of reaching into the car did not violate the Fourth Amendment because the motorist did not possess a legitimate privacy interest in the VIN (*New York v. Class*, 1986, p. 91). Instead, the Court held that a VIN number must remain uncovered because "the VIN is a significant thread in the web of regulation of the automobile" (*New York v. Class*, 1986, p. 88). There is no reason to believe that the Supreme Court would consider the question of privacy with respect to license plate numbers any differently, since license plate numbers must also remain in public view according to law.

Yet, when the issues surrounding LPR use (as opposed to individual, manual license plate checks) are examined, the courts may have some additional concerns. Several authors have made the argument that LPR technology simply automates a process that could be carried out legally by individual officers (IACP, 2009, p. 12; Hubbard, 2008, pp. 6–9). However, this assertion relies on the fact that there is no significant legal distinction between individual officers checking license plates by hand and the use of LPR. In fact, several authors have argued that there is a substantial difference, even with respect to the most common use of LPR, that of detecting stolen vehicles (Hubbard, 2009). Essentially, Hubbard argues that LPR use does not merely make an officer's job more efficient and less costly but also allows the police to gain new abilities that no human could possess. "As a Los Angeles police officer pointed out concerning the technology's ability to read license plates at 60 mph and at night, '[i]t's physically impossible for an officer to do this kind of work ... It's reshaping the way we do policing'" (Hubbard, 2009, p. 34). Hubbard points to a number of U.S. Supreme Court cases (discussed in more detail below) in which the Court has expressed concern about the use of increasingly invasive technologies by police.

Additionally, the argument that LPR simply automates a process that has always been used by police relies upon the fact that there is no difference between manual checks and the *widespread use* of license plate readers at other points on the continuum. In fact, while this "automation" argument might possibly resolve the constitutional issues involved with some uses of LPR, it does not address the act of linking data to other databases or saving data for extended periods of time. This distinction again illustrates why the continuum of LPR uses is important. The continuum represents a clearer framework for agencies considering LPR adoption and also underscores the potential for disparate legal and legitimacy implications connected with different uses. Indeed, a single check of a license plate and the widespread and varied uses of LPR may be viewed differently by future courts adjudicating LPR issues for a variety of reasons.

For example, the second and third steps on the continuum involve connecting a license plate to an individual's motor vehicle records or connecting the license plate with tertiary data unrelated to motor vehicles through the use of vehicular information. These locations on the continuum may be viewed as distinct from the primary use of LPR at step 1 on the continuum because they involve linking LPR data to specific individuals and their records.

This may greatly increase the chance of harm to individuals in the community and may raise serious legitimacy issues if data is misused (IACP, 2009, pp. 11–12). Though the cases mentioned earlier in this section have repeatedly shown that individuals do not have an expectation of privacy in their license plates, the courts have been more willing to find it reasonable that individuals have an expectation of privacy in certain items of personal data. Since the uses at steps two and three of the continuum involve linking LPR data to personal data, courts examining these uses may be unwilling to allow police (or LPRs) to connect with the information contained in some other databases without any suspicion of wrongdoing by the individual. In fact, in *State v. Donis* (1998, p. 40), the New Jersey Supreme Court held that it was permissible for police officers to run random [Mobile Data Terminal (MDT)] searches on license plates to determine if a vehicle was reported stolen or to verify the status of the registered owner's driver's license. However, the Court also held that it was not permissible for police officers to obtain the registered owner's personal information contained in the New Jersey Department of Motor Vehicles ("DMV") database without "reason to suspect wrongdoing" (*State v. Donis* (1998), p. 40). Following this case, the New Jersey Supreme Court required the redesign of all MDTs used in the state to incorporate a two-step process for the protection of individuals' privacy (*State v. Donis* (1998), p. 40).

The two-step process allowed police to check a license plate in order to apprehend stolen vehicles (the first step) but prevented an officer from viewing personal DMV data without initiating a separate process (the second step) (*State v. Donis* (1998), p. 40). In order to initiate the second step of the process, the officer was required to have a particularized and articulable suspicion of wrongdoing; this suspicion could later be challenged in court through a motion to suppress. Like the MDT searches that concerned the New Jersey Supreme Court, steps two and three on the LPR continuum involve the examination of personal data by the police and might be restricted by future court decisions if some individualized suspicion of wrongdoing is absent.

Moreover, steps four and five on the LPR continuum of uses may raise additional issues. Even if all of the uses discussed above are constitutionally permissible, this acceptance may not extend to the collection and storage of a large quantity of data about citizens (many of whom have committed no crime). It is the momentum toward data storage that makes LPR unique in comparison with previous police activities. Significantly, data storage may also implicate the most significant risks to the community through unauthorized disclosure (IACP, 2009, p. 17). Likewise, the decision to save LPR data may involve some particularly nuanced privacy issues because data storage could eventually make it possible for police to recreate the daily activities of individuals through LPR data. It also becomes even more difficult to extend the "automation" argument (or the idea that LPR merely automates processes already being conducted by police) to these steps on the continuum. Police do not currently store large quantities of data about citizens' activities.

No court has examined the issue of data storage at this time and, therefore, previous case law does not resolve this issue. However, it is reasonable to assume that courts may be concerned about individual privacy in the face of large-scale or long-term data storage. Courts may also be concerned that no checks would exist on the power of police with respect to their use of the saved data. Citizens may fear that data storage would result in large increases in the surveillance powers of law enforcement (Reiman, 1995).

As mentioned above, others have argued that the saving of LPR data can greatly impact entirely innocent individuals, not merely those suspected of crimes (Hubbard, 2008; Reiman, 1995).

". . . [T]he collection and recordation functions related to the Automatic License Plate Recognition systems act to track innocent people in the event that they may commit, or be involved in, a crime in the future . . . . The asserted justification is that if in the future the police are looking for a suspect, or even victim, who owns a specific car, then they could check the database and see where the suspect has been in the last few weeks, or last few moments, to help them begin their search." (Hubbard, 2008, p. 28).

While this is an important justification for law enforcement, the saving of data may expose innocent members of the community to harm or embarrassment (Reiman, 1995, p. 35). When LPR data is saved, innocent and guilty individuals may be treated the same. In addition, the potential for large scale surveillance and tracking may be viewed as quite distinct from other technologies by the courts.

Though no court has examined whether or under what circumstances the data storage or potential surveillance functions of LPR may violate the privacy of individuals, a few courts (including the U.S. Supreme Court) have discussed the constitutionality of police surveillance carried out through other means, such as tracking devices placed on vehicles by police (*U.S. v. Knotts*, 1983, p. 276; *U.S. v. Moran*, 2005, p. 467). In these instances, the courts were called upon to adjudicate whether or not police placement of tracking devices onto the vehicles of suspects without probable cause violated these individuals' privacy (Hubbard, 2008, pp. 28-31). Despite the fact that the officers did not possess probable cause, the courts have been unwilling to find a violation of privacy when the police could have obtained the same information by following the suspect's movements on public roads (*U.S. v. Knotts*, 1983, p. 276; *U.S. v. Moran,* 2005, p. 467). The use of tracking devices to do the same work did not create privacy violations. These precedents may suggest that the surveillance powers inherent in LPR data storage will not pose a constitutional issue. However, the courts may also view LPR data storage as allowing the

police to accomplish surveillance tasks that were previously unthinkable—not merely as a technological tool for increasing efficiency in the manner of a mobile tracking device (Hubbard, 2008, p. 33).

Indeed, there are also some Supreme Court cases that might lend credence to this view. As indicated above, in several recent decisions, the Court has seemed to express dissatisfaction with the increasingly invasive character of technology (*Kyllo v. U.S.*, 2001; *Dow Chemical Co. v. U.S.*, 1986). This has lead some authors to come to the conclusion that these opinions might provide support for a finding that the most advanced technologies violate privacy if they allow police to access information that they normally would not be able to access (Hubbard, 2008, p. 38). According to Hubbard (2008, p. 32, citing *U.S. v. Ellison*, 2006, p. 562), LPR may be considered technology not available to the public and, by virtue of the capacity to (1) connect license plates to other records and (2) to engage in wholesale data collection, a court may see this as information that normally could not be collected "without 'intrusion into a constitutionally-protected area.'" If LPR allows the police to gain access to the intimate details of individuals' daily lives, this power may be viewed as a true departure from previous police authority. Indeed, Hubbard (2008, p. 40, citing Donohue, 2006) cites research suggesting that the movements of the average citizen are recorded approximately 300 times a day in London where LPR is routinely in use. Notions such as these may be shocking to the courts reviewing the issues related to LPR, and they may be shocking to the community.

Moreover, Reiman (1995, p. 29) makes the argument that "by accumulating a lot of disparate pieces of public information, you can construct a fairly detailed picture of a person's private life." For example, LPR data may allow police to determine who an individual associates with, which doctors or religious services she visits, which protests she participates in, and even which political party she belongs to. "A piece of information here or there about an individual is not very telling; but when combined, these bits and pieces of data begin to form a portrait of a person" (IACP, 2009, p. 16 citing *U.S. Department of Justice v. Reporters Committee for Freedom of the Press*, 1989, p. 507). Normally, these activities are "dispersed over space and time," so police officers can't see them all at once (Reiman, 1995, p. 29). However, the collection and storage of data may bring many of these bits of information together on one system or connected systems. This is a strong argument for considering the spaces to the right of the continuum as—at the very least—conceptually distinct from those on the left of the continuum. In addition to the potential concerns related to privacy, the IACP report cautions that inaccurate data or even data taken out of context, may yield an erroneous picture to law enforcement, an occurrence that may actually hinder investigations (IACP, pp. 12, 14; Solove, 2006, p. 522). Misleading data may also be very difficult for individuals to refute, since people normally do not keep detailed records of their activities and may not remember their locations once time has passed.

Additionally, courts are likely to be concerned that LPR could impact the exercise of other rights and that individual behavior may eventually change as members of the community realize that their daily activities could be recorded and preserved (IACP, p. 16). It is the hope that LPR may help to suppress an individual's commission of illegal acts, but widespread use of the technology may also lead individuals to suppress unpopular, unconventional, or embarrassing actions that are not illegal (Reiman, 1995, p. 35). Specifically, courts may be concerned that it is difficult to exercise First Amendment rights, such as through participation in a rally or demonstration, without traveling to do so (IACP, 2009, p. 14). The fear is that citizens may alter their behaviors when they know that the locations they visit could be preserved and later used against them as evidence. In other contexts, the U.S. Supreme Court has at times protected individuals against being forced to identify themselves during their exercise of certain rights, for example, free press (IACP, 2009, p. 14, citing *McIntyre v. Ohio Elections Comm'n*, 1995), in their political associations (IACP, 2009, p. 14, citing *Brown v. Socialist Workers' 74 Campaign Comm.*, 1982) and in their involvement with religious groups (IACP, 2009, p. 14, citing *NAACP v. Alabama ex rel. Patterson*, 1958).

Yet, the IACP argues in its report that potential changes to individual behavior resulting from LPR may be minimized by law enforcement policies:

"[T]he development and implementation of policies regulating the collection, uses, sharing, and retention of LPR data can operate to reduce these effects. Deployment of LPR cameras based upon crime analysis that takes into account crime patterns and the types of crime targeted by LPR systems can also reduce the perception that LPRs are simply a tool for public surveillance. Developing retention periods are another way to address the potential chilling effects of LPR systems." (IACP, 2009, pp. 13-14)

The IACP also recommends that agencies develop policies "concerning the collection of license plate numbers by mobile LPR cameras in areas known to reflect an individual's political, religious, or social views, associations, or activities (e.g., churches, abortion clinics, etc.) and limit such collection to instances directly related to criminal conduct or activity." (IACP, 2009, p. 15) We concur on the logic of this statement. Such policing may aid courts in considering how to balance the legitimate interests of law enforcement with individual privacy rights. Such policies may also reduce negative perceptions in the community, although that also remains to be tested. The survey-experiment discussed below begins the process of rigorous testing in this and other areas.

LPR and Police Legitimacy: The Community Survey-Experiment

The LPR continuum of uses and the subsequent legal review reflect and emphasize two important themes in democratic policing. The first theme, as already discussed, stresses the importance of legal protections of the individual in light of crime prevention goals. The second theme is the legitimacy and authority afforded to the police by its community or

jurisdiction. The use of LPR may have important implications for police legitimacy and community-police relations, two factors that may further affect an agency's ability to prevent and deter crime (see Tyler, 1990). To explore this, we implemented a community survey-experiment. Though it is not possible for one survey-experiment to address all of the potential issues related to LPR, many of the issues detailed above have been incorporated into the research design, and this survey-experiment serves as the first to test the concerns reflected at each stage of the LPR continuum of uses.

SURVEY LOCATION AND SAMPLE

We chose to conduct this community survey-experiment in Fairfax County, Virginia, one of the two locations in which we carried out the experimental evaluation described in Chapter 3. Fairfax County is one of the large Northern Virginia suburban counties outside of Washington, D.C., where many individuals who work in the metropolitan D.C. area reside. According to the U.S. Census, it has a population of approximately 969,600 persons; approximately 71% are Caucasian, 10% are African American, 15% are Hispanic, and 17% are Asian. The County spans almost 400 square miles, with a population density of about 2,450 persons per square mile. The police department consists of approximately 1,370 sworn officers serving a well-educated community (over 50% of residents have a college education) with high home ownership rate (70%).

To carry out this survey-experiment, we randomly sampled 2000 Fairfax households, from all residential units/households in Fairfax County. To select only residential properties, we first used a zoning polygon file in ARCGIS, which represented all of the different land use zoning districts within Fairfax County[29] (3,962 zones of a possible 7,496 zones). Then, using a building point file, we selected only the addresses that fell within areas that were zoned as residential. The result was 237,444 residential addresses from which we could randomly draw our sample of 2000 possible respondents.

Once the initial 2000 residences were selected, each was checked individually against the County's public real estate records[30] to ensure that the residence was occupied, that we had the proper mailing address, and that there were no duplicate addresses. If the online

[29] All of the shape files used in this study were accessed through the George Mason University Department of Geography Intranet server. George Mason University obtained these files directly from the Fairfax County Government.

[30] See http://icare.fairfaxcounty.gov/Main/Home.aspx

database indicated that an address didn't exist or referenced a non-residence (such as a church, school, etc.), the address was removed from dataset and replaced with another randomly sampled residence. In total, we replaced 106 cases.

THE SURVEY-EXPERIMENTAL INSTRUMENT

As this was an experimental survey, four different versions were generated.. One version of the survey instrument, as it was mailed, is included as Appendix F along with the consent document/introductory letter.[31] The specific questions comprising the survey represented a mix of demographic questions, general questions about crime and police legitimacy, and questions focused on the continuum of LPR uses presented in Figure 4.1. Participants were asked separate questions about the primary use of LPR (recovering stolen vehicles) and also about uses of LPR not directly related to vehicle enforcement, such as those linking LPR data with tertiary (non-vehicular) databases. Additionally, respondents were asked whether or not they would support a decision by their local police to begin saving LPR data for future use. They were also asked explicitly whether or not LPR data should be considered private information. Finally, questions were framed to gauge the impact of LPR use on individuals' daily activities, for example, whether or not they would be less likely to commit a crime or engage in other types of activities if they knew that their locations could be recorded by LPR readers.

In addition to examining these issues, two experiments were incorporated within the survey. In all cases, individuals were assigned randomly to either the treatment or the control group within each experiment. Since the sample was divided twice (once for each experiment), we produced four discrete versions of the survey. Each version contained either slight variations in the text of the survey or in question ordering, as discussed below. However, respondents were not aware of these variations, and each respondent received only one version of the survey.

The first experiment involved alterations to the ordering of questions on the survey and served two purposes. First, in order to guard against question order bias, we randomly varied the order of the two sections of the survey that contained substantive questions. Thus, half of the respondents received surveys where the first section contained general questions related to crime and legitimacy, and the other half of the respondents received surveys where the first section contained LPR-related questions. In addition to reducing question order bias, this division of the sample also allowed us to conduct a substantive experiment. The section of the survey containing general questions also included questions about police legitimacy, job approval, and respect for civil liberties. Since the "control" group received these questions at the beginning of the survey, this allowed for the establishment of a baseline or assessment of existing opinion with respect to these items.

[31] All four versions are available upon request.

The "treatment" group, however, answered these questions following the section related to LPR. When compared with the answers given by group 1, the responses of group 2 will allow us to gauge the impact of the LPR-related survey questions upon the answers of the respondents with respect to police legitimacy. This experiment allows us to begin evaluating the impact that *knowledge and discussion* of LPR might have in the community. These results may also be compared with a number of survey questions regarding police approval that were asked at critical moments *during* the section of the survey related to LPR. This procedure yields two distinct ways of evaluating the impact of LPR on police legitimacy and job approval.

The second experiment is simpler but was designed to evaluate the impact of a particular argument used in support of LPR adoption. Supporters of LPR use have frequently underscored the potential of the technology to reduce crime. We anticipated that this argument might be a powerful incentive for the public to support expanding the use of LPR. Yet, to ask this question on the survey may influence the results of all questions following it. To combat this, we slightly varied the wording of a question that asked respondents if they would support a police decision to save LPR data. The only variation to this question was the addition of the phrase, "if it can help in solving crimes." Each respondent was presented with only one of these scenarios in order to avoid the potential for bias resulting from seeing the questions in sequence. The results of both experiments are discussed in detail in the section below.

RESPONSE RATE

We sent out the first round of the survey to a sample of 2000 households in May 2010, once the experimental impact evaluation of LPR had been completed in Fairfax County. The survey could be answered by business-return envelope or online. The addressee was "CURRENT RESIDENT," and the consent document explicitly stated the respondent had to be 18 years or older. Approximately every subsequent two weeks, we mailed further reminders about the survey to those addresses from which we had not received a response. We did this until we ended data collection for this report in mid-July 2010. The survey materials noted that the survey-experiment was being administered jointly by George Mason University's Center for Evidence-Based Crime Policy and by the Fairfax Police Department (see Appendix F).

At the conclusion of the data collection period, 457 residents had completed the survey, yielding a response rate of 22.9%. In terms of gender, the response pool was fairly representative of the wider community, with 48.9% female and 51.1% male respondents. With respect to race, the respondents indicated that they were 85.8% Caucasian, 3.7% African-American, 3.4% Latino, and 7.1% Asian/Pacific Islander, which indicated an overrepresentation of White respondents compared to the racial makeup of the county per the U.S. Census. The divisions reported with respect to political party identification were 33% Democrat, 30% Republican, and 37% Independent.

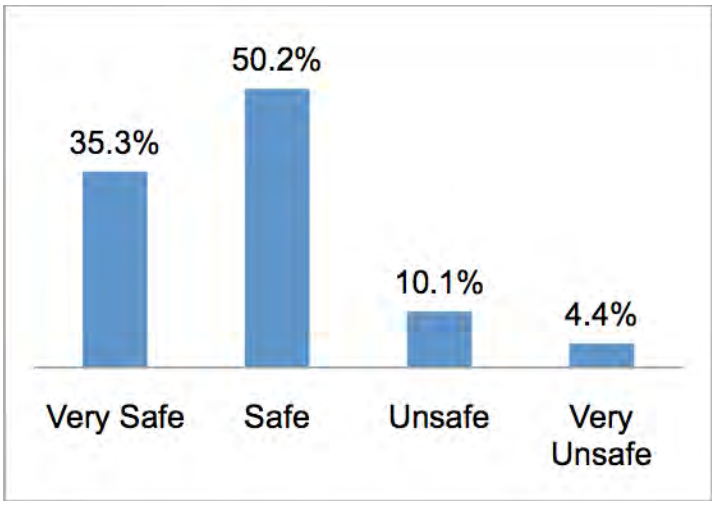
We conducted comparisons between block-group Census estimations of where respondents and non-respondents lived. Specifically, we used GIS software to link Census block-group information to addresses in our sample, and then compared respondents and non-respondents on their block-group estimate means. We compared block-group levels of poverty, unemployment, median family income, home ownership, linguistic isolation, and racial neighborhood composition. T-tests of means did not indicate that those who responded to the survey were significantly different (with regard to social, economic, and demographic factors) than those who did not respond.

Community Survey Results

COMMUNITY VIEWS ABOUT CRIME

An examination of the results of our community survey-experiment demonstrates that the respondents generally regard their community as safe and react positively to police performance in Fairfax County. For example, Figure 4.2 demonstrates that a large majority (85.6%) of respondents feel safe walking alone in the community at night, with totals of 35.3% selecting "very safe" and 50.2% selecting "safe" in response to this question.

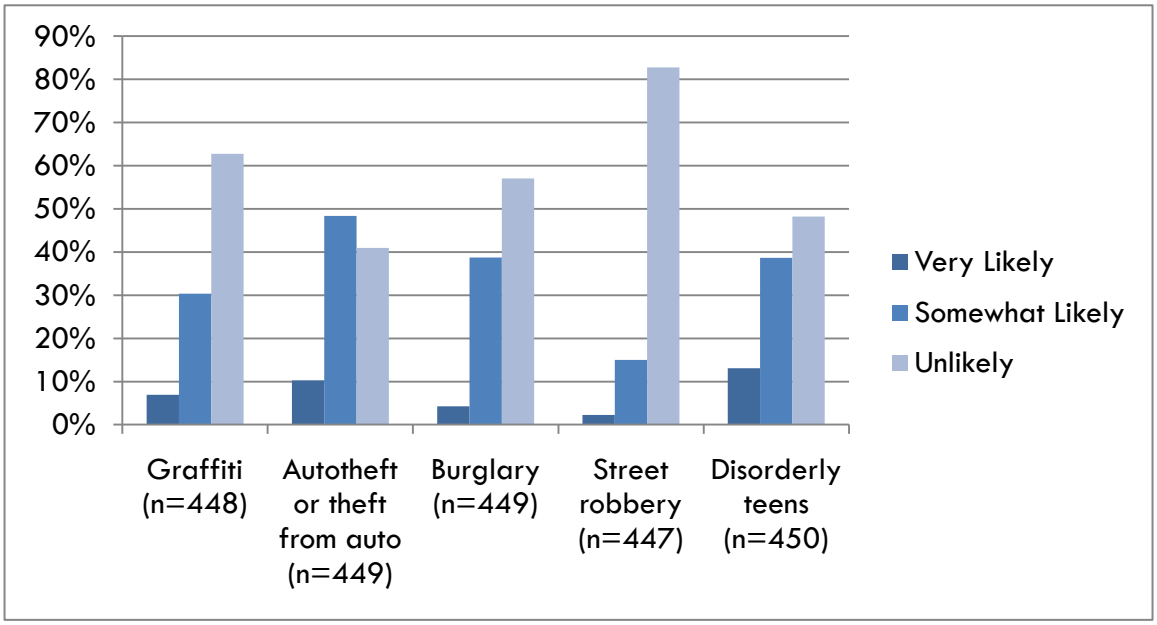
Figure 4.2. How Safe Would You Feel Walking Alone at Night? (n=436)



Similarly, when asked about the incidence of specific crimes, respondents indicated by substantial margins that they felt that street robberies (87.8 %), residential burglaries (57.0 %), and even graffiti (62.7 %) are unlikely to happen in their community (Figure 4.3). Residents believe that auto-related crimes (theft and theft from auto) and incidences of disorderly teenagers on the street are slightly more common, though, with only 41% of residents believing autotheft was unlikely to occur and only 48.2 percent believing

incidences of disorderly teenagers were unlikely to occur in their neighborhood. "Disorderly teens" was the most frequently cited as "very likely to occur," although still at a very low rate (13.1%).

Figure 4.3. How Likely are the Following Crimes to Happen in Your Neighborhood?



Finally, despite being located in close proximity to Washington, D.C., 55.2% of residents indicated that they are "not very concerned" or "not at all concerned" that their community might fall victim to a terrorist attack.

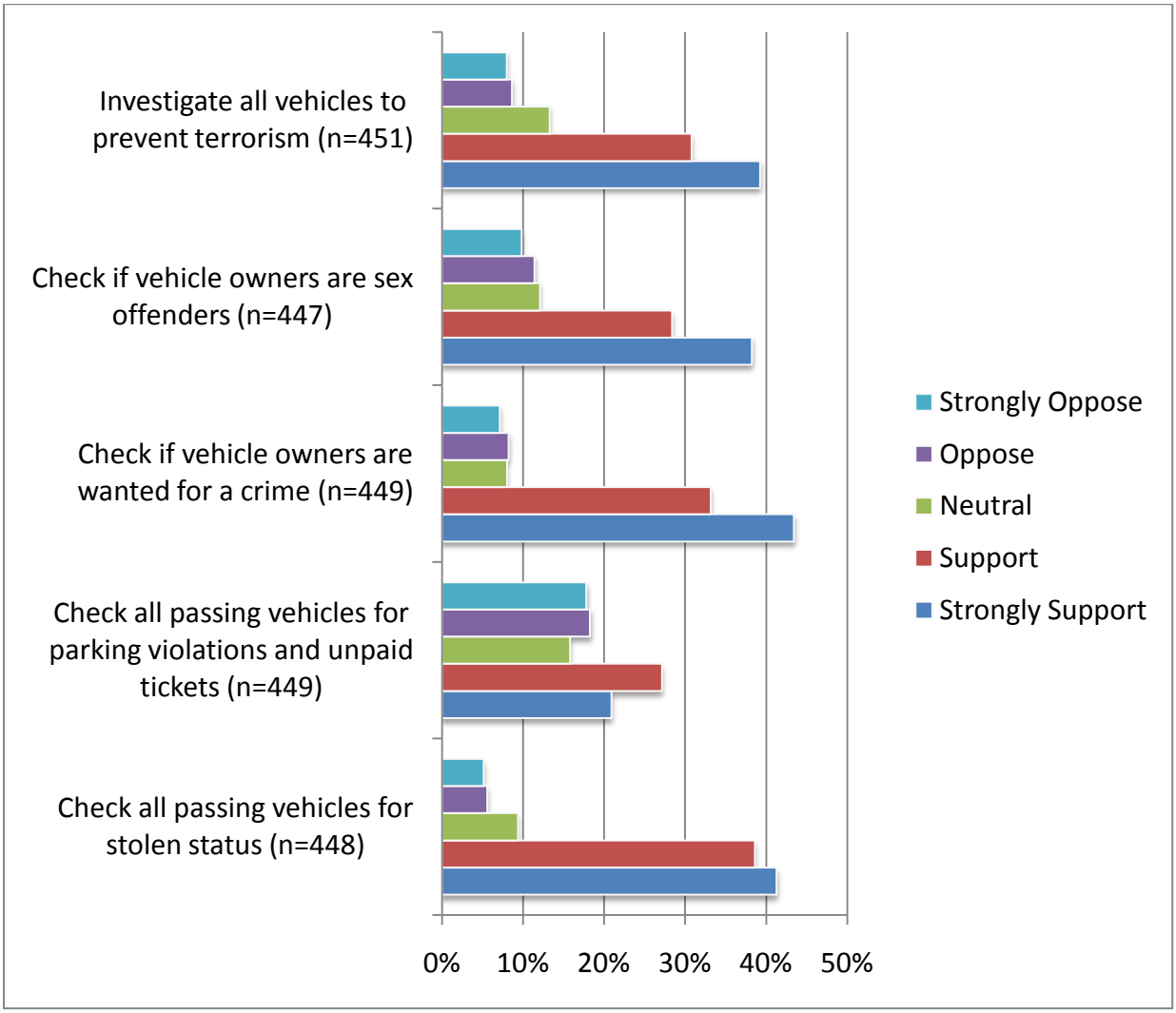
FAMILIARITY WITH LICENSE PLATE RECOGNITION

Our survey finds that members of the community have heard of license plate recognition, but that residents don't know much about the technology. In fact, 62.8% of respondents self-report that they have heard of the technology. However, almost 90% of respondents are willing to admit that they don't know if their local police currently use LPR. When asked a factual question such as this, survey researchers have often found a tendency on the part of respondents to "guess" at the answer rather than admit a lack of knowledge. The fact that nearly 90% of respondents selected "I don't know" rather than guessing about the answer may underscore the degree to which residents are not yet familiar with LPR. These respondents seem to have felt little social stigma attached to a lack of knowledge. These results are not entirely surprising, but they emphasize the fact that public discourse on this issue has been nearly nonexistent to this point. This impression is also confirmed by examining the results of this survey as a whole, because there are a number of questions where significant percentages of respondents expressed no opinion regarding various LPR issues.

PRIMARY AND IMMEDIATE USES OF LPR

Figure 4.4 demonstrates that respondents are supportive of both the primary use of LPR (detecting stolen autos) and what we have termed the other "immediate" uses of LPR (those uses not requiring prolonged data storage). Specifically, when discussing the retrieval of stolen vehicles (or the first space on the continuum of LPR uses), 79.9% of respondents indicated that they would "strongly support" or "support" a decision by their local police to use LPR in this manner. To a certain extent, this result suggests that the views of U.S. courts with respect to license plate checks (that they are largely unobtrusive to the driver) are supported by the community's responses to this survey (*U.S. v. Diaz-Castaneda*, 2007, p. 1151; *U.S. v. Walraven*, 1989, p. 974).

Figure 4.4 Community Responses to Primary and Immediate Uses of LPR



This figure represents a very high level of support, even greater than for those uses of LPR in Figure 4.4 that deal with terrorists or sex offenders. Only 10.7% of respondents indicated that they would oppose or strongly oppose a decision by the police to use LPR to detect stolen vehicles. Further, only 9.4% of individuals indicated that they were neutral on this question. This does not leave a large "undecided" percentage of the community (as is the case with some of the other questions) and may also suggest that respondents have an easier time understanding the issues related to LPR use for stolen vehicle apprehension than for other uses. For agencies considering LPR adoption for stolen vehicle apprehension, these results may suggest that the community will be able to easily comprehend the potential benefits of LPR adoption for "primary use" as discussed on the continuum.

Many of the remaining categories of immediate LPR use described in Figure 4.5 are also supported by the majority of the community. These survey items reflect what we have termed "immediate uses" of LPR, or uses that don't require the storage of LPR data for prolonged periods. Rather, at these points on the continuum, LPR is used to detect crime at the moment that the data is collected. For example, 76.6% of respondents either "strongly support" or "support" the use of LPR to check passing vehicles to see if registered owners are wanted for crimes. Similar to the primary use of LPR, it is not surprising that support for checking outstanding warrants is high, as it is likely that many respondents focused on the potential crime control benefits of these uses. To the extent that respondents thought about privacy concerns related to LPR use, then, it is likely that they ultimately dismissed these concerns, since the question referenced individuals with outstanding warrants (rather than average citizens or law-abiding members of the community).

Indeed, this point also explains the community response to the item that asked about checking all passing vehicles for unpaid tickets and parking violations. Though related directly to traffic regulation and conceptually the closest to the primary use of LPR, this item represents the only use of LPR found in Table 4.4 that is supported by less than a majority of respondents in Fairfax (48.1%). Though a sizable percentage of the community supports this use, the fact that support is significantly lower among members of the community raises an interesting point for agencies considering adoption of LPR. It is clear that the use of LPR on parking violations and unpaid tickets is much less popular in the community than the other uses tested in this survey.

One explanation for this might be that respondents were easily able to recognize and relate to a tangible and personal cost that might result from more efficient enforcement in this area (that of being forced to pay more fines). In thinking about this item, community members may focus only on their own costs and may not be able to associate the payment of parking tickets with a tangible benefit. Potentially, individuals concerned about privacy also may not think enforcement of parking tickets to be an important enough issue to require the use of LPR. These issues may merit careful consideration by agencies in formulating LPR policy.

Community support for the other immediate uses of LPR is also generally high, though not as high as for those uses previously discussed. The remaining scenarios detailed in Figure 4.4 reflect more tertiary uses on the LPR continuum. Specifically, 66.7% of respondents either "strongly support" or "support" the use of LPR to check if the registered owners of passing vehicles are sex offenders. Similarly, 70.1% of respondents either "strongly support" or "support" utilizing LPR to investigate all vehicles passing or parking near important places or buildings for the purposes of terrorism prevention. Despite the fact that suspected terrorists and child molesters are among some of the most despised categories of individuals, support for these uses is somewhat lower than support for the use of LPR to retrieve stolen vehicles. This may result from the fact that neither of these uses are directly related to vehicle enforcement; it is possible that members of community—while still very supportive of these uses—view them as farther removed from the primary use of LPR.

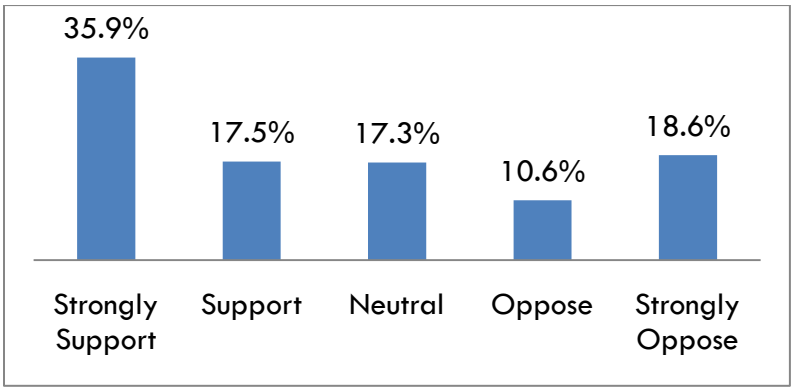
COMMUNITY REACTIONS TO THE STORAGE OF LPR DATA

Figures 4.5 and 4.6 present the results of the survey relating to LPR data storage. To begin, we asked respondents to specify whether they considered the four elements of LPR data (date of observation, time of observation, license plate number, and the location of observation) to be public or private information (Figure 4.5). To avoid confusion, the survey question again specified the four pieces of information considered a part of the LPR data. The question of whether or not the community considers LPR data to be public or private information is an important one because several of the court cases referenced earlier in this chapter have held that individuals do not have a privacy interest in their license plates while driving (*U.S. v. Diaz-Castaneda*, 2007; *U.S. v. Ellison*, 2006; *U.S. v. Walraven*, 1989; *U.S. v. Matthews*, 1980). As we have seen, however, the resolution of this issue may involve larger questions than the constitutional protection afforded to a single license plate check. While the courts may not view individual license plate checks as a violation of privacy, the storage of LPR data may be seen as distinct because an individual's daily activities, preferences, and opinions might eventually be capable of being recreated through saved LPR data.

Regardless of the courts' ultimate opinions about the level of privacy properly afforded saved LPR data, the public will likely form its own opinion on this topic, which is what often occurs with respect to other police practices (see Lum, 2009). Further, given the rapid diffusion of LPR, the public is liable to form this impression prior to any definitive court ruling about the constitutionality of the technology. Once the public has made its judgment about the privacy of LPR data, this reaction might also play an important role in how the technology itself is perceived—as either a useful law enforcement tool or an example of police intrusion into the private lives of citizens. Both of these judgments are also liable to influence overall police legitimacy and job approval. At minimum, these considerations

should influence the level of security that the police accord saved LPR data and perhaps even how frequently it is used.

Figure 4.5. Do You Believe That This Information Should Be Considered Private? (n=451)



Interestingly enough, despite the fact that those in the sample appear very supportive of LPR use, the majority of respondents (53.4%) consider LPR data to be private information. This represents a large number of respondents, particularly given the lack of public debate about LPR up until this point. Currently, most community members have not heard any arguments made by privacy advocates with respect to LPR. Of course, supporters of LPR use have also not had the chance to fully communicate their views either, nor has the public seen potential LPR benefits.[32]

In designing the survey, we purposefully placed this question prior to any questions regarding specific uses of saved data. This was done in order to guard against possible bias that could be introduced through concern over specific uses of saved data. In addition to the majority that responded that LPR data should be considered private, 17.3% of the respondents expressed neutrality with respect to this question. Like some of the other survey items, this reflects a fairly large percentage of undecided individuals. Once the community becomes more familiar with LPR and experiences its use within the community firsthand, the opinions of these individuals may be altered.

In comparison, the results are about evenly split with respect to the question of how long LPR data should be saved (Table 4.1). As a response to this question, the participants were permitted to select one of four options: (1) that the data should be not be saved, (2) that it should be saved for about 1 week, (3) for about 6 months, (4) or for as long as the police wish to save it. In the end, 30% of respondents opted for the 6-month retention

[32] Indeed, though a majority of respondents indicated that LPR data should be considered private, members of the community seem to be much less troubled by data sharing with other government entities. In fact, 74.3% of respondents to our survey felt that the police should be able to share information with other government agencies.

period, while approximately 23% of respondents opted for each of the remaining categories. This result could reflect a small preference for a data storage period of approximately 6 months, but the fact that the responses are so evenly split across all options more likely reflects a lack of developed opinion on this issue. Further, it seems logical that this lack of opinion would stem from the complexity of this question combined with the shortage of public debate and experience with LPR.

Table 4.1. An Experiment: Community Reaction to Data Storage With and Without "Solving Crime" Clause

	Yes, the data should be saved until the police want to erase it.	Yes, the data should be saved for about six months.	Yes, but only for a short period of time (for example, one month)	No, the data should not be saved
Do you think that your local police should save the LPR data? (n=226)	53 (23.5%)	69 (30.5%)	52 (23.0%)	52 (23.0%)
If it can help in solving crimes, do you think that your local police should save LPR data? (n=213)	77 (36.2%)	65 (30.5%)	35 (16.4%)	36 (16.9%)

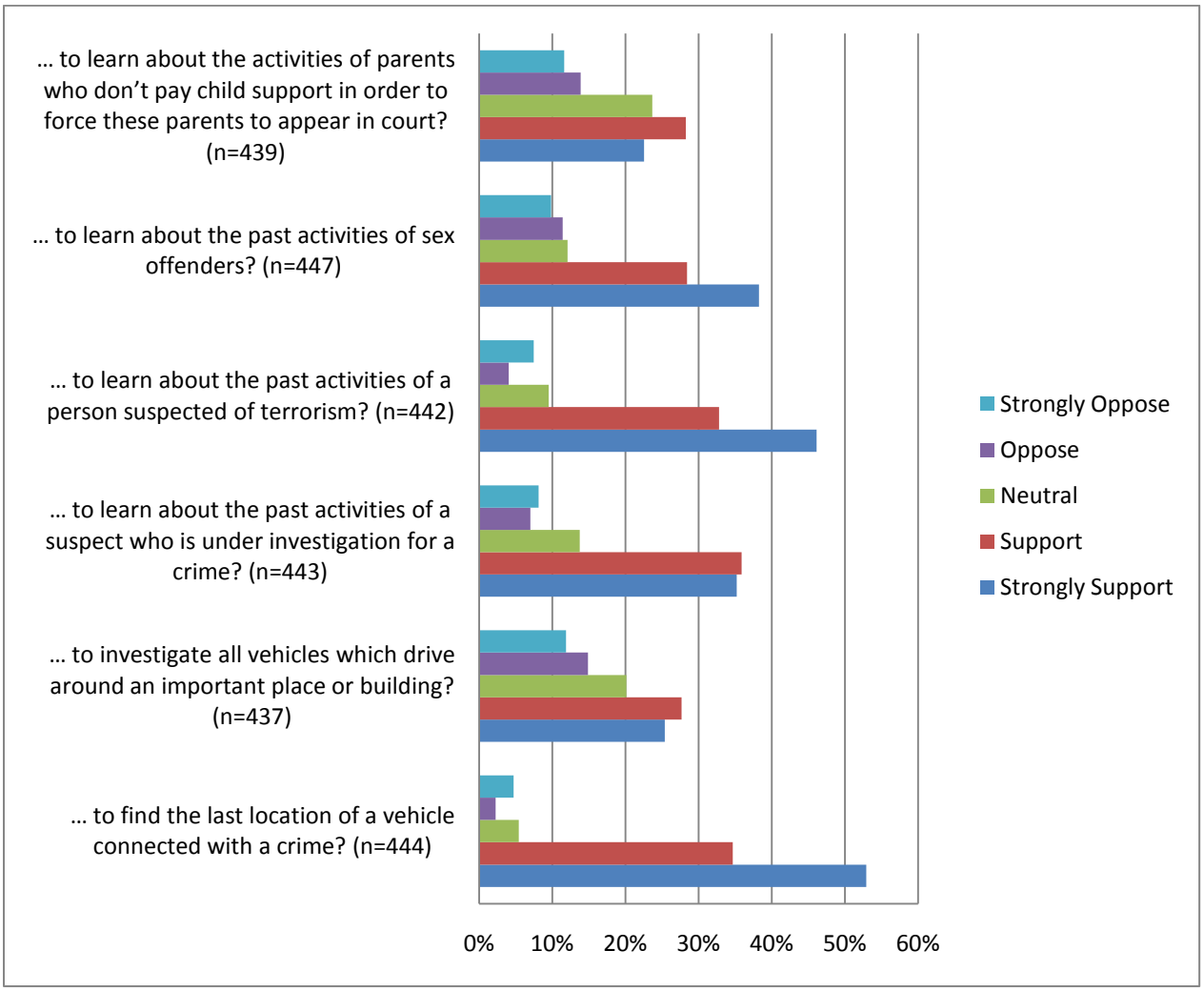
However, an interesting finding results from the experiment that was conducted using a slight variation to this survey item. Law enforcement agencies have made the argument that saving LPR data could help in future crime solving, since an LPR database would allow the police to "look back" at an area or time period surrounding a crime or at the activities of a prime suspect. We wanted to test the persuasiveness of this argument and the impact that it might have upon the willingness of community members to allow LPR data to be saved. For this reason, we split our sample of respondents into two groups and added the clause, "if it can help in solving crime" to the existing question about LPR data storage. Each group of respondents received only one of the two questions listed in Figure 4.6.

The findings presented in the second row of Figure 4.6 demonstrate that this argument seems highly influential to responses regarding the proper length of time to store LPR data. The addition of just a few words about crime resulted in a full 36.2% of respondents indicating that they would allow the police to save their data for as long as the police thought appropriate (as compared to only 23.5% of respondents in the group without this added clause). Further, as can be seen in Figure 4.6, respondents seem to migrate across categories to longer data storage periods once the potential crime control benefits of LPR data storage are mentioned. In fact, even the percentage of respondents

who indicated that data should not be saved for any length of time decreased by approximately six percentage points. Even those who are skeptical about the propriety of saving LPR data appear potentially open to moderation of their positions when reminded of the potential crime control benefits.

The results of the survey with respect to saved data become even more nuanced when we examine the findings targeted to later steps on the LPR continuum. Much like the uses of LPR located on the left side of the continuum, the public generally supports the uses of saved LPR data mentioned on the survey. As Figure 4.6 illustrates, the percentages of respondents replying that they "strongly support" or "support" these uses of saved LPR data remain high, ranging from 50.8% to 87.6% of the community. This is quite a large percentage of the public to support any public policy and—particularly with respect to the very highest percentages of support—may signify that the public has not had much of an occasion to consider the full implications of long-term LPR data storage by police.

Figure 4.6: "The Police Should Be Able to Use *Saved* LPR Data…"



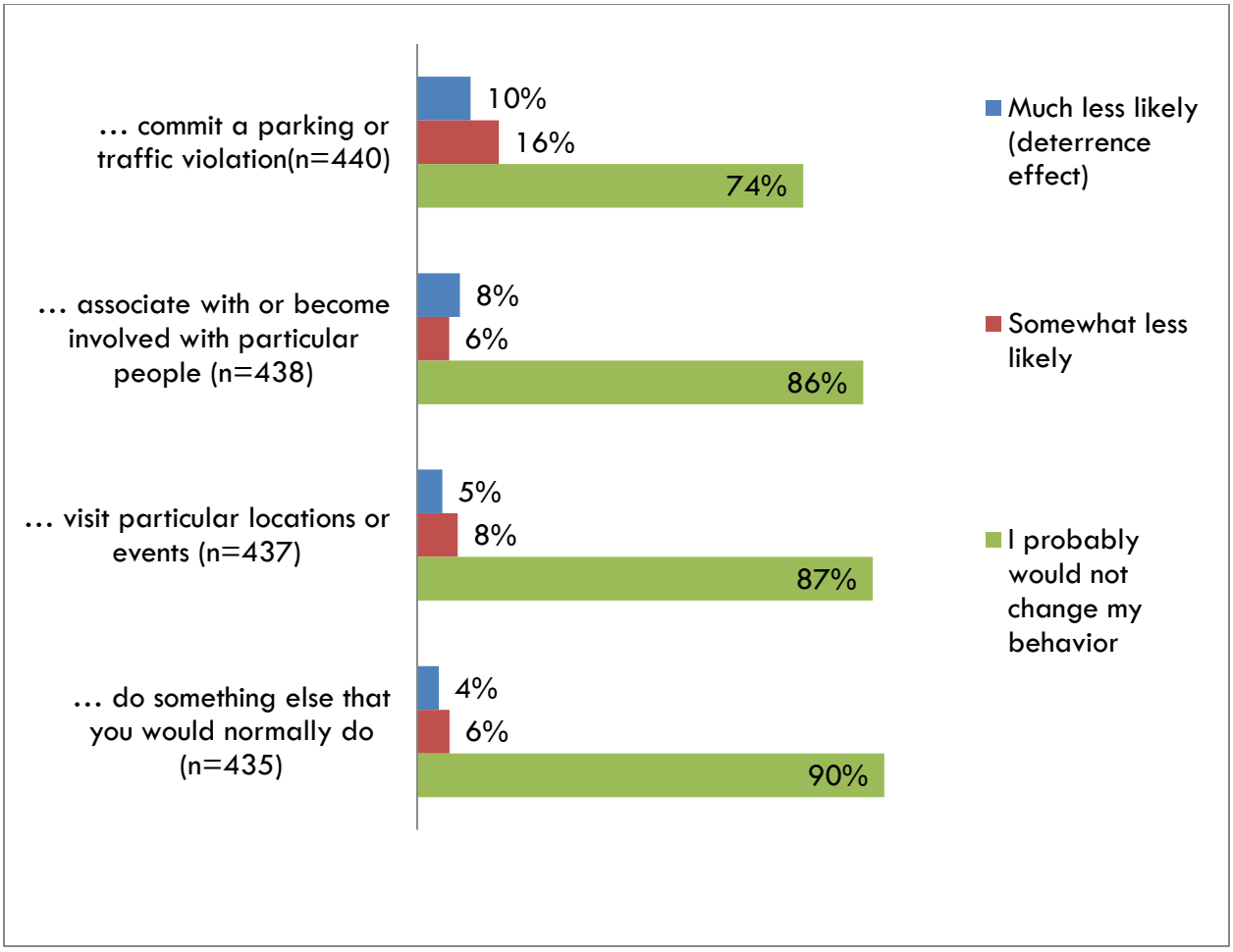
Additionally, it seems that support was again predicated on whether or not respondents felt that a particular use of saved LPR data might impact "average" or "innocent" members of the community. The uses of saved LPR data that would clearly impact "average" members of the community (as opposed to "criminals" or "terrorists") were the least popular. For example, though the use of saved LPR data to learn about the past activities of individuals suspected of a crime (71.1%), vehicles suspected of a crime (87.6%), sex offenders (66.7%), or suspected terrorists (79.0%) each yielded high levels of support, proposals to utilize the same data to investigate "all vehicles which drive around an important place or building" only prompted about 53.1% of respondents to mark "strongly support" or "support."

To be sure, this percentage still represents a majority of respondents. Yet the fact that comparatively few respondents supported the uses of both LPRs and of saved LPR data that might impact "average" members of the community underscores this consideration as potentially very important. This result may also suggest that one argument of privacy advocates—that LPR use and data storage is to be considered seriously because it will impact wholly "innocent" individuals—might have some traction with the public. The argument here is that "innocent" individuals in the community will have their data stored along with the "criminals"; therefore, average community members would be subject to the same potential privacy violations or harm from misused data without any individualized suspicion of wrongdoing.

LPR IMPACT

Since our project was focused on the deterrent effects of LPR on crime generally and auto-related crimes more specifically, Figure 4.7 displays results regarding the impact of LPR on individual behavior. For this question, we opted to select the six month data storage period discussed above and included a statement hypothesizing that the local police department in Fairfax made a decision to store LPR data for this period.

Figure 4.7. "If You knew That the LPR System's Data Was Being Saved for 6 Months by the Police in Your Community, Would You Be Less Likely to…"



In response to this question, 26% of participants indicated that they would be "much less likely" or "somewhat less likely" to commit a parking or traffic violation. This number is substantial because these responses may be based chiefly on the information about LPR contained within our short survey. The impact of LPR upon the commission of parking or traffic violations may increase as the community experiences the efficiency of the technology. Future evaluation studies should follow up on this point and investigate the actual impact of LPR on the commission of these violations, as opposed to the prospective impact investigated by this survey.

Yet, we also possessed a second interest in researching the impact of LPR on the behavior of community members. Since LPR use and computer storage capabilities might eventually progress to the point where it is possible to recreate a person's daily activities from saved LPR data, privacy advocates have been concerned that this capability may influence individuals' non-criminal activities. Individuals who hold political or personal views outside of the mainstream, or who fear criticism for some other choice, may choose to constrain

their activities in order to avoid police knowledge of them (Reiman, 1995, p. 35). As a result, LPR use could also have a chilling effect on the exercise of other rights, such as First Amendment rights (IACP, 2009, p. 14).

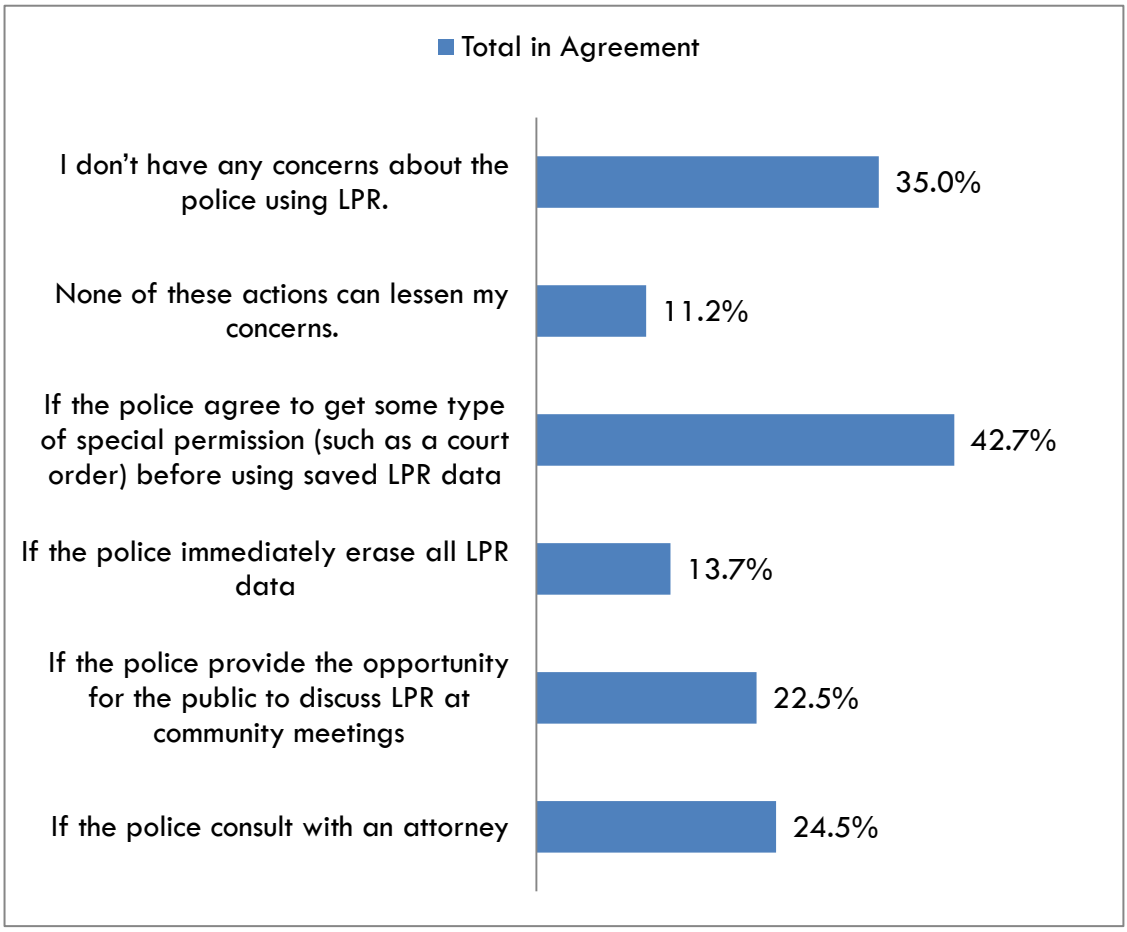
However, when asked if LPR data storage would stop them from "associating with or becoming involved with particular people," a minority (14.4%) of the community said that they would be "much less likely" or "somewhat less likely" to do so. Similarly, when asked if LPR data storage by the police would impact the likelihood that they would "visit particular locations or events," 12.6% said that they would be "much less likely" or "somewhat less likely" to make this choice. Finally, 10.4% indicated that they would be "much less likely" or "somewhat less likely" to "do something else that [they] normally would do." Though not majorities, these percentages represent a substantial portion of the total community, especially when it is considered that the reason why particular actions or opinions might be subject to community criticism is that they are not part of most community members' routines.

For example, only a small portion of a community might hold minority religious or political beliefs. When viewed in this light, the fact that 10–15% of residents might alter their actions seems substantial. Further, these results need to be understood in the context of the Fairfax, Virginia, community—a relatively large, fairly heterogeneous suburban community with a well-educated and mobile population. In another community (such as one that is smaller or more homogeneous), any chilling effect might be magnified.

Finally, the survey asked how the police might lessen any concerns the respondents might have about LPR use. Respondents were given the option of checking up to two items on a list of six. The list also included the option of checking a statement indicating that the individual did not have any concerns about LPR use. Likewise, another option allowed respondents to indicate that no action by the police could alleviate their concerns. The results of this question (Figure 4.8) are interesting. Since community support for the use of LPR is relatively high, it is not surprising that 35% of respondents indicated that they have no concerns about the use of LPR. In comparison, 11.2% responded that the police could take no action that would lessen their LPR-related concerns, and an additional 13.7% of participants asserted that their concerns would only be lessened by the immediate erasure of LPR data.

Taken together, the last two groups mentioned represent about one quarter of the population, which is not insubstantial. Since we allowed participants to check more than one option, there may be some overlap between these two groups; however, it seems unlikely that there is much overlap given the results on police legitimacy and support that are presented in the next section of this chapter. Indeed, we will find that similar percentages (23% of respondents) indicated that they would hold a more negative view of their local police if the decision were made to save LPR data.

Figure 4.8. Respondents' Suggestions for Alleviating Concerns About LPR (n=457)



A similar percentage (24.5%) would like to see the police department consult an attorney about legal issues prior to using LPR. This is actually a slightly greater number of respondents than those who would like to see police allow the public an opportunity to comment on the use of LPR (22.5%). However, by far the largest percentage of respondents (42.7%) indicated that they would like to see police be required to obtain some special permission (such as a court order) before using saved LPR data. The argument that police should not have unfettered access to this information appears to have some traction in the community. For example, a policy that states that police will only look at LPR with some level of cause to suspect criminal wrongdoing might help to lessen the concerns of the community.

POLICE LEGITIMACY AND PERFORMANCE

The community survey-experiment incorporated several distinct measures related to police legitimacy, performance, and job approval. As mentioned in the methodology section above, we chose to ask questions regarding approval of police at several strategic points throughout the survey. Additionally, we incorporated an experiment that involved altering

the order in which various sections of the survey were presented to respondents. This allowed us to obtain a "baseline" reading with respect to legitimacy issues prior to asking any questions about LPR and to obtain a second reading from another groups of respondents to see if discussion of these issues would impact answers to the police legitimacy items. The experimental design allows for comparison of the average answers given by members of the community without fear of biased results that might occur if these questions were asked in sequence.

Table 4.2: Community Response to Police Legitimacy and Job Approval Questions

Responses given before discussion of LPR	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Total**
The police can be trusted to do what is right	54 (23.58%)	131 (57.21%)	28 (12.23%)	12 (5.24%)	4 (1.75%)	229
Most police officers in my community do their job well	80 (34.93%)	116 (50.66%)	28 (12.23%)	5 (2.18%)	0 (0.00%)	229
The police in my community treat citizens with respect	66 (28.82%)	117 (51.09%)	34 (14.85%)	10 (4.37%)	2 (0.87%)	229
The police in my community respect citizens' rights	67 (29.52%)	109 (48.02%)	38 (16.74%)	9 (3.96%)	4 (1.76%)	227
Responses given after discussion of LPR	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Total**
The police can be trusted to do what is right	28 (12.84%)	120 (55.05%)	48 (22.02%)	13 (5.96%)	9 (4.13%)	218
Most police officers in my community do their job well	67 (30.59%)	128 (58.45%)	22 (10.05%)	2 (0.91%)	0 (0.00%)	219
The police in my community treat citizens with respect	56 (25.69%)	117 (53.67%)	38 (17.43%)	7 (3.21%)	0 (0.00%)	218
The police in my community respect citizens' rights	49 (22.58%)	118 (54.38%)	42 (19.35%)	6 (2.76%)	2 (0.92%)	217

The "baseline" readings mentioned above are presented in the top half of Table 4.2. Generally, the top half of Table 4.2 indicates that residents hold positive feelings toward

their local police. The first five rows include only the responses from one-half of the sample—those respondents who answered these questions prior to any discussion of LPR on the survey. 80.79% of respondents expressed "strong agreement" or "agreement" that the local police department could be trusted to do what is right for the community. Similar percentages of the sample also either "strongly agree" or "agree" that the local police do their job well (85.59%), treat citizens with respect (79.91%), and respect citizens' rights (77.54%). In this manner, community sentiment toward the police in Fairfax, Virginia, seems to be very high. This high degree of esteem with which the Fairfax police are viewed by members of community may also influence the degree to which citizens are willing to trust their police to use LPR and store the data.

The experimental design allows us to compare the percentages discussed in the above paragraph with those from the "treatment" group, or the half of respondents who were asked about their feelings toward the police department after answering questions about LPR. Table 4.2 also presents these results in the last five rows. In comparison to the 80.79% of respondents who expressed "strong agreement" or "agreement" in the first sample, only 67.89% answered similarly that the local police department could be trusted to do what is right following discussion of LPR. Though still a sizable majority of respondents, there is also a substantial decline when compared with the responses of the first group. Indeed, this is the case after these citizens grappled with LPR issues for only a short period of time (during the survey). In comparison, we detected decreases in the percentages of respondents who would "strongly agree" with the remaining items, but not in overall support. In fact, Table 4.2 shows that strong agreement with each of the four items (trust in police, job approval, beliefs that police treat citizens with respect, and respect for rights) drops by between 2.51 and 10.74 percentage points following discussion of LPR. Additionally, these results appear even starker when it is considered that group number 2 coincidentally included close to an additional 12 percentage points of individuals identifying as Republicans and political conservatives[33], groups that previous public opinion studies have suggested trust the police at higher rates than others in the community. The changes that occurred in how the respondents answered these questions suggest that with prolonged discussion of LPR in public debate, police departments may reasonably be concerned about the impact of LPR on police legitimacy and community approval.

Our survey design allows for confirmation and replication of these findings and, perhaps, allows us to pinpoint why these changes have occurred. Specifically, we asked respondents to indicate whether they would feel more positively, neutral, or more negatively about the police at critical points during the survey. These results are compared in Table 4.3. The first "checkpoint" occurred after discussion of only the primary use of LPR (stolen vehicle retrieval). At this time, 79.85% of respondents indicated that they would

[33] These groups were measured in two separate survey questions (one related to political parties and one related to political ideology). However, both questions yielded nearly identical results with respect to group 2.

"strongly support" or "support" a decision by the police to use LPR. This finding corresponds with space one on the continuum of LPR uses. Following discussion of the LPR uses located at spaces two and three on the continuum, 35.97% of respondents indicated that they would feel "much more positively" or "more positively" about their police department, while 49.77% remained neutral and 14.25% of respondents indicated that they would feel "more negatively" or "much more negatively" about their local police. Substantial numbers of respondents indicated preferences on both the negative and positive sides of the scale. However, the results seem to suggest that the adoption of LPR uses at spaces one through three on the continuum may, at this time, engender more positive feelings of police than negative.

Table 4.3: Alterations in Community Support for Police as a Result of LPR Use

Question asked after discussion of primary and immediate uses of LPR only . . .	Much More Positively	More Positively	Neutral	More Negatively	Much More Negatively	Total
If the police in your community decided to use LPR, would this cause you to feel more positively or more negatively about your local police?	16 (14.48%)	95 (21.49%)	220 (40.77%)	31 (7.01%)	32 (7.24%)	451
Question asked after discussion of LPR data storage . . .	Much More Positively	More Positively	Neutral	More Negatively	Much More Negatively	Total
If the police in your community decided to save LPR data for six months, would this cause you to feel more positively or more negatively about your local police?	57 (12.75%)	60 (13.42%)	231 (51.68%)	50 (11.19%)	49 (10.96%)	447

Yet, there is also an important point of caution associated with this finding. The majority of respondents also reported that they would be neutral to the decision to utilizing LPR at continuum points one, two, and three. This finding may result from the fact that LPR does not influence views of police for these individuals, or the finding may again result from the fact that there has been so little public discussion of LPR to this point. Agencies considering adopting LPR must also judge how events or a more robust public dialogue may influence these opinions.

Finally, we may also compare responses provided to the same question but this time asked directly following discussion of the possibility that the police department might save LPR data for a 6-month time period. This "checkpoint" corresponds with spaces four and five on the continuum of LPR uses presented earlier in this chapter. Following discussion of the uses of LPR that rely on saved data, only 26.17% of respondents indicated that they would feel "much more positively" or "more positively" about their police department (down from 35.97 above). Additionally, while approximately one half of respondents remained neutral, the number that indicated they would feel "more negatively" or "much more negatively" about their local police rose (from 14.25 to 22.15). This finding suggests that the decreases found in the four items discussed at the beginning of this section (trust in police, job approval, beliefs that police treat citizens with respect, and respect for rights) are likely attributable to concerns over the storage of LPR data.

Conclusions

It is clear from the preceding results that the community of Fairfax, Virginia, feels quite positively about its local police department. At the start of this community survey-experiment, then, our results seemed to indicate that the police department was operating with a good deal of legitimacy in the eyes of the public. In turn, this high level of legitimacy and reserve of goodwill between the police and the community may also have affected the degree to which the community indicated a willingness to trust the police to utilize LPR technology. Indeed, across the board, there are high levels of support within the community for most of the uses of LPR mentioned within the survey. For the purposes of aiding future testing and policy development, this chapter presented a continuum of LPR uses and a survey-experiment specifically targeted to locations on that continuum.

Yet, despite the high levels of police legitimacy found in this community, the survey-experiment detected slippage in opinions about the police following discussion of LPR. This result occurred even though most members of the community have likely had very little actual experience with LPR. Further, the discussion of LPR on the survey was relatively brief. Even in a community with high levels of public support for the police and where the police department commands substantial legitimacy, mere discussion of LPR on a survey results in some reduction of goodwill. This question of legitimacy is crucially important, as it impacts all operations that the police must conduct. In some ways, this is the "toughest test" of whether or not LPR use might impact legitimacy by virtue of the fact that legitimacy was particularly robust in this community. Not surprisingly, the survey item that reflected the slippage mentioned above to the greatest degree was an item asking respondents to assess whether or not the police respected the rights of citizens. While this survey-experiment yielded interesting results, police agencies would be well served by a future survey project in a community with lower pre-existing police legitimacy and job approval. In a community of this type, the impact of LPR may be even more substantial.

In fact, the slippage of opinion regarding the police that was detected in the survey-experiment may only be temporary, as our current research design can tell us nothing about the persistence of this decline. However, it may be just as logical to assume that decreases in legitimacy might also accelerate with increased citizen interaction with and knowledge of LPR. As mentioned previously, these results do not account for the impacts of prolonged discussions of privacy that may occur once a community begins to think about the full implications of the technology. To the best of our ability, we designed this survey to represent an unbiased source of information and, in doing so, we purposefully did not mention any of the "buzz" words that may result in stark changes of public confidence. Further, our survey does not account for serious legitimacy impacts that might result from publicized instances of hacking or improper disclosure of LPR data.

For these and other reasons, public opinion regarding the use of LPR technology may change. For example, we found evidence of this possibility in several items on the survey for which substantial percentages of respondents fell into the neutral category. Not surprisingly, at times, we also detected a response pattern suggestive of a simple lack of knowledge about LPR at this time. The question that asked about the proper length of time for storage of LPR data provides a good example of this. Our sample selected each response category with nearly equal frequency, likely the result of a lack of any true opinion. This may change rapidly with increased exposure to LPR. As is generally the case with questions related to privacy, respondents also seem to have had a difficult time conceptualizing some of the tradeoffs between LPR and civil liberties, but this may change with more widespread LPR use and more frequent discussion in the community.

Yet, the community survey-experiment also yielded several results that may be helpful to agencies in formulating policy, even at this early point in the development of the evidence base. First, it seems that members of the community are responsive to allowing more police discretion with respect to LPR if the technology can aid in combating crime. The community's substantial response to our second experimental stimulus made this clear. Additionally, law enforcement agencies should note that individuals in this experiment were less supportive of LPR uses that seemed to affect them personally or to affect "innocent" members of the community (such as when LPR is used to give parking tickets). These uses are easier for the community to conceptualize and relate to the possibility of experiencing negative consequences personally. The result was that fewer respondents supported these uses. This may also suggest that individuals could be receptive to some arguments by privacy advocates suggesting that LPR targets "innocent" citizens as much as those guilty of a crime. Finally, the majority of respondents indicated that they considered LPR data to be private information, a finding that should be considered by agencies thinking about how to configure their LPR systems.

Indeed, when asked what the police could do to lessen their fears about LPR, the highest percentage of respondents answered that they would like to see the police be required to

obtain some special permission before examining saved LPR data. This result also coincides with the findings of our legitimacy tests, which suggest that residents have greater concerns about data storage than they do about the uses of LPR located to the left side of the continuum. This also coincides with some of the legal arguments that suggest that the courts may have a more difficult time with the storage of data than with the primary use of LPR.

REFERENCES

Anselin, L., Cohen, J., Cook, D., Gorr, W., & Tita, G. (2000). Spatial Analysis of Crime. *Criminal Justice: Measurement and Analysis of Crime and Justice Volume 4*. Washington, DC: U.S. Department of Justice, National Institute of Justice.

Bailey, T. and Gatrell, A. (1995). *Interactive Spatial Data Analysis*. Harlow, England: Pearson Education Ltd.

Bayley, D. & Bittner, E. (1984). Learning the skills of policing. *Law and Contemporary Problems, 47*, 35-59.

Bennett, T., Holloway, K., & Farrington, D.P. (2008). A review of the effectiveness of neighborhood watch. *Security Journal,* 22, 143-155.

Boruch, R., De Moya, D., & Snyder, B. (2000). The importance of randomized field trials. *Crime and Delinquency,* 46(2): 156-180.

Braga, A.A. (2007). Pulling levers focused deterrence strategies and the prevention of gun homicide. *Journal of Criminal Justice,* 36(4): 332-343.

Braga, A.A. (2005). Hot spots policing and crime prevention: A systematic review of randomized controlled trials. *Journal of Experimental Criminology, 1*(3): 317-342.

Brown v. Socialist Workers' 74 Campaign Comm., 457 U.S. 87, (1982).

Bureau of Justice Statistics, U.S. Department of Justice (2009). *Law Enforcement Management and Administration Statistics*. Accessed February 19, 2010 from the Bureau of Justice Statistics Website: http://bjs.ojp.usdoj.gov/index.cfm?ty=dcdetail&iid=248#Methodology

Campbell, D.T., & Stanley, J.C. (1963). *Experimental and quasi-experimental designs for research on teaching*. In N.L. Gage (Ed.). *Handbook on research on teaching*. Chicago: Rand McNally.

Clarke, R., & Weisburd, D. (1994). Diffusion of Crime Control benefits: Observations on the reverse of displacement. In R. Clarke (Ed.). *Crime Prevention Studies Vol. 2* (pp. 165-183). Monsey, NY: Willow Tree Press.

Cohen, Plecas, & McCormick (2007). *A report on the utility of the automated license plate recognition system in British Columbia*. Unpublished report

Cook, T. (2003). Resistance to experiments: Why have educational evaluators chosen not to do randomized experiments? *The Annals of the American Academy of Political and Social Science, 589,* 114-149.

Davis, R.C., Weisburd, D., Hamilton, E.E. (2008). *Preventing repeat incidents of family violence: A randomized field test of second responder program in Redlands, California*. The National Institute of Justice: Washington, DC

Delaware v. Prouse, 440 U.S. 648, (1979).

Donohue, L.K. (2006). Criminal law: Anglo-American privacy and surveillance. *Journal of Criminal Law and Criminology, 96*: 1059

Dow Chemical Co. v. United States, 476 US 227, (1986).

Ellison v. United States, 552 U.S. 947 (2007).

Farrington, D. & Petrosino, A. (2001). The Campbell Collaboration Crime and Justice Group. *Annals of the American Academy of Political and Social Sciences 578*, 35-49.

Federal Bureau of Investigation, U.S. Department of Justice (2009). *Crime in the United States, preliminary semi-annual uniform crime report*. Accessed March 1, 2010 from http://www.fbi.gov/ucr/2009prelimsem/index.html

Henry, L. & Bryan, B. 2000. *Visualising the spatio-temporal patterns of motor vehicle theft in Adelaide, South Australia*. Unpublished paper, Adelaide, AU: National Key Centre for Social Applications of GIS.

Home Office. (2007). *Police Standards Unit: Evaluation of Automatic Number Plate Recognition 2006/2007*. London, United Kingdom: PA Consulting Group

Hubbard, T. E. (2008). Automatic License Plate Recognition: An Exciting New Law Enforcement Tool with Potentially Scary consequences. *Syracuse Science and Technology Law Report* , 2.

Hudson, S. (2009). *Enter into a memorandum of understanding between Arlington County, VA and Prince William County accepting automated license plate readers fully funded by the Department of Homeland Security's Urban Area Security Initiative to be used by county police*. Accessed February 19, 2010 from Prince William County Government website: http://www.pwcgov.org/documents/bocs/agendas/2009/0915/5-L.pdf

Hughes, T. (2010). Police partner with license plate readers. *USA today*, http://www.usatoday.com/news/nation/2010-03-03-license-plate-cameras_N.htm.

International Association of Chiefs of Police (2009). *Privacy impact assessment report for the utilization of license plate readers*. Accessed May 24, 2010 from the International Association of Chiefs of Police website:

http://www.theiacp.org/LinkClick.aspx?fileticket=N%2bE2wvY%2f1QU%3d&tabid=87

International Association of Chiefs of Police (2007). Support for License Plate Reader Systems. Accessed May 24, 2010 from the International Association of Chiefs of Police website: http://www.iacp.org/resolution/index.cfm?fa=dis_public_view&resolution_id=324&CFID=9952799&CFTOKEN=30183528

Joh, Elizabeth E. 2007. Discretionless Policing: Technology and the Fourth Amendment. California Law Review, 95, 199-234.

Katz v. U.S., 549 U.S. 956, (1967).

Kennedy, D.B. (1980). Facility site selection and analysis through environment criminology. *Journal of Criminal Justice, 18*: 239–252.

Koper, C.S., Taylor, B.G., & Kubu, B.E. (2009). *Law enforcement technology needs assessment: Technologies to address the operational needs of law enforcement*. The Police Executive Research Forum: Washington, D.C.

Koper, C. S. (1995). Just enough police presence: Reducing crime and disorderly behavior by optimizing patrol time in crime hot spots. *Justice Quarterly, 12*(4), 649-672.

Kyllo v. United States, 533 US 27, (2001).

Lum, Cynthia and George Fachner. (2008). *Police Pursuits in an Age of Innovation and Reform*. Alexandria, VA: International Association of Chiefs of Police.

Lum, C., Koper, C. & Telep, C. (ONLINE FIRST, 2010). The evidence-based policing Matrix. *Journal of Experimental Criminology*. DOI: 10.1007/s11292-010-9108-2.

Lum, C. (2010). Gadgets for gathering evidence are not evidence of better policing. *Science Progress*, Accessed June 1, 2010 from the Science Progress website: http://www.scienceprogress.org/2010/02/police-technology/

Lum, C., Koper, C. & Telep, C. (2009). The evidence-based policing Matrix. *Online Tool*. Located at http://gemini.gmu.edu/cebcp/matrix.html .

Lum, C., Kennedy, L.W., & Sherley, A. (2006). Are counter-terrorism strategies effective? The results of the Campbell systematic review on counter-terrorism evaluation research. *Journal of Experimental Criminology,* 2(4): 489-516.

Mazerolle, L., Rombouts, S., & McBroom, J. (2007). The impact of COMPSTAT on reported crime in Queensland. *Policing: An International Journal of Police Strategies and Management,* 30(2): 237-256.

McIntyre v. Ohio Elections Comm'n, 514 US 334 (1995).

Marcus, G.E., Sullivan, J.L., Theiss-Morse, E., & Wood, S.L. (1995). *With malice toward some: How people make civil liberties judgments*. Melborne: Cambridge.

Maryland State Highway Authority (2005). *Evaluation of license plate recognition system*. Accessed November 11, 2009 from the American Association of State Highway and Transportation Officials website: http://www.transportation.org/sites/ssom/docs/LPR_report_part3.pdf

Moffa, Steven. (2010). *License Plate Recognition Technology: Tips from the User Community*. Fairfax County, VA: George Mason University. Located at: http://gemini.gmu.edu/cebcp/LPR/for-lpr-deployment.html

NAACP v. Alabama ex rel. Patterson, 357 US 449, (1958).

Nagin, D.S. (1998). Criminal deterrence research at the outset of the twenty-first century. *Crime and Justice, 23,* 1-42

National Research Council (2004). *Fairness and effectiveness in policing: The evidence*. Committee to Review Research on Police Policy and Practices. W. Skogan & K. Frydl (eds.). Committee on Law and Justice, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academies Press.

New York v. Class, 475 U.S. 106, (1986).

New York v. Davila, 901 N.Y.S.2d 787, (2010).

Ohio State Highway Patrol (February 2005) *Automatic plate reader technology*. Planning Services Section Research and Development.

Olabisiomotosho v. City of Houston, 185 F.3d 521, (5th Cir.1999).

PA Consulting Group. (2004). *Driving crime down – Denying criminals the use of the road*. Great Britain, Home Office. Accessed July 21st, 2009 from http://police.homeoffice.gov.uk/news-and-publications/publication/operational-policing/Driving_Crime_Down_Denyin1.pdf?view=Binary.

PA Consulting Group. (2003). *Engaging criminality – Denying criminals the use of the road*. Great Britain. Accessed July 21st, 2007 from http://www.paconsulting.com/es/NR/rdonlyres/8BEBFD54-94DC-4274-8283-EE1A66D0E09E/0/ANPR_report_24_Oct.pdf.

Plouffe, N. & Sampson, R. (2004). Auto theft and theft from autos in parking lots in Chula Vista, CA. In M.G. Maxfield and R.V. Clarke (Eds.), *Understanding and preventing car theft*, Crime Prevention Studies Vol. 17. Monsey NY: Criminal Justice Press.

Reiman, J.H. (1995). Driving to the panopticon: A philosophical exploration of the risks to privacy posed by the highway technology of the future. *Santa Clara Computer and High-Technology Law Journal,* 11: 27-44

Rengert, G. (1996). Auto theft in central Philadelphia. In R. Homel (Ed)., *Policing for prevention: Reducing crime, public Intoxication and injury*, Crime Prevention Studies Vol. 7. Monsey, NY: Criminal Justice Press.

Rice, K.J., & Smith, W.R. (2002). Socioecological models of automotive theft: Integrating routine activity and social disorganization approaches. *Journal of Research in Crime and Delinquency,* 393: 304-336.

Rogers, Everett. (1995). *Diffusion of Innovations*. New York: Free Press.

Sherman, L.W. (1998). *Evidence-based policing*. Ideas in American Police Series. The Police Foundation: Washington, DC.

Sherman, L.W., Farrington, D.P., Welsh, B.C., & MacKenzie, D.L. (2002) *Evidence-based crime prevention*. New York: Routledge.

Sherman, L. W., Gottfredson, D., MacKenzie, D. L., Eck, J., Reuter, P. & Bushway, S. (1997). *Preventing crime: What works, what doesn't, what's promising: A report to the United States Congress*. Washington, DC: National Institute of Justice.

Sherman, L.W. & Weisburd, D. (1995). General deterrent effects of police patrol in crime "hot spots": A randomized controlled trial. *Justice Quarterly, 12*(4): 626-648.

Sherman, L. W., Rogan, D. P., Edwards, T., Whipple, R., Shreve, D., Witcher, D., Trimble, W., The Street Narcotics Unit, Velke, R., Blumberg, M., Beatty, A., & Bridgeforth, C. A. (1995). Deterrent effects of police raids on crackhouses: A randomized, controlled experiment. *Justice Quarterly, 12*(4): 755-781.

Sherman, L. W. (1990). Police crackdowns: Initial and residual deterrence. *Crime and Justice, 12*(1), 1-48.

Sherman, L., Gartin, P., & Buerger, M. (1989). Hot spots of predatory crime: Routine activities and the criminology of place. *Criminology, 27*(1), 27-56.

Sherman, L. W. (1984). Experiments in police discretion: Scientific boon or dangerous knowledge? *Law and Contemporary Problems, 47*, 61-81.

Sherman, L. W. & Berk, R. A. (1984). The specific deterrent effects of arrest for domestic assault. *American Sociological Review, 49*(2), 261-272.

Solove, D.J., Rotenberg, M., & Schwartz, P.M. (2006). *Information privacy law*. Accessed from http://docs.law.gwu.edu/facweb/dsolove/Information-Privacy-Law/files/IPL-Update-2007.pdf

Spelman, W., & Brown, D. K. (1981). *Calling the police: Citizen reporting of serious crime*. Washington, DC: Government Printing Office.

State v. Donis, 157 N.J. 44, 46-48. 723 A.2d 35 (1998).

Taylor, B., Koper, C., and Woods, D. (2010). Combating auto theft in Arizona: A randomized experiment with license plate recognition technology. Washington, DC: Police Executive Research Forum.

Tyler, T. R. and Huo, Y. J. (2002). *Trust in the law: Encouraging public cooperation with the police and courts*. Russell Sage Foundation: New York.

Tyler, T. R. (1990). *Why people obey the law?* New Haven, CT: Yale University Press.

U.S. Const., amend. XIV, § 1.

United States v. Diaz-Castaneda, 494 F. 3d 1146, (9th Cir. 2007).

United States v. Ellison, 462 F.3d 557, (6th Cir. 2006).

United States v. Knotts, 460 US 276, (1983).

United States v. Matthews, 615 F.2d 1279, (10th Cir. 1980).

United States v. Moran, 349 F. Supp. 2d 425 (N.D.N.Y., 2005).

United States v. Walraven, 892 F. 2d 972, (10th Cir. 1989).

US Dept. of Justice v. Reporters Committee, 489 US 749, (1989).

U.S. Department of Homeland Security (2008). DHS announces fiscal year 2009 grant guidance for over $3 billion in preparedness grant programs. Accessed November 11, 2009 from Department of Homeland Security website: http://www.dhs.gov/xnews/releases/pr_1225900531284.shtm=

Virginia Department of Emergency Management. (2008, August 28). *Emergency management update*. Retrieved from http://www.vdem.state.va.us/emupdate/08_emupdate/082708.htm

Weisburd, D. (2008) Place-based policing. *Series on Ideas in American policing*. The Police Foundation: Washington, DC.

Weisburd, D., Bernasco, W., & Bruinsma, G. (eds). (2009). *Putting crime in its place*.: New York: Springer.

Weisburd, D., Morris, N., & Ready, J. (2008). Risk-focused policing at places: An experimental evaluation. *Justice Quarterly, 25*, 163-200.

Weisburd, D., Wyckoff, L., Ready, J., Eck, J., Hinkle, J., & Gajewski, F. (2006). Does Crime Just Move Around the Corner? A Controlled Study of Spatial Displacement and Diffusion of Crime Control Benefits. *Criminology, 44*(3), 549-592.

Weisburd, D. & Lum, C. (2005). The Diffusion of Computerized Crime Mapping in Policing: Linking Research and Practice. *Police Practice and Research: An International Journal*, *6*(5): 419-434.

Weisburd, D., Bushway, S., Lum, C., & Yang, S. (2004). Trajectories of crime at places: A longitudinal study of street segments in the city of Seattle. *Criminology*, *42:2*, 283-321.

Weisburd, D., & Eck, J.E. (2004). What can police do to reduce crime, disorder, and fear? *The Annals of the American Academy of Political and Social Science, 59*(1): 42-65.

Weisburd, D. (2003). Ethical practice and evaluation of interventions in crime and justice: The moral imperative for randomized trials. *Evaluation Review,* 27(3): 336-354.

Weisburd, D. (2002). From criminals to criminal contexts: Reorienting criminal justice research and policy. *Advances in Criminological Theory, 10,* 197–216.

Weisburd, D. (2000). Randomized experiments in criminal justice policy: Prospects and problems. *Crime and Delinquency,* 46(2): 181-193.

APPENDICES

APPENDIX A. RANDOM SAMPLE LPR SURVEY

TO:
REGARDING: Survey on License Plate Recognition Technologies
SPONSORING AGENCIES: Department of Defense (DOD/SPAWAR) and Department of Justice (DOJ), Administered through the Center for Evidence-Based Crime Policy (CEBCP), George Mason University http://gemini.gmu.edu/cebcp .

Your agency has been randomly selected from all U.S. law enforcement agencies to participate in a survey gauging the extent of law enforcement use of **license plate reader/recognition (LPR) technology**. Specifically, the LPR systems mentioned in this survey are those systems, either in fixed positions or mounted on vehicles, which have the ability to scan license plates for investigative purposes. *(Please note: We are **NOT** asking about red light cameras or CCTV technologies in this survey.)*

This short survey will take approximately 10 minutes to complete. Please select the following survey that best describes your agency:

1. If your agency **currently uses LPR** systems, please fill out the information below and complete the brief survey as indicated on page 2 of this letter. For your convenience, this survey may also be accessed at: http://sites.google.com/site/surveycebcp/
2. If your agency **DOES NOT use LPR systems**, please fill out the information below and complete the brief survey as indicated on page 2 of this letter. For your convenience, this survey may also be accessed at: http://sites.google.com/site/surveycebcp/survey-for-agencies-without-lpr-technology

All results from this survey will be treated as confidential information and no individual survey or agency information will be disclosed in the reporting of these results. All survey results will also be made fully available to participating agencies upon request. If you have any questions regarding this survey, please feel free to contact Dr. Cynthia Lum, Deputy Director for the Center for Evidence-Based Crime Policy, directly at clum@gmu.edu or 703-993-3421. Thank you very much for your time.

If you do not have internet access, please fill out the attached survey and return to:
Dr. Cynthia Lum, George Mason University
Fax to: 703.993.8316
Mail to: CEBCP at George Mason, Administration of Justice, 301 Bull Run Hall (MS4F4),
10900 University Blvd, Manassas, VA 20110

Agency name: _____

Contact name and official title of the person who completed this survey: _____

E-mail address: _____

Phone (Example: 999-999-9999): _____

Full business address: (Example: ABC Police Agency, 123 Main Street, Los Angeles, CA)

Survey for Agencies that do <u>not</u> use LPR technology

Please complete ONLY if your agency DOES NOT have LPR technology. If your agency does use LPR, please skip and go to "Survey for Agencies that currently use LPR Technology" on the next page.

1. Does your agency have plans to acquire LPR technology in the next 12 months?
   - ☐ Yes
   - ☐ No
   - ☐ No, but we are interested in acquiring LPR at some point

2. Why hasn't your agency acquired LPR technology to this point? Please check those factors that your agency has specifically considered. Check all that apply. If you also select "Other" please make sure the box to the left of "Other" is checked.
   - ☐ Agency is focused on other priorities
   - ☐ Data files or downloads are not available to support LPR technology
   - ☐ Cost of technology and ongoing maintenance
   - ☐ Lack of outside funding available to purchase LPR systems
   - ☐ Potential for legal or privacy concerns
   - ☐ Lack of familiarity with LPR systems
   - ☐ Concerns about technological problems with LPR systems
   - ☐ Concerns about misuse of data or hacking of data stored in LPR databases
   - ☐ Not enough information on the benefits or best practices associated with LPR systems
   - ☐ Concerns about driver distraction when using LPR system in police vehicles
   - ☐ Concerns about complaints from citizens or community groups
   - ☐ Other (please Describe): _____

Additionally, if you would like to share any other comments or concerns about your agency's discussion concerning the use of LPR technologies, please describe them below.

Survey for Agencies that currently use License Plate Recognition (LPR) Technology

If your agency currently uses LPR technology, please complete the following 10-question survey.

1. How many LPR devices does your agency regularly use? (Please enter a number) _____

2. Who is the vendor (s) of the LPR devices used by your agency?

_____

_____

__

3. Where did your agency obtain funding to acquire LPR devices?
(Check all that apply.)
   - ☐ Federal program or federal grant funding
   - ☐ State program or state grant funding
   - ☐ Funding from annual agency budget

☐ LPR devices are loaned from another agency
☐ Other: _____

4. How are LPR devices used by your agency?
(For each of the following categories, check all that currently apply)

4a. Operational purpose (Check all that apply)
- ☐ Devices are used to detect stolen vehicles or stolen tags
- ☐ Devices are used to detect motor vehicle violations (vehicle with expired registration, unpaid tickets, etc.)
- ☐ Devices are used to initiate traffic stops to address other crimes
- ☐ Devices are used to monitor or record vehicles entering high-crime locations
- ☐ Devices are used to monitor security in high-risk locations (government buildings, key infrastructure)
- ☐ Devices are used to connect licenses to a secondary database (sex offender registry, child support, warrants) for further investigation
- ☐ Other: _____

4b. Frequency of use (Check all that apply)
- ☐ At least one device is always in operation 24 hours a day, 7 days a week
- ☐ Devices are turned on and off during the day or during a shift for a few hours
- ☐ Devices are used on an ad hoc basis for specific operational purposes
- ☐ Other: _____

4c. *Device Platform* (Check all that apply)
- ☐ Devices are mounted at fixed positions along highways or other traffic areas.
- ☐ Devices are mounted on marked police vehicles
- ☐ Devices are mounted on unmarked vehicles
- ☐ Devices use images gathered by other surveillance systems (i.e. CCTV systems, red-light cameras)
- ☐ Other: _____

4d. *Personnel operating the LPR technology* (Check all that apply)
- ☐ Uniformed police officers in general patrol
- ☐ Officers part of a LPR-dedicated or specialized unit
- ☐ Civilian and non-sworn agency employees
- ☐ Personnel in a command center
- ☐ Other: _____

5. Has your agency conducted a formal or published evaluation of your LPR devices?
☐ Yes
☐ No

6. What did your agency do to prepare to use the LPR technology? (Check all that apply)
- ☐ Consulted with another police agency regarding the use of LPR or attended an LPR training session hosted by another agency
- ☐ Reviewed research on LPR technology
- ☐ Created standard operating procedures for the use of LPR

- ☐ Researched the legal implications of the technology
- ☐ Consulted with the agency's attorney
- ☐ Attended a demonstration of the technology by the manufacturer or vendor
- ☐ Created or collected the data to be used by the LPR system
- ☐ Consulted with community leaders on the implementation of the technology
- ☐ Announced the use of the technology through press release or other media campaign
- ☐ Upgraded computer or information technology systems to accommodate LPR technological needs
- ☐ Conducted a needs assessment for the use of LPR
- ☐ Other: _____

7. What concerns does your agency have about the use of LPR? (Check all that apply)

- ☐ Potential for legal or privacy concerns
- ☐ Cost of the technology or ongoing maintenance
- ☐ Lack of familiarity with LPR systems
- ☐ Concerns about technological problems with LPR systems
- ☐ Concerns about the misuse of data or hacking of data stored in LPR databases
- ☐ Concerns about complaints from citizens or community groups
- ☐ Not enough information on the benefits or best practices associated with LPR systems
- ☐ Concerns about driver distraction when using LPR system in police vehicles
- ☐ Concerns about vandalism of LPR units
- ☐ Other: _____

8. Have individuals or community groups voiced concerns about your agency's use of LPR technology?

- ☐ Yes No

9. If so, what was the nature of those concerns?

(Check all that apply. If you select "Other" please make sure the box to the left of "Other" is checked)

- ☐ Potential for legal or privacy violations
- ☐ Cost effectiveness of the technology
- ☐ LPR system errors in detecting vehicles associated with law violations
- ☐ Concerns about misuse of data or hacking data stored in LPR databases
- ☐ Not enough information on the benefits or best practices associated with LPR systems
- ☐ Concerns about driver distraction when using the LPR system in police vehicles
- ☐ Concerns that the agency should be focused on other priorities
- ☐ Other: _____

10. Has your agency faced any legal challenges related to the use of LPR technology?

- ☐ Yes
- ☐ No

Additionally, if you would like to share any other comments or concerns about your agency's use of LPR technologies, please describe them below. Specifically, please list other uses of LPR that your agency has considered or concerns with this technology not mentioned above.

APPENDIX B. OFFICER INSTRUCTION SHEET FOR HOT SPOT PATROL WITH LPR UNITS

TRAINING FOR IMPLEMENTATION OF EXPERIMENT
ALEXANDRIA PD AND FAIRFAX COUNTY PD

A. Contact information if there is any concerns or questions before, during or after experiment.
(Cynthia Lum xxx-xxx-xxxx) (Julie Willis xxx-xxx-xxxx) (Breanne Cave xxx-xxx-xxxx)

B. Time length of the experiment:

1. 30 WORKING days, beginning February 8th, 2010, ending when individual officer completes 30 consecutive working days (30 envelops will be given to each unit, thus, 60 total envelops to each supervisor for two officers).
2. Each unit/officer will be assigned five (5) hot spots to patrol for 30 minutes each.
3. The experiment takes on average, about 3 - 4 hours of each officer's shift (thus, officer can be disrupted by arrest, reports, other duties and still complete the experimental assignment).

C. General responsibilities of officer regarding the experiment.

1. Pick up sealed assignment each consecutive working day from Supervisor or OIC -open.
2. Officer "A" is always Officer "A" (same with "B").
3. In sealed envelope will be daily assignment. In the order they appear and are numbered, (e.g., "1", "2", …), officer will complete the experiment within his or her shift.
4. NOTE! Officers may be assigned to visit the same hot spot more than once in one day.
5. Immediately upon leaving the hot spot, officer fills out information on the map.
6. After all 5 sheets are completed, officer puts all sheets and final days log back into envelop, seals, signs, and gives to Supervisor.
7. Supervisor holds envelopes for weekly pickup and check in by Project Staff..

D. Specific instructions for officer while in each hot spot.

1. ONLY turn on LPR device right before entering the hot spot, and turn off device immediately after leaving hot spot.
2. ONLY stay in the hot spot during the 30 minutes. When finished with the assignment, return to regular patrol or normal duties.
3. At the very least, the following deployment must be implemented: Driving through every street segment within hot spot (parking lots/structures if possible) and scanning.
4. If extra time after scanning, any specific deployment given the officer's judgment and discretion of the area can be used.

E. If you must leave the hot spot in the middle of the 30 minutes allocated:

1. If the reason is because of an arrest due to the implementation of the LPR device, continue with arrest, and then once arrest process is finished (and if more than 30 minutes had elapsed), continue to next hot spot sheet, in the order they appear.
2. If someone else is processing the arrest and you are still within the 30 minutes allocated, continue as planned in that same hot spot in those thirty minutes.
3. If drawn away from that hot spot for some other emergency reason, please note on sheet. Only return if within 30 minutes. If not, move to next hot spot.

APPENDIX C: SAMPLE HOT SPOT ASSIGNMENT SHEET AND MAP

Instructions:

1. Turn on LPR ONLY when in designated hot spot
2. Stay within the boundaries of the hot spot for a total of 30 mins.
3. Complete table below immediately after leaving hot spot

Log for LPR hotspot patrol	
Officer Name	
Date of Patrol	
Entry time into hot spot	
Exit time leaving hot spot	
Activity	
# of plates scanned	
# of hits	
# of accurate hits	
Outcomes for Hot Spot	
Unoccupied stolen vehicles found	
Arrests- stolen vehicle	
Arrests -stolen plates	
# of arrests (other)	
Notes – please write what you did while in hot spot.	

If during this implementation of this experiment you have any questions, please feel free to contact the project team.

Cynthia Lum xxx-xxx-xxxx
Julie Willis xxx-xxx-xxxx
Breanne Cave xxx-xxx-xxxx

Hotspot XX

Day_____ Order #_____
OFFICER "B"

N: Edson St/ Commonwealth Ave; E: Commonwealth Ave; W: Mosby St; S: Landover St/ Ancolt St

APPENDIX D: TRAINING MANUAL FOR GMU LPR EXPERIMENT

SECTION 1: GENERAL RESPONSIBILITIES

Supervisor or OIC:

- Holds 60 envelopes (30 per officer) in secure location for daily pick up.
- Receives sealed envelopes with completed sheets at the end of shift.
- Point of Contact with GMU team member.
- Supervisor and officers will have copy of this training manual.

Officer (2 assigned per jurisdiction)

- Patrols the 5 area assignments as directed; responsible for fidelity.
- Accurately Logs information on each sheet after 30 minute patrols.
- Returns all information back to envelop after each day and seals.

GMU Team (Lum, Willis and Cave)

- Provide any support at any time via cell phone or in person.
- Picks up sealed envelopes once/week at Supervisor's convenience.
- Checks in with officers each week to ensure experimental fidelity.
- Lum will supervise the entire project, and will be responsible for all issues.
- Willis will be assigned to APD specifically to pick up packets
- Cave will be assigned to FCPD specifically to pick up packets.

SECTION 2: INSTRUCTIONS UPON OPENING ENVELOPES

- Patrol the hot spots according to the order that they appear in the envelope. They will be numbered at the right hand corner by Day and by Order # (1,2,3,4,5). *Do not deviate from that order even if the hot spot numbers themselves seem out of order.*

- *See sample instructions and hot spot map in Appendices B and C.*

- Turn on LPR right before entering each area, and log the time of entry on that area's map sheet.

- Spend ONLY 30 minutes patrolling each hot spot. If you make arrests, stops, or have to deviate from that area, only return if you are still within those 30 minutes. If not, go on to next area.

- 30 minutes begins when you ENTER hot spot, not while in transit.

- Turn off LPR right after exiting each area, and log the time of exit.

- Immediately complete the Log on each map upon leaving each hot spot. Don't forget to write what you did in the blank section on each map – use the back if you need more space.

- Move to next location and repeat # 2-6 upon arrival.

- After completing all five areas and logging efforts, put all materials back into this envelop. Note any special concerns, problems or issues on the back of the instructions sheet. Seal and sign the seal.

- Returned sealed envelope back to supervisor upon completing that day's assignment.

- Each packet contained five hot spot assignments as randomly constituted. Each page for each hot spot appeared as the following: (See Appendix C)

SECTION 3: DEPLOYMENT ORDERS WHILE IN THE HOT SPOTS

- First, sweep entire area, covering all streets with LPR.

- Then, after initial sweep, tactics are up to officer discretion. RECORD what you do on your log in the area labeled "Notes – please write what you did while in hot spot." Be as descriptive as possible, use the back of the paper if necessary.

- If you must leave the hot spot in the middle of the 30 minutes allocated: Only return if still within 30 minutes (or if you hadn't been there for too long), or if you cannot return within 30 minutes, continue to the next assigned area.

- If you cannot complete that day's assignment, please note reasons on the back of this sheet.

SECTION 4: INSTRUCTIONS IF OFFICERS GET A POSITIVE HIT ON A VEHICLE OR LEAVE THE AREA

If you receive a positive hit on a vehicle:

- Proceed as you would in patrol and follow through. Return to the assigned hot spot only if after you are done with your arrest/stop, you are still within the 30 minutes. LOG this special activity on the sheet.

- If outside of 30 minutes, upon return from arrest processing, continue with next assigned area in the envelope.

If you must leave the area:

- If less than 15 minutes, return and resume that area's assignment.

- If more than 15 minutes, move to next assignment.

- Don't begin a 30-minute assignment if you know you will be diverted.

If you are disrupted from the experiment

- If you haven't started the assignment, consider today a "non-working" day and just resume with this assignment tomorrow.

- If already within assignment and your shift has ended, use the "Notes" page on the back of the instructions page and write reason you were not able to complete the assignment.

- For the next day, continue with the next envelope as planned.

- Always feel free to call any of the three GMU team members if a question arises (cell numbers are on the instruction sheet)

SECTION 5: ANTICIPATED PROBLEMS

It is acceptable to:

- Not go immediately to the next hot spot. (you have entire shift to complete five, 30 – minute hot spots patrols)

- Make arrests and stops in the hot spot which may result in spending more than 30 minutes in area. (*)

- See the other LPR unit in the same hot spot. Just continue as planned and ignore the other unit (unless that unit needs backup).

- Return to "business as usual" or other duties *ONLY WHEN FINISHED WITH FULL ENVELOPE ASSIGNMENTS (and envelop is sealed and returned to supervisor)*.

Officers should try to absolutely avoid:

- Spending any more than around 30 minutes in each hot spot unless an action needed to be taken(arrest, stop, back-up).

- Deviating from your assigned hot spot during the 30 minutes.

- Patrolling outside of the five hot spots assigned, until you seal the envelop and finish that day's assignment.

- "Estimating". Dates, times, number of hits, descriptions of problems must be accurate and precise.

- Forgetting to put EVERYTHING back into envelope. If it came from the envelope, it goes back into the envelope, even instructions.

APPENDIX E. QUESTIONS FOR LPR INTERVIEWS

Theme 1: The Experiment
First, we would like to start by asking about your understanding of the experiment.

Can you tell us about the LPR project?
- What it was about
- What was the objective/point of the project
- Rules of the experiment

Can you describe your "usual day" while doing the LPR experiment?
- What they did each day to start the experiment
- What did you do each day during the experiment
- What did you do each day to end the experiment

Now, we want to ask some questions about your experience with carrying out the experiment.

Can you describe any challenges you faced while carrying out the experiment?
- Problems completing hot spots each day
- Getting called away from hot spot during
- Problems finishing hot spot in 30 min.
- Ran out of things to do in 30 min.
- Was it hard to follow rules of the experiment? If so, why?
- Ever have to break rules of the experiment? If so, why?

Theme 2: Officer Interaction with LPR Technology
Next, we would like to hear about how you ran the LPR units while carrying out the experiment.

Can you describe how the LPR unit works?
- What the unit does
- How it works
- How does data license plate data get into unit
- What happens when there is a hit
- What happens to stored scan information after you use the LPR?

Can you describe the different ways you used the LPR to scan plates in the designated hot spots?
- Scanned patrol
- Stationary scans
- Any other strategies used?

How easy or difficult was the LPR to run?
- Any problems while driving and running unit?
- Any problems scanning plates?
- Were there any weather issues (i.e., snow)

- Problems patrolling certain geographies (i.e., parking garages, alleyways, etc.)

Did you ever have any problems with the LPR equipment? If so, what were they?
- Software updates
- Problems scanning (i.e., missed hits, reads fences or other objects as plates, etc.)

Theme 3: Crime Prevention and Detection and LPR
Now we would like to hear about how the LPR was used to deal with crime problems.

Prior to this experiment, how were auto thefts calls/reports typically handled?
- What they did
- Was the LPR used prior to the experiment for these calls/reports? If so, how?
- Were maps used to diagnose problem areas for auto related crimes?
- Were hot spots used to identify areas of auto related crimes?
- Were there any problems of handling calls/reports this way? What were they?

Is LPR useful to law enforcement and crime?
- If so, how?
- If not, why?

Throughout this experiment, what were the different ways you used the LPR?
- Patrol Scans
- Stationary scans
- Any other activities?

For each of the strategies you used, can you describe any operational issues (i.e., not being able to enter into parking garages while patrolling, not able to read plates because of way cars were parked, etc?) you had with the LPR unit?
- Problems scanning certain areas
- Parking garages
- Ways cars were parked
- Narrow streets (alleys, etc.)
- Any other problems?

If there were operational problems, how did you handle them?

What did you think WOULD BE the most effective strategy for using the LPR? Please explain why.

What do you think WOULD BE the most ineffective strategy for using the LPR? Please explain why.

Can the effects of police activities on crime vary by how the LPR is used? If yes, please explain.

Overall, what do you think about the hot spots approach to auto thefts and auto related crimes?
- Does it work/Does it not work
- Best uses
- Does it help reduce crime?

- Does it help clear open cases?

In general, should hot spots approaches be used with the LPR technology?
- If yes: Why?
- If no: Why not?

Legality and Legitimacy Issues and Concerns
Now we are going to switch gears a little bit and talk about any legal or legitimacy concerns that arise from the police using LPR.

What do you think might be some legal concerns with using LPR?

What do you think might be citizen concerns with using LPR?
- Potential for legal or privacy violations
- Cost effectiveness of technology
- LPR system errors in detecting vehicles associated with law violations
- Concerns about misuses of data or hacking
- Not enough information on the benefits or best practices of LPR
- Concerns about driver distractions when using LPR
- Agency should be focused on other priorities

Have legal, ethical, or legitimacy concerns regarding LPR uses ever come to mind?
- Private information about vehicle owners
- Information about time, date, and location of car
- Use of LPR data for other law enforcement activities
- Sharing LPR information with other agencies
- Any others

What do you think might be some legal concerns with using hot spots policing?

What do you think might be citizen concerns with using hot spots policing?

Have legal, ethical, or legitimacy concerns regarding hot spots policing ever come to mind?
- Private information about vehicle owners
- Information about time, date, and location of car
- Use of LPR data for other law enforcement activities
- Sharing LPR information with other agencies
- Any others

Did you observe any response from citizens while using the LPR or during your presence in the hot spot? If so, can you describe?
The Evaluation Experience
For the last set of questions, we want to talk to you about the LPR evaluation overall.

In your view, what was the purpose of the LPR experiment?

What was your initial reaction and impression of the LPR evaluation study?

- If good: Why was it good? What about the project or the idea of evaluating LPR did you like?
- If not good: What might help improve that initial interaction/approach in the future?
    - Presentation
    - Approach to determining what to evaluate
    - Other suggestions

Was an evaluation of LPR was needed?

- If yes: Why?
- If no: Why not?

Are there any differences between prior conceptions about LPR and now?

Have you worked with evaluation researchers before?

- If yes, what describe prior experience – type of project, feelings/reflections about evaluation

Would you participate in evaluation research again on another type of tactic or technology?

- If yes:
    - Why?
    - Is there a particular tactic or technology you think needs to be evaluated?
- If not: Why not?

Are there incentives that might facilitate further participation from officers in future evaluations?

- If so: What are they?
    - Commendations
    - Compensations
    - Other suggestions for incentives
- If no: Why would incentives not work?

APPENDIX F. THE COMMUNITY SURVEY[1]

GEORGE MASON UNIVERSITY &
FAIRFAX COUNTY POLICE DEPARTMENT
COMMUNITY SURVEY

Consent form and information sheet

DESCRIPTION OF THIS PROJECT
This survey, carried out jointly by George Mason University (GMU) and Fairfax County Police Department (FCPD) is intended to gauge the community's feelings about police services, and also the use of a technology to reduce auto theft and crime.

ANSWERING A SHORT SURVEY
We would very much appreciate your participation in this short survey. If you agree to participate, you will be asked to answer the attached survey, either in writing, or using our automated internet form located at http://gemini.gmu.edu/cebcp/LPR.html . The survey will take approximately 15 minutes to complete. You must be at least 18 or over to participate in this survey, and the survey is anonymous.

RISKS/BENEFITS
There are no foreseeable risks and/or benefits to any individual for participating in this research.

CONFIDENTIALITY
Your answers will be kept confidential and anonymous. Please do not write your name on the survey you complete. The number at the right hand corner of the survey is only to identify the survey itself for administrative purposes. We are only interested in aggregate responses of the entire Fairfax County community in this survey, not any one particular response. You may choose either to mail back your completed survey in the provided, stamped envelope, or you can complete it online. Both choices are anonymous choices.

PARTICIPATION
Your participation is voluntary, and you may withdraw from the study at any time and for any reason.

CONTACT
This research study is being conducted by George Mason's University, Center for Evidence-Based Crime Policy (CEBCP) in partnership with Fairfax County Police Department. The researcher team may be reached at 703-993-3421 or cebcp@gmu.edu for questions or to report a research-related problem. You may also contact the George Mason University Office of Research Subject Protections at 703-993-4121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research. George Mason Human Subjects Review Board has chosen to waive the requirement for a signature on this consent form. However, if you still wish to sign a consent form, please contact the CEBCP at 703-993-3421.

[1] Note that there were four versions of the survey so that an experiment within the survey could be conducted.

George Mason University and Fairfax County Police Community Survey

You may complete this survey either on paper and return it using the enclosed stamped envelope, or fill it out online at http://gemini.gmu.edu/cebcp/LPR.html. Both are anonymous. Once you answer a question, please do not go back and change your answer. **SURVEY NUMBER <<Unique ID>>**

SECTION I: QUESTIONS ABOUT POLICE SERVICES

Please mark the level of your agreement or disagreement with the following statements:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The police can be trusted to do what is right.					
Most police officers in my community do their job well.					
The police in my community treat citizens with respect.					
The police in my community respect citizens' rights.					

How safe would you feel walking alone at night in your neighborhood? Please circle one:

Very Safe Safe Unsafe Very unsafe

How likely are the following crimes to happen in your neighborhood? Please check **one box for each crime.**

	Very Likely	Somewhat Likely	Unlikely
Graffiti			
Car being stolen or broken into			
House being burglarized			
Person being robbed on the street			
Teenagers hanging around and being disorderly			

How concerned are you that you or your neighbors might be a victim of a terrorist attack? Please circle one:

Very Concerned Somewhat Concerned Not Very Concerned Not at all Concerned

Which of the following statements comes closest to your view? Please circle one number along this range.

In order to lower the risk of terrorism in this country, I am willing to give up some civil liberties.		Neutral		We should preserve our freedoms above all even if there remains some risk of terrorism.
(1)	(2)	(3)	(4)	(5)

SECTION II: QUESTIONS ABOUT A NEW LAW ENFORCEMENT TECHNOLOGY

Some law enforcement agencies use license plate recognition systems (LPR) in order to scan license plates and check them against reports of stolen vehicles. The police in these cities can place a LPR system in either a fixed location or on a police vehicle and then use the system to automatically check the license plates of all vehicles which pass by. The next set of questions asks for your opinions about the use of this technology.

Prior to this survey, have you ever heard, read about, or seen the use of License Plate Recognition (LPR) technology?

CIRCLE ONE: Yes No

To your knowledge, do your local police use LPR?

CIRCLE ONE: Yes No I don't know

If your local police agency decided to use LPR to check all passing vehicles to see if any have been stolen, would you support this decision? CIRCLE ONE:

Strongly Support Support Neutral Oppose Strongly Oppose

License Plate Recognition (LPR) technology may be used in many other ways. Please tell us which other uses of LPR you would support by marking **one box on each line** below:

An officer should be able use LPR technology in order to:	Strongly Support	Support	Neutral	Oppose	Strongly Oppose
… check all passing vehicles for parking violations and unpaid tickets.					
… check if the registered owners of all passing vehicles are wanted for a crime.					
… check if the registered owners of all passing vehicles are sex offenders.					
… investigate all vehicles passing or parking near important places or buildings to try to prevent terrorism.					

LPR systems take a photograph of a vehicle's **license plate number**, which can then be linked to the vehicle's registered owner. The system can also be set up to record the **date, time and exact location of a vehicle** at the moment the photograph is taken. Do you believe that this information should be considered private? Please circle one number along this range.

Private Information (1) (2) (3) (4) (5) Not Private Information

If the police in your community decided to use LPR, would this cause you to feel more positively or more negatively about your local police?

Much more positively (1) (2) Neither positively nor negatively (3) (4) Much more (5) negatively

After an LPR system records data, the police may choose either to save the data for future use or to erase the data. Do you think that your local police should save the LPR data? Please circle one number:

(1) No, the data should not be saved	**(2) Yes, but only** for a short period of time (for example, **one month**)	**(3) Yes**, the data should be saved for about **six months.**	**(4) Yes**, the data should be saved until the police want to erase it.

If the police decide to save the LPR data (license plate number, date/time, location of the vehicle), the police will be able to look at the saved data in the future. Please tell us which uses of saved LPR data you would support by marking **one box on each line below**.

The police should be able to use saved LPR data in order to:	Strongly support	Support	Neutral	Oppose	Strongly Oppose
… find the last location of a vehicle connected with a crime?					
… investigate all vehicles which drive around an important place or building?					
… learn about the past activities of a suspect who is under investigation for a crime?					
… learn about the past activities of a person suspected of terrorism?					
… learn about the past activities of sex offenders?					
… learn about the activities of parents who don't pay child support in order to force these parents to appear in court?					

Should the police department be able to share information collected by the LPR system with other government agencies? Yes No

If you knew that the LPR system's data (license plate number, date, time, exact location of vehicle) was being saved for six (6) months by the police in your community, would you be less likely to . . .

	Much less likely	Somewhat less likely	I probably would not change
… commit a parking or traffic violation?			
… associate with or become involved with particular people?			
… visit particular locations or events (such as certain types of medical facilities, businesses, religious services, or political protests)?			
… do something else that you normally do?			

If the police in your community decided to save LPR data for six months, would this cause you to feel more positively or more negatively about your local police? Please circle one number along this range:

Much more positively		Neither positively nor negatively		Much more negatively
(1)	(2)	(3)	(4)	(5)

If you have concerns about the use LPR, how could the police **best lessen these concerns**? Please mark (x) up to TWO answers that are important to you. If you don't have any concerns about LPR, please mark only the last answer.

_____ If the police consult with an attorney about possible legal or privacy issues before using LPR
_____ If the police provide the opportunity for the public to discuss LPR at community meetings
_____ If the police immediately erase all LPR data
_____ If the police agree to get some type of special permission (such as a court order) before using any saved LPR data
_____ None of these actions can lessen my concerns.
_____ I don't have concerns about the police using LPR technology.

Thank you for your participation. In order to complete the survey, please answer some general questions about yourself.

What is your gender? Male Female

Generally speaking, do you usually think of yourself as a Republican, a Democrat, or an Independent?

Republican Democrat Independent

Please circle the racial or ethnic group with which you most closely identify yourself.

_____ White/Caucasian
_____ Black/African American
_____ Hispanic/Latino
_____ American Indian or Alaskan Native
_____ Asian or Pacific Islander

In what year were you born? _____

Some people are very interested in politics and political campaigns. Others prefer to spend their time in other activities. Overall, how interested would you say that you are in politics?

Little Interest(1) (2) Medium Interest (3) (4) (5) High Interest

Generally speaking, how would you characterize your political ideology?

Very Liberal	Liberal	Slightly Liberal	Moderate	Slightly Conservative	Conservative	Very Conservative
(1)	(2)	(3)	(4)	(5)	(6)	(7)

What is the highest level of education that you have completed?

_____ Some high school
_____ High School Graduate (or equivalent)
_____ 4-year college graduate
_____ J.D. (law degree)
_____ Ph.D. or equivalent
_____ Other graduate degree

In the last two years, how many times have you been pulled over by a police officer for a traffic-related issue (such as speeding or running a red light)? _____