From:	Patricia Gannon
To:	John Knox White; Malia Vella; Tony Daysog; Marilyn Ezzy Ashcraft; Lara Weisiger; Trish Spencer
Subject:	[EXTERNAL] Automatic license plate readers (ALPRS)
Date:	Monday, January 31, 2022 4:41:59 PM

Honorable Marilyn Ezzy Ashcraft.
Mayor of Alameda
Honorable Members of the City Council

Tomorrow evening you will again discuss installing automatic license plate readers (ALPRS) at all entrances to Alameda. I strongly urge you to vote tomorrow night to do so immediately. Numerous police chiefs including our own Police Chief have strongly recommended them as an important crime deterrent. Our own Police Chief in Alameda has committed to keeping this information confidential.

Alamedans overwhelmingly support ALPRS as an important tool in promoting safety. Please do the right thing and vote unanimously to install them as soon as reasonably possible.

Thank you.

Patricia M. Gannon
1019 Tobago Lane, Alameda 94502
pg3187@gmail.com

From:	gaylon parsons
To:	City Clerk
Cc:	Marilyn Ezzy Ashcraft; Trish Spencer; Tony Daysog; Malia Vella; John Knox White
Subject:	[EXTERNAL] Feb 2 Council meeting, Item 7-A - Do not pursue
Date:	Monday, January 31, 2022 4:27:28 PM

Dear mayor and city council members,

Alameda Police Department has a generous budget. I oppose increasing it, particularly for a technology that does not prevent crime or improve clearance.

From the staff report, "The use of ALPR technology has rapidly spread in neighboring communities and around the nation. The hope is that such a system, along with other enforcement efforts, will contribute to investigative efficacy and efficiency."

This appears to me to encapsulate two of the three reasons why council may pursue purchasing ALPRs to be installed at the locations identified (i.e., at every entry and exit point on the island): 1) everyone else is doing it, and 2) we hope it works, despite there being no evidence of same. Neither is a good reason to spend this kind of money on installation, use, and maintenance. The third reason is a perceived, or at least rhetorical, spike in crime and a feeling of being unsafe. Arguing for hundreds of thousands of dollars based on an unquantifiable interior experience is often effective (fear works, as we've seen many times in our political life), but council members need to be held to a different standard. What does the data tell us?

From the staff report, " There is limited data and/or research surrounding the rates of case clearance of crimes due to the use of ALPRs." We are too small a city to be a test case.

Reject the expansion of surveillance of our neighbors. Reject the expansion of the budget of the police. Reject this unproven tactic.

Thank you,
Gaylon

--
Gaylon Parsons

From: Laura Gamble
To: City Clerk
Subject: [EXTERNAL] Item 7-A
Date: Monday, January 31, 2022 3:51:38 PM

City Council,

Please vote no on the approval of license plate readers.

There is no meaningful data to that license plate readers decrease crime or improve clearance rates.

Investing hundreds of thousands of dollars in an unproven technology, further bloating the budget of a department that has surveilled us despite explicit direction from this council not to (Clearview AI), is fiscally irresponsible and does nothing to keep our communities safer.

These cameras, at best, are placebos that may make those in our community most susceptible to fear-mongering *feel* safer - they do anything more.

Make investments in our community that actually make us safer - poverty safety nets, pedestrian-friendly streets, road diets, mental health programs.

Thank you,
Laura Gamble

From:	Blair
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer; Lara Weisiger; Eric Levitt
Subject:	[EXTERNAL] Automatic License Plate Readers
Date:	Monday, January 31, 2022 3:38:35 PM

Dear City Council Members and Other Interested Parties:

I am writing to strongly support the automatic license plat readers. The crime in our city has continued to get worse and worse and I believe the readers will reduce the level of crime.

Below are some specific reasons to take this action:

1. Mounting cameras at all our entrances and exits to Alameda started in our community and requested by various Police Chiefs.
2. The cost of this equipment has gone down from the initial request from approximately $500,000 to about a tenth the cost, according to the Police Department.
3. Auto theft and auto burglaries have dramatically increased, particularly experienced in the East end and Bayfarm. We know of neighbors who've had catalytic converters stolen multiple times as well as cars broken into multiple times.
4. Having both the Police Department head count trimmed as well as experiencing the nationwide challenge of hiring and training new officers to fill existing vacancies, APD needs to employ such data driven tools for them to more readily solve the sorts of crimes such as mentioned above, and those more violent in nature.
5. Not employing such technology when jurisdictions bordering us have done so, is a message that says to non-resident criminals that it is easier to get away with crimes committed in Alameda.
6. Privacy is a concern to all of us, but hearing that the Police Chief is advocating that the City must exclusively control data collected; outside agencies such as Homeland Security should not have unfettered access to our data; the Chief will set narrow and documented standards for releasing data for APD criminal investigations; and data collected is destroyed in a year or less; these are all factors that make the use of this technology the right balance between protecting our civil rights while keeping us safe from criminal activity.
7. The opposition to ALPRs have relied upon the lack of any definitive study to show the efficacy of ALPRs. Many departments have released data to show many cases that have been solved with the use of the ALPRs, but these are not the same as conducting an efficacy study.
Maybe we should remove the firearms from a random sample of Police Officers in order to study the efficacy of unarmed Officers, all of whom work in communities where the criminals very often are better armed than they are. (No, America is not ready for this, nor should we be the first to test it out).
8. Many folks are afraid and concerned for their own safety as well as family members and neighbors. Alamedans have become accustomed to being able to safely walk, drive and shop all over town, day or night, without fear of being assaulted in your own driveway, while walking to your car while shopping, even going to the movies or eating at many of our favorite restaurants. And being or just looking elderly,

Asian, Muslim, Jewish, or any other number of innocent groups being targeted, is very unsettling to many in what was a very safe city. When you hear your neighbors talking about selling their house and moving to a safer area, this is not a good thing for our community as a whole. If installing ALPRs makes us feel safer, it is a cheap investment.

Blair Skellie
432 McDonnel rd

From:	Edward Sing
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer
Cc:	Lara Weisiger; Reyla Graber
Subject:	[EXTERNAL] City Council Mtg 2/1/2022 - Agenda Item 7 - Automated License Plate Readers (ALPRs)
Date:	Monday, January 31, 2022 1:52:24 PM

ALL:

Along with many other Alamedans, **I support and urge you to support**:

(1) **Immediate Installation and use of ALPRs.** I believe they have been demonstrated to be an effective tool in crime prevention and investigation in neighboring cities. I do not believe the use of ALPRs is an invasion of our privacy. If this is the case, then everyone should stop using their smart phones, navigation enabled cars and computers which track us everywhere we go! Implementation of ALPRs in Alameda has been stalled for too long!!

(2) **Repair and use of existing ALPRs on our police cars:** This capital investment was made several years ago and is languishing for indescript reasons. Repair them and put this investment to good use!!

(3) **Phased installation of ALPRs on all police cars:** Recognizing the cost of installing ALPRs on all of our police cars, budget for the installation and use of ALPRs for the entire fleet of police cars over a short multi-year cycle. ALPRs on police cars can help our officers identify stolen and missing cars and those used in previous crimes.

Its time to implement ALPRs in Alameda and curtail the crime wave we have seen over the past few years!!

Thank you for your attention to this!

Ed Sing
Bay Farm Resident (26 years)

From:	Mckenzie Lyon
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer; Lara Weisiger; Eric Levitt
Subject:	[EXTERNAL] IN FAVOR OF ALPR"S
Date:	Monday, January 31, 2022 11:44:42 AM

Hello City Council,

We are writing to ask for license plate readers to be installed in our city. This is not the first time I've written an email asking for readers to be installed in Alameda, but our feelings have intensified about the topic as time has gone on. I ride my bike to Fruitvale daily from Bay Farm. On my way to and from my teaching job, I encounter reckless drivers and speeders endangering pedestrians and cyclists daily. It's my belief that when word spreads that Alameda has this technology, people will think twice about blowing through lights, stop signs, and using bike lanes as passing lanes. In addition, crime has risen dramatically since Covid. Citizens are using Ring, Nest, and cell footage to help find the perpetrators. Why wouldn't the city use similar technology to do the same? Please keep our beautiful city from deteriorating even further than it has and get license plate readers placed throughout Alameda.

Respectfully,

McKenzie Lyon and Rich Brown
Purcell Drive.
Alameda

From:	Reyla Graber
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer
Cc:	Lara Weisiger
Subject:	[EXTERNAL] Please vote for the ALPRS
Date:	Monday, January 31, 2022 11:44:39 AM

Dear Honorable Mayor and Council Members,

The majority of Alameda residents want you to vote YES for ALPRS.
Please vote to install them in Alameda Tuesday night.
I understand Oakland and SF have the ALPRS; so why not Alameda?
Our crime is increasing and your primary duty, by law, is to protect Alameda residents.
So, let's use this technological support to deter crime.
The cost has come down also.

Also ,per that old study --Mesa Arizona in 2011 is not comparative to Alameda in 2022.
Additionally, regarding Piedmont Calif-- Piedmont attorney Dana Sack says their ALPRS installation did successfully reduce
Piemont crime until the arrival of Covid with its attending increase in crime.
Without ALPRS in Piedmont, it's likely that post Covd crime would have increased even more without the ALPRS.
And BTW-Security cameras are legal and considered acceptable throughout Alameda. So why not ALPRS?
And I think President Obama, with his sympathetic nature for victims-- would approve of Alameda installing ALPRS.
Thank you,
Sincerely
Reyla Graber
Bay Farm/HBIA

From:	Patricia Baer
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer
Cc:	Lara Weisiger
Subject:	[EXTERNAL] Item 7A
Date:	Monday, January 31, 2022 10:50:56 AM

Council Members,

I am very much in favor of the ALPRS program and urge you to adopt it now. It’s pretty apparent that the bad guys, either here or on the mainland, know that we are not protected by a full police force or license readers, and choose to do their work here. Our increase in crime rate confirms this.

Please vote in favor of this program.

Thank you,

Patsy Baer

From:	robert mcbride
To:	mezzyashcroft@alamedaca.gov; Malia Vella; Tony Daysog; Trish Spencer; John Knox White
Cc:	City Clerk
Subject:	[EXTERNAL] council agenda -7A automated license plate reader
Date:	Monday, January 31, 2022 10:31:33 AM

Council members,

As a 44 year resident of Alameda I encourage you to pass the Automated License plate reader program. With the crime increasing everywhere I think it would be a good tool for the police dept. if it's vetted properly. It has proven to work well in other cities. We're hoping that it would be helpful protection for the citizens of Alameda.

Thanks for your time,

Robert McBride

From:	Ezra Denney
To:	City Clerk; Tony Daysog; Marilyn Ezzy Ashcraft; Trish Spencer; Malia Vella; John Knox White
Subject:	[EXTERNAL] License Plate Readers are a (non)Solution in Search of a Problem
Date:	Monday, January 31, 2022 9:41:56 AM

City Council,

I write today to express my dismay at the proposal to bring LPRs to Alameda. Other letters have more clearly and more effectively laid out the arguments against LPRs, so I will try not to repeat too much.

LPRs are a placebo that have no clear correlation to a cessation of crime. There are tons of studies that show this. In addition, more than half of APDs arrests are locals, so collecting information on those coming into town would be even less effective.

More than that, the civil liberties question of what APD would do with the data is troubling to me. Until APD proves that they are capable of making good decisions (and not, you know, throwing Black men to the ground for dancing or killing a Brown man needlessly) I don't believe they have earned the trust to keep this kind of information.

So, LPRs will not help anything but making a few scared old white people feel better and they come with a large price tag and all sorts of ethical questions. Sounds like an en easy NO vote to me.

Thanks,

Ezra Denney

From: John Barhaugh
To: T Krysiak
Cc: Marilyn Ezzy Ashcraft; John Knox White; Malia Vella; Trish Spencer; Tony Daysog; Lara Weisiger; Eric Levitt
Subject: [EXTERNAL] Re: Lets Proceed with ALPRS
Date: Sunday, January 30, 2022 8:25:25 PM

>
> Dear Alameda City Council Members;
>
> As a citizen concerned with rising crime rates and as an Alamedan who believes in Police Chief Joshi's abilities and expertise, I strongly feel that now is the time to finally embrace Alameda's License Plate Reader Program.
>
> It is a well known fact that the City's police department is demoralized, understaffed and it is having difficulty recruiting quality, socially sensitive officers. ALPRS would augment the existing policing efforts and would address the citizenry's demands for crime prevention. Please lend your support.
>
> Thank you.
>
> Best Regards,
>
> John Barhaugh
> Stonington Pointe
>
> Sent Via My iPhone

From:	T Krysiak
To:	Marilyn Ezzy Ashcraft; John Knox White; Malia Vella; Trish Spencer; Tony Daysog
Cc:	Lara Weisiger; Eric Levitt
Subject:	[EXTERNAL] Lets Proceed with ALPRS
Date:	Sunday, January 30, 2022 7:02:39 PM

Dear Alameda City Council Members;

As a citizen concerned with rising crime rates and as an Alamedan who believes in Police Chief Joshi's abilities and expertise, I strongly feel that now is the time to finally embrace Alameda's License Plate Reader Program.

It is a well known fact that the City's police department is demoralized, understaffed and it is having difficulty recruiting quality, socially sensitive officers. ALPRS would augment the existing policing efforts and would address the citizenry's demands for crime prevention. Please lend your support.

Thank you.

Best Regards,

Tom Krysiak
Sweet Road

Sent Via My iPhone

From:	Laura Porter
To:	City Clerk
Subject:	[EXTERNAL] We Support ALPRs
Date:	Sunday, January 30, 2022 6:43:37 PM

Dear Mayor Ashcraft and City Council Members,
We are writing to support Automated License Plate Readers and hope that the Alameda City Council votes to approve using this technology in our city.

Due to Alameda's geography compared to our surrounding communities, we are able to effectively and economically install cameras at all Alameda entrances and exits, as requested by our Police Chief. It is very concerning that auto theft, auto burglaries, and catalytic converter thefts have dramatically increased in our city. Having the Police Department headcount lowered and the challenge of hiring and training new officers to fill existing vacancies, APD needs to use technology such as ALPRs to prevent and solve crime in our city.

Many people we know, including ourselves, are afraid for our own safety. We chose to live, and now retire, in Alameda and have become accustomed to being able to safely walk, drive, shop and dine in our city, day or night, without fear of being assaulted. If installing ALPRs helps us deter crime, it is a worthy investment.

Thank you,
Laura and John Porter
352 Channing Way
Alameda

From:	deligato@gmail.com
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer; Lara Weisiger
Cc:	Ben Deligato
Subject:	[EXTERNAL] Vote YES for Automatic License Plate Reader
Date:	Sunday, January 30, 2022 3:12:37 PM

Dear Council Members:

With all the CRIME in and around Alameda, I urge you to vote in favor of ALPRs!

Please, help our police officers protect and serve your constituents and vote in favor of ALPRs.

Sincerely,
Ben Deligato
135 Justin Circle
Alameda, CA 94502

From:	Andy Murdock
To:	City Clerk; John Knox White; Malia Vella; Marilyn Ezzy Ashcraft; Trish Spencer; Tony Daysog
Subject:	[EXTERNAL] Comment on Automated License Plate Readers (Item 7-A, Feb 1, 2022 agenda)
Date:	Sunday, January 30, 2022 10:40:57 AM

Dear Councilmembers,

I am pleased to see such broad support in the public correspondence for the City to spend additional time and money on increasing public safety. However, there are more cost-effective — and, most importantly, *actually effective* — ways to increase public safety than automated license plate readers (ALPRs).

Apart from occasional anecdotes where ALPRs helped solve individual cases there is no clear evidence that they have any effect on crime deterrence or significantly improve the ability of the police to solve cases. On top of this, ALPR systems are expensive, frequently abused (including two cases just this month in San Diego County), and raise serious privacy concerns.

There are legitimate public safety problems in Alameda that require action — e.g., preventing dangerous driving and pedestrian injuries and deaths should be high priority. As a suggestion for a productive way forward, instead of starting with a technology and asking "Do we need this?", it would be more helpful to have a workshop that lays out the public safety challenges Alameda faces and the menu of approaches to address those specific problems. In such a comparison, it would become quickly clear that dollar-for-dollar, impact-for-impact, ALPRs are not the solution we need.

Thank you for your time!

Andy Murdock - Windsor Drive

From:	Joyce Mercado
To:	City Clerk
Subject:	[EXTERNAL] City council meeting Feb 1st - LPRs
Date:	Saturday, January 29, 2022 7:18:31 PM

Hello, I'm writing in strong support for License plate readers in Alameda. Alerting police when a stolen vehicle enters Alameda would prevent crime in our town. Please give our police this valuable tool. Three of my neighbors have been victims of crime recently. Crime is a big issue in our neighborhood and installing License Plate Readers would help.
Sincerely,
Joyce Mercado

Sent from my iPhone

From:	Karen MIller
To:	Marilyn Ezzy Ashcraft; Malia Vella; John Knox White; Tony Daysog; Trish Spencer
Cc:	Lara Weisiger
Subject:	[EXTERNAL] Item 7A
Date:	Saturday, January 29, 2022 8:55:33 AM

Dear Mayor and Council members,
Please support the adding of license plate readers to the APD's arsenal of tools to better protect the citizens of Alameda. Other cities have had great success with the. Thank you.

Regards,

Karen Miller

From:	STEPHEN DEMOULIN
To:	City Clerk
Subject:	[EXTERNAL] Fwd: ALPRs
Date:	Thursday, January 27, 2022 5:28:06 PM

Sent from my iPhone

Begin forwarded message:

From: STEPHEN DEMOULIN <sjdemoulinrph@aol.com>
Date: January 27, 2022 at 2:25:03 PM PST
To: clerk@alameda.ca.gov
Subject: ALPRs

My name is Stephen DeMoulin. I am a resident of Alameda, Ca since 1974. I came here as a pharmacist at Alameda Drug (Guy's Alameda Drug) on Park Street. It is gone and I am retired. I bought my home at 1050 Jost Lane on Bay Farm Island in 1977 and still live in this home today.
I am here to say that the way we did things in those early days is very different than the way we need to do things now. We have technology to help us now. We can solve a lot of our problems with simple affordable technology. Crime is no exception ! I want to make Alameda less attractive to criminals by supporting Automated License Plate Readers at all the entrances and exits from this town. Innocent law abiding people will have no reason to fear this use of technology. It will be a deterrent to criminals as well as enabling our police officers to solve crimes easier and making the existing officers more efficient when they are doing their jobs. Innocent law abiding people will have nothing to fear. Many cities and towns already are using this technology and it definitely is working. No Criminal wants to do their "work" in a city where they know this technology is in use ! This is a cheap investment to protect the innocent people in our community and it will help to protect their property too. In 1974 Alameda did not have so many criminal problems. You seldom if ever heard about armed robberies and cars being regularly stolen and broken into on our streets and people being accosted. Sadly, this is changing. ALPR Technology is here and we need it now !
Sincerely, Stephen DeMoulin
1050 Jost Lane
Garden Isle Townhomes
Alameda, Ca 94502
cell: 510-604-5281
Email: sjdemoulinrph@aol.com

Sent from my iPhone

January 27, 2022

Dear Mayor Ashcraft and City Council Members,

My public support of the ALPRs began in 2014 when the subject was discussed in a community forum at the Alameda Free Library. That support was based upon my 20 years experience as a Police Reserve Officer serving with Berkeley PD (1974-1994). In the intervening years, I am even more adamant that Alameda should install such cameras at all vehicular entrances and exits to our island community. These devices would certainly be an effective investigative tool for APD, but would serve as a deterrent to those who still believe that APD will catch you if you dare to commit crimes on our island.

For many in our community, the longterm belief that Alameda as a safe place to live has been seriously shaken, especially during this pandemic. I haven't come to this conclusion because of surveys conducted by Next Door or other social media, but by numerous conversations that I've had with the residents in my predominantly Asian neighborhood of Costa Brava HOA.

As president of this 201 family association, I've had numerous occasions where adult family members have told me that they have radically adopted new routines to protect themselves when venturing out in public, for fear of assault or other harm. Nearly all have installed cameras and other devices to further protect themselves and their property from crime. And these comments pertain to simply going about their business in Alameda. All have asked me in one form or another why the Mayor and Council haven't already installed these cameras for the public safety. More than one have repeated the remark, "It's a no brainer".

Nearly all of these comments have come from adult Asian women. They are all registered voters. They and their non-Asian neighbors are all aware of what is not happening with these cameras. Most knowing the fact that insufficient numbers of officers patrol our city, they and I believe that the you are simply making excuses for not better protecting our community.

Michael Robles-Wong
30-Year Alameda Resident

From:	Brandon Svec
To:	City Clerk
Subject:	[EXTERNAL] Item 7-A Recommendation to Provide Direction to Staff Regarding the Use of Fixed and Mobile Automated License Plate Readers.
Date:	Wednesday, January 26, 2022 2:41:05 PM

Please share for the record or as appropriate to council, staff, etc:

I urge the council to ***not*** approve this item.

There has been no proof presented that ALPR systems do anything significant to deter crime or clear cases. Even the studies cited by APD offer very little data to support that claim.

APD has previously abused this type of system and I am not aware they ever addressed it or even acknowledged what they did.
See: https://www.buzzfeednews.com/article/ryanmac/clearview-ai-local-police-facial-recognition

Until APD can build back some trust I don't think they should be provided more money for anything and certainly not this wasteful "toy" that they have shown no capability to be able to manage or operate correctly and securely.

If council insists on voting in favor, I urge at the very least APD to find the money in their existing budget of over 41 million dollars and we get assurances that the public's privacy and safety is protected and the system is not abused and if it is there are consequences.

Thank you,

Brandon Svec
Bay Farm Resident

From:	Paul Mitton
To:	City Clerk
Subject:	[EXTERNAL] ALPRs
Date:	Tuesday, January 25, 2022 4:03:26 PM

Dear City council,
I have been a resident in Bay Farm for 25 years and am now a disabled old man living alone. I used to be able to walk around the neighborhood at all times of the day, but not anymore. There are cars taring around the streets burning their tires and doing donuts at every intersection. Vulnerable people are being robbed at gunpoint and even robbed while working in their own garages. They drive over the bridges and rob from our stores with no fear at all. Pretty soon our stores will have to close and go to places where they can find some security to do business and our houses will be worth nothing and then our little jewel of a city Alameda will revert back to the wild west.
Please vote for the ALPRs and stop these criminals having a free for all in our town.
Thank you for your attention in this matter.
Paul Mitton a very concerned citizen

From:	Arnie Quan
To:	Lara Weisiger
Subject:	[EXTERNAL] IN FAVOR OF ALPR"S.
Date:	Monday, January 24, 2022 12:28:35 PM

I live on Bay Farm Island.
I am concerned about increasing theft and violence in Alameda
I do not consider the readers an invasion of privacy.

Please vote in favor of license plate readers.

Thanks,

Arnie Quan

From:	Susan Dunn
To:	John Knox White; Marilyn Ezzy Ashcraft; Malia Vella; Tony Daysog; Trish Spencer; Lara Weisiger; Eric Levitt
Subject:	[EXTERNAL] Urging you to vote to institute ALPRS - and I plan to join the next City Council meeting to speak on this
Date:	Monday, January 24, 2022 10:25:54 AM
Attachments:	PastedGraphic-1.tiff

Dear Mayor and Council,

Those of us who live in Alameda know that we have a traffic speeding and reckless driving issue in town which has escalated greatly over the last few years. And from the issues that have been going on with Side Shows and other group car sports on our city streets, we know there is a need for an automated response that will enable us to meet the challenge of these persistent infractions.

Here are my thoughts on this issue which I feel must be taken into consideration.

1. Mounting cameras at all our entrances and exits to Alameda started in our community and requested by various Police Chiefs.
2. The cost of this equipment has gone down from the initial request from approximately $500,000 to about a tenth the cost, according to the Police Department.
3. Auto theft and auto burglaries have dramatically increased, particularly experienced in the East end and Bayfarm. We know of neighbors who've had catalytic converters stolen multiple times as well as cars broken into multiple times.
4. Having both the Police Department head count trimmed as well as experiencing the nationwide challenge of hiring and training new officers to fill existing vacancies, APD needs to employ such data driven tools for them to more readily solve the sorts of crimes such as mentioned above, and those more violent in nature.
5. Not employing such technology when jurisdictions bordering us have done so, is a message that says to non-resident criminals that it is easier to get away with crimes committed in Alameda.
6. Privacy is a concern to all of us, but hearing that the Police Chief is advocating that the City must exclusively control data collected; outside agencies such as Homeland Security should not have unfettered access to our data; the Chief will set narrow and documented standards for releasing data for APD criminal investigations; and data collected is destroyed in a year or less; these are all factors that make the use of this technology the right balance between protecting our civil rights while keeping us safe from criminal activity.
7. The opposition to ALPRs have relied upon the lack of any definitive study to show the efficacy of ALPRs. Many departments have released data to show many cases that have been solved with the use of the ALPRs, but these are not the same as conducting an efficacy study.
Maybe we should remove the firearms from a random sample of Police Officers in order to study the efficacy of unarmed Officers, all of whom work in communities where the criminals very often are better armed than they are. (No, America is not ready for this, nor should we be the first to test it out).
8. Many folks are afraid and concerned for their own safety as well as family members and neighbors. Alamedans have become accustomed to being able to safely walk, drive and shop all over town, day or night, without fear of being assaulted

in your own driveway, while walking to your car while shopping, even going to the movies or eating at many of our favorite restaurants. And being or just looking elderly, Asian, Muslim, Jewish, or any other number of innocent groups being targeted, is very unsettling to many in what was a very safe city. When you hear your neighbors talking about selling their house and moving to a safer area, this is not a good thing for our community as a whole. If installing ALPRs makes us feel safer, it is a cheap investment.

I will be at the next meeting to hear any rebuttal to these compelling points.

All best,
Susan and Jeff Dunn

Susan Dunn
36 Sunny Cove Circle
Alameda, CA 94502
510-337-1354 (home)
510-759-9771 (cell)

From:	John Knox White
To:	Lara Weisiger
Cc:	Brian Hofer
Subject:	FW: [EXTERNAL] Re: FYI
Date:	Monday, January 24, 2022 8:50:49 AM
Attachments:	We sent you safe versions of your files.msg ALPR Isn"t Effective - Snippets From 3 Reports.pdf PERF REPORT MESA AZ combating auto theft in arizona - a randomized experiment with lpr technology 2011.pdf 2010 George Mason Report ALPR_FINAL.pdf Efficacy of Automated License Plate Reader Hits in Piedmont, California by Jonathan Hofer-compressed.pdf

Good morning, Lara.

Mr. Hofer has requested that the following documents be added to agenda 7a (ALPR) on 2/1.

Best,

John Knox White
City Councilmember, Alameda
(he/him or they/them)

From: Brian Hofer <brian@secure-justice.org>
Sent: Saturday, January 22, 2022 11:35 AM
To: John Knox White <JknoxWhite@alamedaca.gov>
Subject: Re: [EXTERNAL] Re: FYI

Mimecast Attachment Protection has deemed this file to be safe, but always exercise caution when opening files.

Brian Hofer
Executive Director

Cell: (510) 303-2871
Twitter personal: @b_haddy
Twitter org: @SecureJustice
Oakland, CA
secure-justice.org
Hofer bio
Donate to Secure Justice

2011 Mesa Arizona (PERF study)

"LPR use **did not reduce crime** in the hot routes and zones" (pg. vii, para 2)

"Lum and colleagues (2010) found that the use of LPRs in auto theft hot spots **did not result in a reduction of crime generally or auto theft specifically**, during the period of time measured." (pg.7, para 2) (*this is the George Mason report we also cite to in our Secure Justice analysis, as it further confirms ALPR are not effective crime fighting tools*)

"Table 1 also shows that the direction of changes in vehicle theft from the two week pre-intervention period to the intervention weeks and from the intervention weeks to the postintervention weeks were not indicative of treatment effects from LPR use. Vehicle theft dropped in all three groups from the pre-intervention to the intervention weeks. **In the post-intervention weeks, the LPR routes had a slight increase in vehicle theft, while the manual and control routes experienced further declines**." (pg. 27, para 1) (*this is why statistical regression models are necessary, crime rises and falls independent of surveillance tech since it has no deterrent effect*)

Fn "In our later multivariate models, where we control for pre-intervention levels of vehicle theft, we no longer observe a difference between the LPR route and the control group on this measure. **However, the manual group does emerge as having lower two week post intervention vehicle theft levels** (based on UCR data) than the control group." (pg. 27, para 1)

"**The assigned treatment (either manual or LPR) did not have a statistically significant impact on vehicle theft CFSs relative to controls during the treatment period**. However, although LPR hot routes do not see a significant change during the post two-week period, the manual group witnessed a statistically significant decline. **Manual hot routes in the post two-week period after treatment had decreased odds of having a call-for-service for vehicle theft by 75% (1 minus the odds ratio of .25) compared to the control group**." (pg. 31, para 1) (*manually checking license plates was more effective than automated license plate readers*)

"**Given the general lack of effects** in the models above, particularly for the LPR treatment, **displacement and diffusion seem unlikely**. **The statistical non-significance of the indicator for treatment** in adjacent routes also provides some indication that neither displacement nor diffusion occurred." (pg 32, Sec. 5.4) (*translation: ALPR is not a statistically significant treatment, and it did not push crime out of view around the corner away from the testing zone*)

"**No statistically significant differences were observed (see Table 6) across the control, LPR and manual groups** based on CFS (control= 0.94, LPR= 1.72, and manual= 1.33; F= 1.00, df=2, 51; p= 0.374, n= 54) or UCR crime reports (control= 0.67, LPR= 0.72, and manual= 0.67; F= 0.02, df=2, 51; p= 0.983, n= 54) **for vehicle theft during the intervention weeks**." (pg. 37, Sec. 6.2.2, para 2)

"**Impacts of the LPR and manual check treatments were statistically non-significant during both the treatment weeks** and the post-intervention weeks." (pg. 39, para 1)

“The assigned treatment (either manual or **LPR) does not have a statistically significant impact on auto theft calls relative to controls** during the treatment period or two weeks post-treatment.” (pg. 40, Sec. 6.3.2)

“This pattern and the lack of direct effects in the target areas leads us to conclude that neither the LPR nor the manual check patrols produced displacement or a diffusion of benefits into surrounding areas.” (pg. 42, para 1)

Fn. 36 “The small number of vehicles recovered during the experiment precluded us from doing a rigorous analysis of whether LPR use leads to faster recoveries of stolen vehicles. However, based on our small number of cases, **we did not find indications that vehicles detected by LPR were recovered more quickly than other vehicles**.” (pg. 43)

“However, the manual group does emerge as having lower two-week post intervention vehicle theft levels (based on UCR data) than the control group in Phase 1.” (pg. 44, para 1) (*translation – the visual impact of human police manually checking is likely more effective than mostly invisible technology doing the same task*)

“Our results, at least based on Phase 1, suggest that a specialized vehicle theft unit can have an effect on reducing vehicle theft compared to the control group, **but only when this group does manual checking of plates as opposed to using the LPR equipment**.” (pg. 44, para 2)

“However, **we did not find evidence that the LPR reduced actual vehicle theft rates** for our targeted areas. Instead, we found that the same **special vehicle theft unit conducting manual plate checks was able to reduce vehicle theft rates**, but only in Phase 1. The fact that we did not lower vehicle theft rates with the use of the LPR equipment is in some ways not too surprising. First, **our results are similar to Lum and colleagues’ experimental study (2010) that recently demonstrated that LPR equipment was not associated with reductions in auto theft**.” (pg. 49, Sec. 7.2, para 1)

“Regardless of potential impact, cost alone is likely prohibitive in the current economic climate, where many police departments (especially in Arizona) are under such budgetary pressure that layoffs of personnel are being considered. And the other side of the cost question is return on investment. If a police chief asks, “what do I get in return for my $80,000 investment?;” the response from this study (based on Phase 1 data) is a hit rate of 24 hits divided by 457,368 plates scanned or a **hit rate of .00005** (or in terms of hours: 45 LPR routes * 8 hours each= 360 hours and this produced 24 hits; or 1 hit every 15 hours of use of the device). This is even less compelling given the outcomes produced by the special unit manual condition (8 hits in Phase 1), and the evidence of a deterrent effect with this condition. **It could be reasonable for a police chief to conclude that his or her agency might be able to achieve a reasonably high hit rate and greater deterrence of auto theft simply by re-assigning a small number of officers to the auto unit and increasing the rate of manual checking or perhaps by requiring patrol officers to do extensive manual checking in designated hot routes** (thereby saving $80,000).” (pg. 50, para 1)

***********policeforum.org/assets/docs/Free_Online_Documents/Technology/combating%20auto%20theft%20in%20arizona%20-%20a%20randomized%20experiment%20with%20lpr%20technology%202011.pdf

March 2018 Vallejo Study (done by BetaGov – a known law enforcement ally in "statistical" research)

"The control data also showed that **35 percent of all hits were misreads for the mobile readers, with a similar number (37 percent) for the fixed readers**." (pg. 14 "Trial and Results")

"The study was conceived and run by **the officers**;" (pg. 15, para 1)

*******theiacp.org/sites/default/files/2018-08/March%202018%20RIB.pdf

2010 George Mason "Center For Evidenced-Based Crime Policy"

"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." (pg. vii, para 3)

"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**." (pg. 4, para 2)

"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**." (pg. 5, para 3)

"In the PERF study, **no crime reduction impact was found from LPR use on auto theft** in hot spots." (pg. 9, para 3)

"While results show **no statistically significant reductions on crime** in experimental hot spots…" (pg. 29, para 2)

"Similarly, we did not discover a statistically significant specific deterrence effect of LPR deployment in hot spots on auto theft or auto-related crimes." (pg. 53, para 1)

"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." (pg. 56, para 3)

********cebcp.org/wp-content/evidence-based-policing/LPR_FINAL.pdf

Final Report to NIJ

Police Executive Research Forum

Combating Auto Theft in Arizona: A Randomized Experiment with License Plate Recognition Technology*

December 7, 2011

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EXECUTIVE SUMMARY / ABSTRACT

License Plate Recognition Technology (LPR) is a relatively new tool for law enforcement that reads license plates on vehicles using a system of algorithms, optical character recognition, cameras, and databases. Through high-speed camera systems mounted on police cars or at fixed locations, LPR systems scan license plates in real time, and compare them against databases of stolen vehicles, as well as vehicles connected to fugitives or other persons of interest, and alert police personnel to any matches. Although the use of LPR technology is extensive in the United Kingdom and becoming more prevalent in the United States, research on LPR effectiveness is very limited, particularly with respect to how LPR use affects crime.

This report presents results from a randomized field experiment with LPRs conducted by the Police Executive Research Forum and the Mesa, Arizona Police Department (MPD) to target the problem of auto theft. The experiment sought to determine whether and to what extent LPR use improves the ability of police to recover stolen cars, apprehend auto thieves, and deter auto theft. We did this by examining the operations of a specialized 4-car MPD auto theft unit that worked in auto theft hot spots over a period of time both with and without LPR devices.

The experiment was conducted in two phases. Phase 1 of the study, which lasted 30 weeks, involved operations focused on “hot routes”—high risk road segments, averaging 0.5 miles in length, that we believed auto thieves were likely to use based on analysis of auto theft and recovery locations and the input of detectives. At randomly selected times over this 30-week period, officers worked 45 randomly assigned routes using the LPR equipment (each police car was equipped with an LPR system) and another 45 randomly selected routes doing extensive manual checks of license plates. An additional 27 routes were randomly assigned to serve as a control group for the analysis of trends in auto theft. (These routes received only normal patrol operations.)

In Phase 2, conducted over 18 weeks, operations shifted to larger "hot zones" of auto theft activity that averaged about 1 square mile in size. Fifty-four hot zones were identified and randomly assigned to the same conditions as in Phase 1. At randomly selected times during Phase 2 officers worked 18 zones using the LPRs and another 18 zones doing manual license checks. The remaining 18 zones served as a control group that received only normal patrol.

Each phase involved the same number of officers working approximately one hour a day in each LPR and manual route/zone for eight days spread over two weeks. (For purposes of surveillance, investigation, and pursuit, the auto theft unit operated as a team with all officers working in the same route or zone at the same time.) The main difference was that in Phase 2 the officers conducted more roving surveillance.

Experimental results showed that LPR use considerably enhanced the productivity of the auto theft unit in checking license plates, detecting stolen vehicles and plates, apprehending auto thieves, and recovering stolen vehicles. Combining results across both phases, the use of LPRs resulted in 8 to 10 times more plates checked, nearly 3 times as many "hits" for stolen vehicles, and twice as many vehicle recoveries. Further, all hits for stolen plates, all arrests for stolen vehicles or plates, and all recoveries of occupied vehicles were attributable to use of the LPRs (all arrests for stolen vehicles and recoveries of occupied vehicles occurred in Phase 1).

Across both phases, use of the LPRs produced 36 hits for stolen vehicles or plates, 5 arrests for stolen vehicles or plates, and 14 vehicle recoveries (4 of which involved occupied vehicles). These numbers are modest relative to the time officers spent using the LPRs (the officers worked 192 shifts over the course of the two phases, using LPRs approximately half of the time); however, the results were constrained by a number of factors, including limits on the data that were entered into the LPR system (which consisted primarily of state-level data on stolen automobiles), relatively low levels of auto theft in Mesa during the experiment, and, perhaps most importantly, the design of the experiment, which required the officers to work the locations according to a predetermined, randomized schedule (in order to ensure that the places and times worked with LPRs were comparable to the places and times worked without LPRs). Data from other operations by the auto theft unit suggest that officers using LPRs can improve hits for stolen vehicles considerably when targeting operations based on recent theft data and daily traffic patterns. Our experiment primarily demonstrates the improvements in productivity that police can achieve using LPRs relative to manual license checks under equal conditions.

LPR use did not reduce crime in the hot routes and zones, though note that the dosage of LPR intervention in each location was modest. However, the manual license check operations produced short-term reductions in auto theft during Phase 1 of the experiment. We speculate that the unit had a more visible presence when doing manual checks because they spent more time moving along the main routes as well as roaming parking lots, apartment complexes, and side streets—often at slow speeds and with frequent pauses. This may have made the officers more conspicuous and made it more obvious to onlookers that they were checking vehicles. These effects were likely intensified by the smaller locations the officers worked during Phase 1. When using the LPRs in Phase 1, in contrast, the officers were more likely to make quick passes through side streets and parking lots and then remain at fixed positions along the route. Finally, we did not find evidence of crime displacement or a diffusion of crime control benefits associated with either form of patrol in either phase.

We conclude by discussing limitations of the study, questions for future research, and policy implications of the results (such as how police might optimize the use of LPRs to improve recoveries of stolen vehicles and apprehension of auto thieves while also achieving the crime reduction benefits of the manual license check patrols).

1. INTRODUCTION

The field of vehicle theft research has been growing and receiving increasing attention by the research community in recent years (Clarke & Harris, 1992; Herzog, 2002; Kriven & Ziersch, 2007; Levy, 2008; Maxfield, 2004; Rice & Smith, 2002; Walsh, 2009; Walsh & Taylor, 2007a, 2007b). This is good news as this is an all too common offense (despite the recent downward trend) with around a million vehicle thefts occurring per year (ranging from 1.64 million in 1990 to just fewer than 800,000 in 2009 [FBI, 2010]). Also, research suggests that 90 percent of vehicle thefts are reported to the police, a rate much higher than for other types of thefts (Krimmel & Mele, 1998). The high frequency and high reporting rate of vehicle thefts leads to this being a sizeable portion of police work in many jurisdictions. According to the FBI's Uniform Crime Reports (UCR), property loss as a result of motor vehicle theft totaled $7.6 billion for 2005 (down to about $6.4 billion for 2008; FBI, 2009), accounting for 11% of Part I offenses recorded by the FBI (Lamm Weisel, Smith, Garson, Pavlichev, & Warttell, 2006). The volume of vehicle theft rose from the mid-1980s to the early 1990s and then began to decline (Newman, 2004). While the data indicate a downward trend in vehicle theft since the 1990s, this may be due to the results of a number of enhancements to vehicle security at the manufacturer level (Newman, 2004). However, motor vehicle theft remains a significant problem for the police across the U.S. Although about 57% of the value of vehicles stolen is recovered, most thefts do not result in an arrest (FBI, 2009). The arrest rate for vehicle theft nationwide was only about 10% in 2009 (FBI, 2010).

One recent innovation which could serve as a useful tool for law enforcement in addressing this serious problem is license plate recognition (LPR) technology. Like many new technologies, there is evidence that an increasing number of law enforcement agencies are turning to LPR equipment as a tool to address vehicle theft. However, this equipment is expensive and to-date there is little rigorous evidence of its effectiveness. While there may be some obvious efficiency gains from automating the process of checking license plates, it is unclear if this equipment is effective at driving down the number of vehicle thefts or increasing the arrest rate for vehicle theft. These are the key questions examined in this paper based on data collected during a randomized experiment with LPR equipment in Mesa, Arizona.

2. LITERATURE REVIEW

LPR is a relatively new technology in the U.S. but has been used since the 1980s in Europe to prevent crimes from vehicle theft to terrorism (Gordon, 2006). LPR is based on optical character-recognition technology originally developed in Italy for sorting letters and parcels and later extended to reading license plates. LPRs serve as a mass surveillance system for reading license plates on vehicles using a system of algorithms, optical character recognition, cameras, and databases. Through high-speed camera systems mounted to police cars, LPR systems scan license plates in real time, and compare them against databases of stolen vehicles, as well as vehicles connected to fugitives or other persons of interest, and alert police personnel to any matches. Under "Description of Intervention," we provide a detailed description of LPR technology. The use of LPR technology is part of a broader movement in law enforcement to adopt new technologies such as surveillance systems (see Koper, Taylor & Kubu, 2009). An extensive literature has emerged on the use of surveillance systems, particularly closed-circuit television, or CCTV (see Welsh & Farrington, 2008). Based largely on studies in the United Kingdom, this technology appears to be effective in reducing vehicle crimes on public streets and in parking facilities. However, there has been little research to date on LPR surveillance technology.

In their detailed review of the LPR literature, Lum and colleagues (2010) identified two main types of evaluations of LPR technology. 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. In this first area of research, the outcome assessed included areas such as the number of plates accurately scanned within an hour, the number of accurate "hits," and in some cases 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 (see Lum, Merola, Willis, and Cave, 2010) and include studies by Cohen, Plecas, and McCormick (2007), the Maryland State Highway Authority (2005), the Ohio State Highway Patrol (2005), the PA Consulting Group (2003, 2004) and the Home Office (2007). These studies on the efficiency of LPRs are reviewed below. The second line of research examines the effectiveness of LPR on crime outcomes. Currently, other than this PERF study, only one other study of the effectiveness of LPRs exists. This is the experimental evaluation conducted by Lum and colleagues (2010) from George Mason University. In that randomized controlled trial, also funded by the National Institute of Justice, Lum and colleagues examined both the efficiency of LPR units and their crime control effectiveness compared to other approaches. We will discuss the findings from the George Mason study later in this review.

2.1. Efficiency Research on LPR Technology

The UK has the greatest amount of law enforcement related experience with LPR technology, which it used to aid in responding to attacks by the IRA in the 1990s (Manson, 2006). In fact, the Home Office made £32.5 million available to British police for the years 2005-07 for the use of LPR (see *******police.homeoffice.gov.uk). One of the first UK agencies to use LPR was Northamptonshire. In the first year of using LPR, officers stopped 3,591 vehicles which yielded 601 arrests, and produced £500,000 in revenue from untaxed vehicles (Innovation Groups, 2005). Also, a 17-percent reduction in vehicle-related crime was recorded in the first six months. In another UK pilot, officers used LPR to recover £2.75 million in stolen vehicles/goods, seize £100,000 worth of drugs, and achieve an arrest rate more than 10 times the national UK average (PA Consulting Group, 2004).

Currently in the U.S., LPR systems are being utilized at toll booths, in parking areas/structures, in traffic studies, and for building security. In a recent national survey of large law enforcement agencies

(LEAs) completed by the Police Executive Research Forum (Koper, Taylor & Kubu, 2009), about 38% of the sample of LEAs reported using LPR technology,[1] with only 5% reporting that their LPRs were obsolete and 63% reporting them to be effective at scanning license plates. Of the 62% of the sample not using LPRs, about one-quarter planned to acquire LPR technology and about one-third felt that the LPR would be a valuable technology for their agency and help them address an important operational need.

In 2004, the Ohio Highway Patrol became one of the early adopters of LPR technology and attached LPR devices to toll plazas (Patch, 2005). After four months, they recovered 24 stolen vehicles and made 23 arrests. When compared to the same time period in 2003, this represented a 50-percent increase in stolen vehicle recoveries with a combined total of $221,000 in recovered property. In a pilot test of LPR software conducted by the Washington Area Vehicle Enforcement Unit, that agency recovered 8 cars, found 12 stolen plates, and made 3 arrests in a single shift (McFadden, 2004). Anecdotally, we have learned that a small number of other agencies have implemented LPR technology in single police vehicles, with the Sacramento Police Department having nearly 3 years of experience with LPRs, and the Los Angeles Police having equipped 36 vehicles with LPRs.

Although LPR systems have documented benefits, there are also limitations. First, inaccuracies may arise due to plates that are bent, are covered with certain reflective material, are positioned high (as on certain trucks), are very old, or are obscured by common obstructions such as trailer hitches, mud and snow, and vanity plate covers (see McFadden, 2005). Some states have addressed these issues by making certain obstructions of license plates illegal. Next, one reason why the LPR system was successful in the UK is the uniformity of the UK license plate design. Plate designs in the U.S. vary by state and even within states. This results in false hits when plate numbers from one state match those of cars stolen in other states. The devices also sometimes misread plates, though this problem should decline as the

[1] . In another national survey, Lum et al. (2010) found that 37% of large agencies and 4% of small agencies were using LPR as of 2009. However, the vast majority of agencies using LPRs—86%--had no more than 4 of the devices.

technology improves. Also, there may be some concerns about invasion of privacy issues, potential abuse, and erroneous traffic stops. However, an important advantage to this technology is that it does not raise concerns about racial or ethnic discrimination. As opposed to some profiling approaches, plates are examined for all passing vehicles, and the system only alerts the officer if the vehicle is stolen.

Another limitation to the use of LPR technology for apprehending vehicle thieves is that thieves may often abandon stolen vehicles before the cars are reported stolen and entered into police data systems. In Mesa, Arizona (our study location), we estimate that only one-third of car thefts are reported within three hours of occurrence, based on analysis of data from 2006 and 2007. These delays reflect lags in the discovery of vehicle thefts (e.g., a car stolen at night might not be discovered as missing until the following morning) as well as delays in reporting by victims after their discovery of a theft.[2] Further, some vehicle thieves switch the license plates of stolen vehicles with those stolen from other cars; victims who have had their plates swapped for those of a stolen car may be unaware of this for a long period, thus providing thieves with additional time to operate their stolen vehicles.

Despite these limitations, LPRs are a promising law enforcement technology with the potential to help police increase recoveries of stolen cars (and the speed with which stolen cars are recovered), increase apprehension of vehicle thieves, reduce vehicle theft (through incapacitation and deterrence), and apprehend other wanted persons (which may help to reduce crimes besides vehicle theft). In some instances, the devices may also help police solve criminal investigations by providing records of cars that were in or near a crime location around the time of a criminal act. The LPR also has the potential to help counteract the arrest avoidance strategies of vehicle thieves. Copes and Cherbonneau (2006) outline a number of strategies that vehicle thieves use to avoid being arrested and demonstrate that thieves are aware of how they drive and act to present an appearance of being a normal driver so that police and others pay them no attention. Using LPR equipment, police are not reliant solely on their ability to spot

[2] Note that these are rough estimates because the exact time of many vehicle thefts cannot be determined.

suspicious activity because every driver is scanned and this technology may nullify the skills some vehicle thieves have developed.

Nevertheless, there have been only a small number of pilot evaluations of LPR programs, and only one other study using rigorous experimental methods (see below).[3] The potential benefits of LPR use must also be weighed against their costs, which could include financial costs (the devices range from $20,000 to $25,000 in price) as well as some loss of privacy for citizens whose plates are scanned (thus resulting in a record of where they were at a given time).[4]

2.2. Effectiveness Research on LPR Technology

Working with the Alexandria (VA) Police Department and Fairfax County (VA) Police Department, Lum and colleagues (2010) report on a randomized controlled trial involving auto crime hot spots and LPR deployment across two jurisdictions. Lum and colleagues (2010) tested for both specific deterrence of auto-related crimes and for general deterrence of crime. To do this, they randomly allocated LPR deployment in half of all hot spots (n=30) across two jurisdictions to test whether LPR use by a marked patrol unit yields a specific deterrent effect on auto thefts and a more general deterrent effect on crimes. Of the 30 hot spots, 15 were randomly assigned to receive the LPR deployment intervention, while the other 15 received "business as usual" policing (no change in the existing police activities in that area). To select approximately equal number of hot spots from each jurisdiction (13 of the hot spots fell in APD's jurisdiction

[3] The situation has not been much better with regard to the evaluation of other vehicle theft prevention programs (e.g., use of bait cars). While they are greater in number (see Barclay, Buckley, Brantingham, Brantingham, and Whinn-Yates, 1995; Burrows and Heal, 1980; Decker and Bynum, 2003; Poyner, 1991; Maxfield, 2004; Mayhew, Clarke and Hough, 1980; Plouffe; Research Bureau Limited, 1977; Riley, 1980; and Sampson, 2004), none of these auto-related evaluations applied randomized experimental designs or rigorous quasi-experimental methods.

[4] A counter perspective on this issue, brought to our attention by an anonymous reviewer, is that while the lingering attitude (resentment over "Big Brother" technology) does present a public relations problem, LPR use is not an invasion of privacy when conducted on public roads. Some believe that there is no reasonable expectation of privacy in public spaces where no one can expect to remain invisible or unscanned.

and 17 in FCPD's jurisdiction), they 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 of two officers. For each working day for each officer, they 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. Lum and colleagues (2010) found that the use of LPRs in auto theft hot spots did not result in a reduction of crime generally or auto theft specifically, during the period of time measured. This may be due to the relatively low intensity of the LPR intervention during the experiment (about 30 minutes per day for 10 non-consecutive days of intervention per LPR hot spot), which were limited by resources and shift constraints, or the timeliness and comprehensiveness of the base of data that the LPR units accessed.

3. GUIDING FRAMEWORK FOR THE STUDY

Our study was designed to advance the field of policing research through a large-scale randomized experiment in Mesa, AZ with LPR devices, grounded in a hot spot policing framework and the "journey-after-crime" literature, to study an understudied area of the effects of LPR devices on vehicle theft. Specifically, we sought to test the utility of LPR use at locations with heavy concentrations of vehicle theft transit activity identified through journey-after-crime analyses. In our study, we extend the concept of "hot spots" of crime to "hot routes" of crime. That is, transit routes that are used as thoroughfares to move stolen vehicles. Given that vehicle theft involves the rapid movement of the stolen property (i.e., the motor vehicle); we do not limit our analysis to the location of the vehicle theft but instead consider the route the auto thief took after stealing the vehicle. Focusing on these "hot routes," we examine how LPR use affects recoveries of stolen cars, apprehension of vehicle thieves, and levels of vehicle theft.

Our study builds on work that has been done on hot spots of crime. This work has highlighted data which shows that crime is not evenly distributed across a city and that instead is concentrated in small areas (see Brantingham & Brantingham, 1981; Sherman, Gartin &. Buerger, 1989; Sherman & Weisburd,1995; Pierce et al., 1988). The studying of the relationship between crime and geography is not new and dates back to the 1800s (see Guerry, 1833; Quetelet, 1842) in Europe and in the U.S. to the "Chicago School" of sociology (see Burgess, 1925; Shaw & McKay, 1942). In the late 20th century work on crime concentrating in small places was rekindled in places like Boston (Pierce, Spaar & Briggs, 1986) and Minneapolis (Sherman, Gartin & Buerger, 1989). Additional evidence for crime concentration at places has been found for crimes such as burglary (Forrester, Chatterton, & Pease, 1988; Forrester, Frenz, O'Connell, & Pease, 1990; Farrell, 1995), property crime (Spelman, 1995), gun crimes (Sherman & Rogan, 1995b), and drug dealing (Weisburd & Green, 1995; Eck, 1994).

By locating the LPR equipment in our study in areas where auto thieves are most likely to travel we hoped to capitalize on this general criminological finding that there is something about a few places that facilitates crimes and something about most places that prevents crimes. The theoretical underpinning for hot spots is based generally on routine activity theory/situational crime prevention (Cohen & Felson, 1979; Felson 1994) and offender search theory (Brantingham & Brantingham, 1981). Routine activity theory and situational crime prevention can also facilitate understanding of hot spots policing by identifying whether policing strategies strengthen capable guardianship via increasing risks and efforts, reducing rewards and provocations or removing excuses for crime (Eck & Weisburd, 1995; Eck & Clarke, 2003). Offender search theory recognizes that crime is very opportunistic and that offenders respond to cues given out by the environment. These “releaser cues” stimulate the release of otherwise inhibited behavior, and hot spots policing focuses on reducing these opportunities (also known as opportunity blocking [Clarke, 1992; 1995]).

The existing body of research on other policing strategies based on hot spots has been impressive. In the Minneapolis Hot Spots Experiment (Sherman & Weisburd, 1995) the concept of developing a policing strategy on the location of hot spots was first formally tested. Sherman and Weisburd found that preventive patrol was more effective when it was more tightly focused on hotspots. More recently, Braga (2001, 2005) presents evidence from five randomized controlled experiments and four quasi-experimental designs that hot spots policing programs generate crime control gains without significantly displacing crime to other locations. These crime prevention effects were reported at general crime hot spots (Sherman & Weisburd, 1995), high-activity violent crime places (Braga, Weisburd, Waring, Green Mazerolle, Spelman, & Gajewski, 1999), gun violence hot spots (Sherman & Rogan, 1995a), and drug markets (Weisburd & Green, 1995; Sherman & Rogan, 1995b). While none of these studies were focused on reducing vehicle theft, we hypothesized that the same logic that led to successful outcomes for these hot spot interventions should apply to our experimental evaluation of vehicle theft and LPRs. As an intervention targeted at vehicle theft, LPR is a type of situational crime prevention (Clarke, 1995) and can serve as a type of approach that alters the environmental risks for vehicle thieves.

In considering the placement of LPRs in our study, we built on the existing literature on the geographic concentration of vehicle thefts (see Barclay, Buckley, Brantingham, Brantingham, & Whinn-Yates, 1995; Copes, 1999; Fleming, Brantingham, & Brantingham, 1995; Henry & Bryan, 2000; Plouffe & Sampson, 2004; Potchak, McCloin & Zgoba, 2002; Rengert, 1996; Rice & Smith, 2002). Spatial analyses of crime have generally examined two different but related aspects: (1) the spatial patterns of the offense locations (e.g., Craglia, Haining, & Wiles, 2000; Levine & Associates, 2000); and (2) the spatial patterns of the paths related to crime activities (also known as the "journey-to-crime") (e.g., Smith, 1976; Phillips, 1980; Costanzo, Halperin, & Gale, 1986; Wiles & Costello, 2000). Within the journey-to-vehicle theft literature, researchers have reported that most vehicle thieves travel relatively short distances to steal vehicles (Levine & Associates, 2000). Moreover, certain locations experience more vehicle thefts than do other locations (e.g., Kennedy, 1980; White, 1990), due to having environmental characteristics that are very attractive to vehicle thieves. For example, in a study in Chula Vista, CA, the researchers (Plouffe & Sampson, 2004) identified 10 hot spots that accounted for 23% of the city's vehicle thefts in 2001. Rice and Smith (2002) found that vehicle theft was higher in areas close to pools of motivated offenders, where social control mechanisms were lacking, and where there were suitable targets such as bars, gas stations, motels, and other businesses. A number of studies have identified non-residential locations as hot spots for vehicle theft, including: parking lots close to interstate highways (Plouffe & Sampson, 2004), high-traffic areas (Rice & Smith, 2002), areas near schools (Kennedy, Poulson & Hodgson, n.d.), mall parking lots (Henry & Bryan, 2000), and entertainment venues (Rengert, 1996).

Of direct relevance to our proposed project is a newer area of research in the criminal travel patterns literature, explored by Yongmei Lu, which examines the spatial patterns of stolen-vehicle recoveries and the "journey-after crime." The journey-after-crime is an offender's trip with the stolen vehicle in order to realize its expected utility, such as a trip to sell or strip the vehicle, a trip to another offense (e.g., a robbery), or a joy-ride (Lu, 2003). Dr. Lu demonstrated how GIS and Exploratory Spatial Data Analysis can be extended from journey-to-crime to journey-after-crime analyses in a study of 3,271 vehicle theft offenses in 1998 in Buffalo (see Lu, 2003). First, Lu (2003) drew theoretical support for her approach from Rational Choice Theory (Clarke, 1983; Cornish, 1993) and Routine Activity Theory (Cohen & Felson, 1979). Also, Lu (2003) built on the work of one of the only other published studies of spatial patterns of stolen-vehicle recoveries, completed by LaVigne, Fleury, and Szakas (2000), in which the researchers designed search strategies to track stolen vehicles taken to "chop shops." In Lu's analyses (2003) she found that vehicle thieves' trips from vehicle-theft locations to vehicle-recovery locations were mostly local in nature, with travel distances significantly shorter than randomly simulated trips, and she recommended that police responding to vehicle theft should check nearby locations first. Dr. Lu found that the difference in travel direction between observed and simulated trips was a combined result of both the criminals' spatial perception and the city's geography (e.g., street networks).

4. METHODS

4.1. Research Site

We conducted this study in the city of Mesa, Arizona with the Mesa Police Department (MPD) from 2008 to 2009. MPD has about 800 sworn officers. With a population of about 460,000, Mesa is one of the United States' fastest-growing cities (since 2000, it has had population growth of about 13%) and currently ranks as the 38th largest. The selection of a large urban area is important, for vehicle theft is predominately an urban problem (see Clarke & Harris, 1992). Households in urban areas have rates of vehicle theft that are more than three times the rate of rural areas (Bureau of Justice Statistics, 2004).

Like many large cities, Mesa has a considerable vehicle theft problem. According to sources in the auto insurance industry, the greater metropolitan area of Phoenix, Mesa, and Scottsdale, Arizona ranks fourth in the nation for auto theft (http://www.autoinsurancetips.com/car-theft-rates-state). There are a number of reasons that contribute to the vehicle theft problem in Mesa and the state of Arizona as a whole (Arizona Automobile Theft Authority, 2006). First, Mesa and other cities in Arizona have experienced a dramatic population increase over the past 20 to 25 years (Arizona Automobile Theft Authority, 2006), with transiency arising from the many multi-family housing units found in Mesa. In these types of residential areas, vehicles may be at greater risk to be stolen. Due to the dry, moderate climate in Arizona, vehicles also tend to maintain higher value than in other areas of the U.S. due to less weather/road-related wear on vehicles. Also, the close proximity with Mexico allows thieves to get easy access to a foreign shipping point. There are seven official ports-of-entry along the 354-mile Arizona-Mexico border, and major California seaports are less than eight hours away. Further, the public transit system is very limited in Mesa, and MPD officers believe that this also contributes to the city's vehicle theft problem.[5]

The number of vehicle thefts in Mesa since 1999 has gone up dramatically and then dropped again in most recent years. It has dropped about 35 percent since 2003 (FBI, 2009). In 1999 there were 2,851 vehicle thefts, which increased for three successive years until reaching a high of 5,089 in 2002 and

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[5] In the view of some MPD officers, many auto thieves simply steal automobiles as a form of transportation for getting from point A to point B (also see Copes, 2003 for the motivation of auto thieves).

dropping to 4,563 in 2003 and 3,745 in 2004 before increasing again in 2005 to 4,248. These numbers went down further to 3,654 vehicle thefts in 2006 and continued to decrease, dropping to 2,047 in 2008 (the year our study began) and 1,303 in 2009 (the year our study concluded) (see http://www.fbi.gov/about-us/cjis/ucr/ucr). With about 39 vehicle thefts per week in Mesa at the outset of the project, there was still a reasonable pool of cases on which the LPR could have a potential impact, making Mesa an attractive site from a research perspective. Later on in the discussion section, however, we consider the impact of conducting our study during a 10-year low in vehicle theft in Mesa. Also, like many police departments, MPD is able to arrest only a small percentage of the vehicle thieves—fewer than 6% in 2006 and 2007.[6]

4.2. Description of Intervention

LPRs are a mass surveillance system involving high-speed cameras that use optical character recognition and algorithms[7] to read and evaluate license plates on vehicles. There are a number of LPR devices on the market. MPD used the Remington Elsag Mobile License Plate System (REMLPS) (Model: MPH-900S) and deployed all four of its LPR devices for the study.[8] The REMLPS operates independently in the background and works at patrol and highway speeds, with the capability to handle oncoming differential speeds in excess of 120MPH and passing speeds in excess of 75MPH. Two infrared cameras mounted on a cruiser take photos of passing license plates. The cameras are triggered by the reflective material in the plate. A laptop computer uses character-recognition software to determine the letters and

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[6] This estimate is based on the number of vehicle thefts and vehicle theft arrests in Mesa from January 2006 through November 2007. The arrest figures include arrests for thefts that occurred in other jurisdictions, which is why we report the arrest rate in terms of its upper bound.

[7] The algorithms provide for plate localization (finding and isolating the plate on the picture), plate orientation and sizing (compensates for the skew of the plate and adjusts the dimensions to the required size), normalization (adjusts the brightness and contrast of the image), character segmentation (finds the individual characters on the plates), optical character recognition, and syntactical/geometrical analysis (check characters and positions against local government-specific rules) (see **********.cctv-information.co.uk/i/An_Introduction_to_ANPR for more detail on the technical elements of LPR technology).

[8] During the study period, the LPRs were used only by the officers participating in the experiment.

numbers of the license plate. That plate is then instantaneously checked against data on stolen cars, stolen plates, warrants, and/or other information accessible to the system (below, we discuss the data that MPD utilized for their LPR system). An alarm sounds for each possible match. The officer then verifies the accuracy by looking at the tag before taking any action. The REMLPS is able to read up to 4 lanes of traffic with a single vehicle and can read 8,000 to 10,000 plates in just one shift with just a single vehicle mount. The REMLPS also has a GPS/time stamping function which records the GPS coordinates and time for every plate it reads.

LPRs automate a process that in the past was conducted manually tag-by-tag and with much discretion (see Lum et al., 2010). Officers would see a car that appeared suspicious and provide that plate number to a dispatcher, who would check the plate against a database such as the National Crime Information Center (NCIC) to see whether the vehicle was stolen (Lum et al., 2010). As pointed out by Lum and colleagues, 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. While LPR's may be more efficient than manual checking approaches, the question still remains as to whether this technology is more effective in reducing, preventing, or even detecting crime (Lum et al., 2010). Especially with law enforcement technologies, efficiency is often mistakenly interpreted as effectiveness, which can perpetuates a false sense of security and a mythology that crime prevention or progress is occurring (Lum, 2010). 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 (Lum et al., 2010).

Based on prior experience with the LPRs and consideration of practices used by other agencies, MPD chose to deploy their LPRs with a specialized vehicle theft unit focused on the recovery of stolen cars, apprehension of auto thieves, and prevention of auto theft. The vehicle theft unit consisted of four police officers and one supervisory officer (not involved in the actual street work) working together in four cars;

two were unmarked smaller cars that did not look like police cars, one was an unmarked patrol car, and one was a marked patrol car without a light bar. The unmarked cars provided more investigative options (e.g., for surveillance) for the vehicle theft unit, while the patrol cars (particularly the marked one) were used for chasing uncooperative suspects. The unit was provided with four LPR systems (one for each car for each of the four non-supervisory officers, allowing for the simultaneous use of all four LPR systems). Each of the LPR systems used in our study contained two mobile cameras that were mounted on the rear of the vehicles. The use of a specialized vehicle theft unit also had some advantages in that all of the officers of the unit had specialized knowledge and training in vehicle theft and had developed increased proficiency in vehicle theft surveillance and investigation. Over time, the vehicle theft unit also developed more refined skills in the nuanced use of four LPR devices at once, and the unit was given the time to just focus on vehicle theft and did not have to respond to other calls-for-service.

The data loaded into the LPR systems consisted primarily of state-level data on stolen vehicles, stolen license plates, and other vehicles of interest (e.g., vehicles linked to robberies). The data also contained information on warrants for a few nearby localities (Tucson and Gilbert) but not for Mesa itself. The LPR systems did not have wireless, real-time connections; thus information was loaded into the system manually on a daily basis. However, officers could add information into the system based on recent alerts while they were in the field.

As described below, the research team worked closely with the MPD to design a two-phase randomized experiment in which the vehicle theft unit was assigned to work at particular locations and times using the LPR devices. They were also assigned to work at other comparable locations and times doing manual checks of license plates. This enabled us to compare the productivity and impacts of the vehicle theft unit when using LPRs and when not using LPRs.

4.3. Experimental Design

Among the flaws found in many policing intervention studies are designs with non-comparable comparison groups (see Mazerolle, Soole, & Rombouts, 2005). While there are exceptions, many policing intervention studies make little attempt to draw comparison groups in ways that maximize the likelihood that they will be similar to the intervention/treatment group. The problem with these types of studies is that although measured differences can be statistically controlled, the many unmeasured variables related to the outcome variable (e.g., susceptibility to change) cannot be controlled. Randomized controlled trials (RCTs) are typically thought of as the best method or the "gold standard for eliminating threats to internal validity in evaluating social policies and programs (Berk, Boruch, Chambers, Rossi, & Witte, 1985; Boruch, McSweeny, & Soderstrom, 1978; Campbell, 1969; Campbell & Stanley, 1963; Dennis & Boruch, 1989; Farrington and Petrosino, 2001; Riecken, Boruch, Campbell, Caplan, Glennan, Pratt, Rees, & Williams, 1974; Weisburd, 2003). RCTs provide the best counterfactual describing what would have happened to the treatment group if it had not been exposed to the treatment (Cook, 2003; Rubin, 1974; Holland, 1986). Our project, along with the Lum and colleagues study (2010), represents the first study of LPR equipment with an experimental design (specifically a place-based randomized control design).

4.3.1. Two-Phase Design

We conducted our study in two phases. In the first phase, conducted over 30 weeks from August 2008 to March 2009, we maximized the number of hot locations in our study to include 117 auto theft "hot routes"—i.e., high-risk road segments that we believed auto thieves were likely to use based on analysis of auto theft and recovery locations and the input of detectives. These 117 identified routes were randomly assigned to one of three conditions: the auto theft unit working with LPRs, the auto theft unit working without LPRs, or normal patrol with no LPR monitoring and no auto theft unit. In Phase 2, conducted over 18 weeks from April 2009 to August 2009, we moved to a smaller number of larger "hot zones" (n= 54) for auto theft activity.[9] Each of the 54 hot zones was randomly assigned to a similar set of three conditions. Each phase involved the same number of officers providing approximately one hour of treatment a day to each route/zone for eight days spread over two weeks. The main difference was that in Phase 2 the officers were able to do more roving surveillance, which the officers felt better corresponded to the way they would use the equipment after the study. Phase 1 provides for a more statistically powerful comparison of the LPR equipment, even introducing some artificiality in how the officers were constrained in their patrol activity to smaller hot spots and more fixed surveillance, to answer the theoretical question of does LPR have a measureable effect under the most controlled circumstances. Phase 2 provides a test of LPR use in what would likely be a more typical operational context for MPD. By conducting our study in two phases, we will have better data to help to improve LPR deployment strategies.

4.3.1.1. Design considerations for both phases. One of the first considerations we had to consider was where to use the LPR equipment. The MPD felt that if they just used the LPRs evenly across the city they would miss many stolen cars. There was broad agreement that the LPRs need to be used in places where stolen cars were most likely to be driven. Based on discussion with MPD, the lag time it takes before a vehicle is reported to the police as stolen and entered into the MPD database precluded our team from using the LPR device in the specific hot spots where vehicles are actually typically stolen. Instead, in planning for Phase 1 of the experiment, we used "journey-after-crime" spatial analyses and input from MPD personnel to identify all the main transit routes in Mesa (n= 117) where vehicle thieves are most likely to drive stolen vehicles (including dumping/destination points). In addition to using geographical analysis to determine our study locations, we also wanted to include a number of detective/officer nominated routes to assure that our routes were based on the latest intelligence collected by MPD, much of which is not reflected in official MPD crime statistics and is often of a more qualitative nature. To assure no

[9] While phase 1 and phase 2 were carried out over different time periods, the same conditions were present for all the randomly assigned groupings and unbiased estimates can be derived for each assigned hot route/zone.

bias entered into our study, we used the variable of who designated the route (i.e., was the route selected based on geographical analysis or by designation by a detective/officer) as a stratification variable in our random assignment at Phase 1, assuring that all three study conditions had an equal proportion of routes designated through these different methods. We also analyzed the variable of who designated the route in our later statistical models and found this variable to be non-significant in all models. Thus, in defining our sample, we sought to strike a balance between having a sample large enough to provide reasonable statistical power, selecting routes that were sufficiently active (i.e., “hot”), accounting for officer intelligence, and garnering officer support for the project. As described below, the Phase 1 hot routes also provided the basis for the design of the hot zones in Phase 2.

4.3.1.2. Description of Phase 1 hot routes. For Phase 1, the hot routes were on average about a half mile in length, were a mixture of residential and business areas, and included different types of roads (interstate roads, highways, and residential streets).[10] Two-thirds of the 117 routes were selected based on geographic analysis of theft and recovery locations.[11] Using data on 1,668 automobiles that were both stolen and recovered in Mesa during 2007 and using the shortest travel time between each corresponding theft and recovery location as a likely estimate of thieves’ journey after crime, we selected 78 roadways that had the highest number of estimated trips by vehicle thieves. However, the other one-third of the 117 routes was selected based on interviews with detectives and officers.

4.3.1.3. Description of Phase 2 hot zones. For Phase 2 of the study, the research team worked with the auto theft officers to divide the entire area encompassing the Phase 1 hot routes (and their and

[10] In defining the routes, we divided roads into smaller segments based on natural divisions (i.e., intersections and other natural breaks).

[11] This approach is not without its limitations given that it was based on recovered cars only, leaving out a considerable percentage of vehicles that are never recovered. That is, it is possible that the routes used by thieves who steal cars that are never recovered may in fact be different from the routes of recovered cars. As a result, our methodology may be based on a non-representative sample of “hot routes.” However, there is little that the research team could do about this (after all, the routes remain unknown because the vehicles were never recovered). Also, while this may affect the generalizability of our findings, it does not affect the internal validity of our study.

corresponding theft and recovery hot spots) into 54 zones of approximately equal size. The boundaries for these zones were determined based on both the Phase 1 GIS analysis and the officers' expert judgment and were designed around roadways and other natural divisions. The hot zones were on average about 1.2 square miles in size. Similar to the Phase 1 routes, they contained a mixture of residential and business areas and different types of roads (interstate roads, highways, and residential streets

4.3.2. Random Assignment and Intervention Delivery

In each phase, the hot locations (either routes or zones) were randomly assigned to a similar set of three conditions using computer generated random numbers (see Shadish, Cook & Campbell, 2002). We used a stratified random allocation procedure (see Boruch, 1997) and randomized hot routes and zones within statistical "blocks" to allow for the likely substantial variation across places (Weisburd & Green, 1995).[12] Routes and zones assigned to condition 1 received LPR enhanced patrol by the vehicle theft unit. Condition 2 involved assigning routes or zones to the same specialized vehicle theft unit for patrol and surveillance without the LPRs (in these routes and zones, the officers did manual plate checks through their car mounted computer terminals). Condition 3 was our control condition; these routes and zones received normal patrol only (i.e., no patrol by the auto theft unit, with or without LPRs). We used this third group of routes as a comparison group to assess how the operations of the auto theft unit affected trends in auto theft in the treated routes and zones. It is worth noting that all three conditions (LPR, manual license plate checking and the control group) received standard patrol services, except the control group received no

[12] This type of randomized block design, of allocating cases randomly within groups, minimizes the effects of variability on a study by ensuring that like cases will be compared with one another (see Fleis, 1986; Lipsey, 1990; Weisburd, 1993). Pre-stratification ensures that groups start out with some identical characteristics and will ensure that we have adequate numbers of places in each of the cells of the study. For Phase 1, we used four stratification variables: length of the hot route, speed limit of the route, ease of surveillance for running plate checks (as graded by MPD officers/detectives), and whether the route or zone was determined based on geographical analysis or by designation by a detective/officer. For Phase 2, we stratified based on the size of the hot zone, whether or not the zone contained a major freeway, and the number of auto thefts in the zone during the prior year.

other interventions beyond standard patrol services. Our objective was to assess the effectiveness of LPR technology— not special units versus non-special units. Therefore, we included two types of control groups that would not use the LPR equipment: one group would be a specialized vehicle theft unit doing manual license plate checking and another group would be regular patrol units doing manual license plate checking. All of the assignments were followed carefully by the MPD in both phases.[13]

For Phase 1, 45 of the 117 transit routes were randomly assigned to receive LPR enhanced patrol by the vehicle theft unit, another 45 routes were assigned to the same specialized vehicle theft unit for patrol and surveillance without the LPRs, and 27 routes were assigned to normal patrol (the control condition).[14] We divided the 30-week intervention period into 15 bi-weekly periods. Routes selected for intervention by the vehicle theft unit (both the LPR routes and manual check routes) were randomly assigned to receive treatment during one of these bi-weekly periods (the officers worked 10-hour shifts 4 days a week, resulting in 8 days of treatment for each route). During each bi-weekly period, the unit worked three LPR routes and three manual check routes, each of which was patrolled daily for approximately an hour (each route received a approximately eight hours of intervention by four officers, or 32 officer-hours). The time of day during which the unit patrolled each route was also varied according to a preset schedule so that the unit would not work the same routes at the same time each day (the unit conducted their patrols Wednesday to Saturday from 3:00 p.m. to 1:00 a.m.).[15] Hence, both the bi-weekly

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[13] We discussed the option of an "override process" as a safety valve for the MPD. That is, if a location is deemed by the Chief of MPD to require the LPR intervention, then that place will receive it. Despite this option, no "overrides" were deemed necessary by the MPD in either phase.

[14] It is worth noting that all three conditions (LPR, manual license plate checking and the control group) received standard patrol services, except the control group received no other interventions beyond standard patrol services.

[15] The LPR and manual routes and zones were scheduled in alternating order each day (i.e., the officers would work an LPR route, followed by a manual route, followed by another LPR route, etc.). On some days, the unit could not work all scheduled routes or zones due to special circumstances (such as making an arrest that took the unit out of commission for the rest of the shift). In these instances, the unit resumed patrolling the next day according to the schedule set for that day. These deviations cancelled out over the course of the experiment so that the unit spent equivalent amounts of time working LPR and manual check routes and zones.

treatment period and time of day patrolled were determined randomly for each route. This type of design ensured that the places and times worked with LPR and without LPR were comparable.

When using the LPRs, the officers' general operating strategy was to "sweep" each route (checking parking lots and side streets within the targeted route) at the beginning of the shift and then conduct fixed surveillance on the route (with officers positioned along different sides and parts of the route). When working the manual check routes, the officers used the same initial sweeping strategy and then focused their efforts on particular parts of the assigned routes by roaming around these areas to maintain speeds with the local traffic or by parking at traffic lights to check plates. The officers doing manual checks were not able to remain stationary, for that limited their ability to see and check license plates of cars passing by rapidly.

For Phase 2, 18 of the 54 hot zones were randomly assigned to receive LPR enhanced patrol by the vehicle theft unit, another 18 zones were assigned to the same specialized vehicle theft unit for patrol and surveillance without the LPRs, and 18 routes were assigned to normal patrol (the control condition). We divided the 18-week Phase 2 intervention period into nine bi-weekly periods. Routes selected for intervention by the vehicle theft unit (both the LPR routes and manual check routes) were randomly assigned to receive treatment at a similar dosage as was provided in Phase 1 (8 days of treatment for each zone with approximately one hour of dosage per day by four officers, or 32 officer-hours). The time of day during which the unit patrolled each zone was also varied (as was done in Phase 1) according to a preset schedule so that the unit would not work the same zones at the same time each day. As with Phase 1, both the bi-weekly treatment period and time of day patrolled were determined randomly for each route in Phase 2. As noted earlier, officers put more emphasis on roving surveillance during Phase 2 in comparison to Phase 1.

4.3.3. Monitoring the Assignment Process

For both phases, procedures were established to monitor the integrity of the assignment process (and monitor for expectancy, novelty, disruption, and local history) and to measure and statistically control for any contamination (especially for hot spots contiguous with each other). We were able to use the LPR equipment, which provides a GPS coordinate for every license plate scan, to check that the officers were using the LPR equipment to assess the integrity of the treatment assignment process and assess if officers strayed out of their assigned areas (which none did, except for a few emergency cases in both phases where the vehicle theft unit was needed to provide backup in a few high-level calls-for-service related to violent crime). The officers also maintained logs to document their time at the hot routes/zones, deviations from the study protocol, and the nature and results of any "hits" from the LPR and manual checks (see the "measures" section below). In both phases, our team conducted detailed interviews and "ride-alongs" with the vehicle theft unit officers and other patrol officers to assess their use or non-use of the LPR equipment and conduct treatment integrity checks (e.g., query them on their adherence to the study protocols). No problems were revealed through these treatment integrity checks.

4.4. Measures

First, we collected a series of variables to describe the hot routes in our study based on public works/engineering data from the city of Mesa. Our length of route variable we categorized into three groups: short (.02 miles to .43 miles), medium (.44 miles to .89 miles) and long hot routes (0.9 miles to 2.01 miles). The shorter routes tended to be in more residential areas and the longer routes tended to be on highways or other major thoroughfares. We calculated the average speed limit of route and created three categories(1=25 or 30 mph, 2=35 or 45 mph, 3= 55 mph), We developed a four point rating scale to measure whether the hot route provided good opportunities for conducting surveillance (e.g., a large sign for the officers to hide their car behind). Two detectives used a four-point scale to assess each route in our study (1= very hard, 2= somewhat hard, 3= somewhat easy, and 4= very easy to do surveillance) and achieved high inter-rater reliability (over 0.9). We also recorded whether the hot routes were determined by geographical analysis (coded as 1) or by recommendation from an auto theft detective (coded as 0) that this was an area that was traveled by auto thieves frequently. For the large hot zones of the Phase 2 experiment we included some additional measures, including: the presence of a freeway(s) in the zone (yes or no), and the size of the zone (in square miles).

Next, we collected a variety of traditional police outcome measures of enforcement activity for the hot spot transit routes/zones and surrounding areas, including calls-for-service (CFS) data for vehicle theft, incident/Uniform Crime Report (UCR) data on vehicle thefts, and arrest data on vehicle theft. We also worked with the MPD to develop a vehicle theft/LPR database to track police contacts and other activity associated with the LPR use and manual license plate checks. For both the LPR and manual check treatments, the vehicle theft unit collected data on the number of plates scanned or typed, the number of "hits" (i.e., matches to stolen plates and plates of stolen vehicles), date and time data on these "hits,", number of occupied and unoccupied vehicles recovered, number of persons arrested, and the number of hours spent scanning or checking license plates during each treatment of a route.[16]

For the Phase 1 analysis, we also created 500-foot and 2,500-foot buffers around each hot route. The 500-foot buffer was used to define the boundaries of the hot route; that is, a "hit" or a vehicle theft would "count" for a route for the purposes of our research if it occurred either on the specific street of each hot route or within 500 feet of the route. This allowed us to include parking lots along the route and other similar areas in the immediate proximity of the hot route that officers covered during their sweeps. The 2,500 foot buffer was used to measure potential crime displacement or diffusion of crime control benefits

[16] The LPR devices collect much of this data automatically. They also store a record and GPS coordinates of each scan and each "hit."

into other micro areas surrounding the hot routes. (For Phase 2, we tested for possible displacement or diffusion effects based on changes in adjacent zones.)

Our auto theft outcome measures were collected for all pre-intervention, intervention, and post-intervention weeks of the study period. We focus on effects during the two-week period of the intervention for each route/zone and for the two-week period immediately after the intervention. Our post-intervention measure of only two-weeks was selected to correspond to the two-week intervention period and also because we hypothesized that the effects of the intervention were not likely to last beyond a short-time frame. That is, it is hard to imagine implementing a two-week intervention that could create effects beyond a short period of time. Therefore, we did not test for longer term effects unless there was evidence of change during the two weeks immediately following the intervention.

We have divided our results section into two parts: (1) Finding from Phase 1 and then (2) findings from Phase 2. In the discussion section we discuss and compare the results across the sections.

5. PHASE 1 RESULTS

The first sets of analyses (see Table 1 and 2) describe the key analytic variables and summarize the nature of the distribution of our data. Table 1 includes means and standard deviations for continuous/interval-level variables (with statistically significant analysis-of-variance results noted on the left side of the table). Table 2 presents counts, percentages and chi-square results for data with more limited distributions. Note that 15 hot routes corresponding to freeway segments were dropped from our analysis of the UCR and CFS data because they do not appear as location points within MPD’s data system. Consequently, our analysis of auto theft patterns is based on 102 hot routes.

TABLE 1

Phase 1: Means (standard deviations) for Three Study Conditions and Entire Sample

Variable	MEAN (SD)				N
	LPR	Manual Plate Checking	Control	All cases	
Number of CFS (911) for vehicle theft					
Before txt period	.78(1.6)	.41(0.7)	.83(1.3)	0.65(1.3)	102
During txt period	.65(1.1)	.38(0.6)	.57(0.8)	0.53(0.9)	102
2 weeks after txt	.70(1.8)	.08(0.3)	.35(0.8)	0.38(1.2)	102
Number of vehicle theft offenses (UCR)[17]					
Before txt period	.35(0.7)	.26(0.7)	.22(0.5)	.28(0.7)	102
During txt period	.30(0.6)	.26(0.4)	.26(0.5)	.27(0.5)	102
2 weeks after txt ($F=4.7$ [2,99] $p<.01$)	.25(0.4)	.05(0.2)	.04(0.2)	.13(0.3)	102
Number of plates checked for criminal activity ($F=128.8$ [1,88] $p<.001$)	10,164 (5,196)	1,313 (609)	_____	5,738 (5,774)	90
Average length of route in miles	.57(0.4)	.62(0.5)	.57(0.4)	.59(0.5)	117
Average speed limit of route	37(8.6)	36(9.1)	38(9.5)	37.1(8.9)	117
Average surveillance rating for route	2.8(1.1)	2.8(1.1)	2.8(1.1)	2.8(1.1)	117
Routes determined by GIS analysis	.64(0.5)	.69(0.5)	.67(0.5)	.67(0.5)	117

5.1. Analysis for Pre-Treatment Differences across the Three Study Conditions

As seen in Table 1, no pre-treatment differences emerged in our three study conditions based on the length of the routes, speed limit of the routes, potential for effective surveillance, whether the routes were determined by GIS analysis or officer/detective nomination, pre-treatment UCR crime levels, or pre-treatment CFS levels. The evidence from Table 1 suggests that our random assignment process worked as planned and created comparable intervention/control conditions.

Next, we examine whether the routes covered by the specialized vehicle theft unit with the LPR had more “hits” (positive detections of a vehicle theft crime), more arrests for vehicle theft crimes (stealing of vehicles and/or license plates), and more recoveries for stolen vehicles than the routes covered by the

[17] There were 117 routes in the study. However, for our 15 highway routes we generally do not have UCR data measures (generally highway routes are not noted as location points within MPD’s UCR database), leaving us with complete data for these measures on fewer cases (n= 102).

specialized vehicle theft unit with manual plate checking. These results are followed by tests of whether the routes covered by the specialized vehicle theft unit with the LPRs had reductions in vehicle theft compared to the routes covered by the specialized vehicle theft unit with manual checking and compared to standard patrol (no specialized unit and no LPR).

5.2. Bivariate Models

5.2.1. Effects of LPR, Compared to Manual Checking, on "Hits," Arrests, and Recoveries

The vehicle theft unit when using the LPR (457,369 total plates checked or 10,164 on average across the LPR covered routes) conducted statistically more ($F=128.8$ [1,88] $p<.001$) license plate checks (7.74 times more) than when the same unit (see Table 1 above) did manual plate checking (59,073 total plates checked or 1,313 on average across manual routes). The routes with the LPR had statistically (2.7 times) more total hits for stolen cars crimes (see Table 2 below) than the manual routes (16 versus 6; X^2= 3.7, $p<.05$).[18] The routes with the LPR had eight hits for stolen plates (see Table 2) compared to statistically fewer (zero) hits for stolen plates for the manual routes (X^2= 10.3 [1], $p<.01$). The routes with the LPR had three arrests for stolen cars (see Table 2) compared to statistically fewer (zero) arrests for stolen cars for the manual routes (X^2= 4.3 [1], $p< .05$). The routes with the LPR had one arrest for stolen plates (see Table 2) compared to zero arrests for stolen plates for the manual routes (a non-statistically significant result of X^2= 1.4 [1], $p=.24$).[19]

The routes with the LPR had four recoveries for occupied stolen vehicles (see Table 2) compared to (marginally) statistically fewer (zero) recoveries for occupied stolen vehicles for the manual routes

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[18] It can also be seen in Table 2, that the "hit" rate is larger than the combined total of stolen vehicles and stolen plates recovered (16 to 10 in the LPR category of Table 2 on page 25). This can be accounted for by the fact that some vehicles are identified as stolen by the LPR system but the auto theft unit is unable to stop the vehicle safely and it gets lost it in heavy traffic.

[19] Although our focus here is on hits and results related to auto theft, it is also worth noting that the auto theft unit obtained 5 hits for other matters (e.g., matches to the license plates of vehicles belonging to people wanted on warrants) when using the LPRs in contrast to only 1 such hit when doing the manual checks. Arrests for crimes not related to auto theft (e.g., arrests for warrants or other crimes witnessed by the officers) numbered 5 in both the LPR and manual check routes.

(Fisher's Exact Test, p<.05). The routes with the LPR had six recoveries for unoccupied stolen vehicles compared to a statistically similar number of recoveries (five) for unoccupied stolen vehicles for the manual routes (X^2= 1.5, n.s.). Thus, by nearly every measure, the productivity of the vehicle theft unit was several times higher when using the LPR devices.

TABLE 2

Phase 1: Comparison of Counts/Percentages for Key Analytic Variables

Variables	LPR	Manual Plate Checking	All cases	X^2[df]	N
Number of arrests					
Vehicle theft arrest	3 (6.7%)	0 (0%)	3(2.8%)	4.3 [1]*	90
Stolen plate arrests	1 (2.2%)	0 (0%)	1(1.1%)	1.4 [1]	90
"Hits" for crimes					
Stolen cars	16 (26.7%)	6 (13.3%)	22 (20%)	3.7[2]*	90
Stolen license plates	8 (15.6%)	0 (0%)	8 (7.8%)	10.3[2]**	90
Number of recoveries for stolen vehicles					
Occupied stolen vehicles	4 (8.9%)	0 (0%)	4 (4.4%)	5.7[1]*	90
Unoccupied stolen vehicles	6 (11.1%)	5 (11.1%)	11 (11.1%)	1.5[2]	90

5.2.2. Effects of LPR on Levels of Vehicle Theft: Intervention Weeks

Table 1 shows the average level of vehicle theft, as defined by 911 calls and UCR reports, for the LPR and manual check groups during three successive periods: the two weeks prior to the intervention, the two intervention weeks, and the two weeks following the intervention. To provide a comparator for the treated hot routes, control routes were also randomly assigned a "treatment" bi-weekly period (from among the 15 bi-weekly periods during which the interventions were implemented). Thus, we compare changes in vehicle theft in the treated routes during their intervention and post-intervention weeks (which were selected randomly) to changes in the control routes during randomly selected weeks.

No statistically significant differences were observed (see Table 1) across the control, LPR and manual groups based on CFS[20] (control= .57, LPR= .65, and manual= .38; F= 0.956, df=2,99; p= 0.39, n=

[20] We note that the category of CFS is uniformly larger than the UCR report data. The reason for this is that the CFS database includes a broader group of cases than the UCR database which only counts actual reported crime. For example, the CFS

102) or UCR crime reports (control= .26, LPR= .30, and manual= .26; F= 0.081, df=2,99; p= 0.92;n= 102) for vehicle theft during the intervention weeks.

5.2.3. Effects of LPR on Levels of Vehicle Theft: Post-Intervention Weeks

During the two post-intervention weeks, CFS related to auto theft were lowest in the manual check routes (0.08), followed by the control routes (0.35) and the LPR routes (0.70). These differences had marginal levels of statistical significance (F= 2.64, df=2,99; p= .08, n= 102). However, we observed a statistically significant difference (see Table 1) across the control, LPR and manual groups based on UCR crime reports (control= 0.04, LPR= 0.25, and manual= 0.05; F= 4.73, df=2,99; p = .01, n= 102) for vehicle theft during the two week post-intervention period. The LPR group had a slightly higher number of vehicle thefts (based on UCR) in the two week period post intervention compared to the manual plate checking group or control group.[21] Table 1 also shows that the direction of changes in vehicle theft from the two-week pre-intervention period to the intervention weeks and from the intervention weeks to the post-intervention weeks were not indicative of treatment effects from LPR use. Vehicle theft dropped in all three groups from the pre-intervention to the intervention weeks. In the post-intervention weeks, the LPR routes had a slight increase in vehicle theft, while the manual and control routes experienced further declines.

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database can include reports of stolen autos that turn out to be unfounded because the person found their lost car that they thought might have been stolen.

[21] In our later multivariate models, where we control for pre-intervention levels of vehicle theft, we no longer observe a difference between the LPR route and the control group on this measure. However, the manual group does emerge as having lower two-week post intervention vehicle theft levels (based on UCR data) than the control group.

5.3. Multivariate Models

Although not strictly necessary because we are working with experimental data, we will also introduce a set of covariates to our vehicle theft crime models.[22] Introducing covariates is increasingly common in analyzing data from randomized experiments (Patel, 1996). The introduction of covariates allows us to assess the role of substantively interesting variables on vehicle theft and simultaneously improve the precision of the treatment comparisons and correct for any major imbalances in the distribution of these covariates across the treatment and control groups that may have occurred due to chance (Armitage, 1996). Adding covariates also can help adjust for the natural variation between cases within the comparison groups (Gelber & Zelen, 1986). To follow is an examination of the effectiveness of the LPR equipment in reducing vehicle theft (UCR) incidents and CFS for vehicle theft using a count model approach (in one case Poisson regression and the other case negative binomial regression based on the distribution of the data). In order to enhance the statistical power and precision of these models, we created a panel database pooling data from all routes over the 15 bi-weekly intervention periods, the two weeks before the experiment, and the two weeks after the experiment.[23] This yielded a total of 102 * 17 = 1,734 data points after the removal of the freeway routes (discussed earlier).[24]

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[22] We do not use multivariate modeling with our other outcome measures ("hits," arrests and recoveries) for a number of reasons. First, some of these other measures have little or no variability to assess with multivariate modeling. For example, all of the stolen plate hits were generated using the LPR (n=8) compared to no stolen plate hits for the manual plate checking routes. Also, for some of the measures (e.g., "hits") we do not have pre-intervention measures thus removing the inclusion of substantively interesting covariates.

[23] We included data points for the weeks before and after the experiment in order to examine pre-post changes and lagged effects for routes that were treated during the first and last periods of the experiment.

[24] Hence, for the treatment routes, we included weeks before, during, and after the intervention. Pooling the data in this fashion also allows us to simultaneously examine effects during the treatment and post-treatment periods.

5.3.1. Impact of LPR on Vehicle Theft (UCR) Incidents Based on Count Modeling

In Table 3, we present the results of the impact of the randomly assigned treatment on UCR vehicle thefts within a Random Effects Poisson count model,[25] controlling for time period, adjacent hot routes, and a number of hot route characteristics, including length, visibility, and prior levels of vehicle theft.[26] Note that our measure of lagged vehicle theft for each route and bi-weekly period corresponds to that route's level of vehicle theft during the same bi-weekly period of the prior year. We used this seasonally lagged measure rather than the immediately prior two weeks because of the possibility that the latter measure would be contaminated by displacement or diffusion effects stemming from interventions in nearby routes. As one measure of possible displacement or diffusion effects, the adjacent route indicator represents, for each route and time period, the number of adjacent routes that were being treated simultaneously (i.e., receiving LPR or manual patrol by the vehicle theft unit). The bi-weekly indicator controls for common time trends (vehicle theft was declining in Mesa throughout the study period).

Statistically significant predictors of vehicle thefts were the prior seasonal vehicle theft count and the length of the hot route.[27] Hot routes that had higher rates of vehicle theft one year prior had more vehicle thefts, while mid-length routes (.45 to .9 miles) experienced fewer vehicle thefts, relative to short-length hot routes (under .45 miles). This model also includes two treatment effects, each of which is estimated separately for the LPR and manual check interventions: the impact of assigned treatment during the treatment weeks and the impact of assigned treatment in the two weeks after treatment (changes in both groups of treatment routes are interpreted relative to those in the control routes). After controlling for

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[25] The random effects approach assumes that unmeasured differences between routes are distributed as a random variable and uncorrelated with the variables in the model. Most importantly, our estimate of the treatment effect should be uncorrelated with these unmeasured differences by virtue of our experimental design.

[26] All subsequent models were estimated using STATA 10.1 xt commands for cross-sectional time series data.

[27] An additional hot route characteristic was the speed limit of the hot route. Due to colinearity with other predictors this variable was dropped from the analysis. As noted earlier, we also confirmed in preliminary modeling that there was no association between the outcome measures and the method by which each route was chosen (GIS analysis versus selection by detectives).

other factors, we see a statistically significant 75% reduction in the odds of a UCR vehicle theft in the two weeks after treatment in manually treated hot routes (p=.05) compared to the control group. Additional modeling (not shown) indicated that this effect faded after the initial two weeks following the manual check patrols.[28]

TABLE 3

Phase 1: Poisson (Count Model) Regression for UCR Vehicle thefts Incidents

	Odds Ratio	Std. Err.	Z	P>|z|
Lag UCR Vehicle theft	1.22	0.06	3.14	0.002
Biweekly Time Trend	0.98	0.01	-1.49	0.137
LPR Treat Period	1.25	0.30	0.74	0.46
Manual Treat Period	1.15	0.33	0.42	0.672
LPR Post 2 Weeks	1.00	0.33	0.00	1.000
Manual Post 2 Weeks	0.25	0.71	-1.93	0.052
Mid-length Hot Route	0.61	0.22	-2.26	0.024
Long Hot Route	1.10	0.24	0.38	0.701
Good Visibility	1.09	0.11	0.79	0.427
Adjacent Treated	0.97	0.14	-0.21	0.833
Intercept	0.19	0.41	-4.01	0.000
/lnalpha	0.57	0.23		
alpha	1.78	0.13		

Likelihood-ratio vs. pooled: chibar2(01) = 74.21 Prob>=chibar2 = 0.000
N. observations= 1,734; N. groups=102, Per group observations= 17;
Wald $X^2(10)$= 27.16; Log likelihood= -925.73069; Prob > X^2= 0.0025

5.3.2. Impact of LPR on Vehicle Theft Calls-for-Service (CFS) Based on Count Models

The impact of assigned treatment on vehicle theft CFS is presented in Table 4. As in Table 3, treatment impact is assessed through two variables, one for the period of treatment delivery and the other corresponding to the two-week period post-treatment. Similar to the results for UCR reported vehicle theft,

[28] More specifically, we tested whether this effect persisted throughout the observed post-intervention period and found that this was not the case.

the seasonal one year prior vehicle theft CFS rate is significantly related to the number of calls. Hot routes with higher vehicle theft rates in the prior year continue to have more CFS for vehicle theft. In addition, mid-length hot routes tend to have fewer vehicle theft CFSs, relative to shorter hot routes. Also, our time trend variable is statistically significant, indicating that as the experiment progressed the incidence rate of CFSs for vehicle theft generally declined across all routes. The assigned treatment (either manual or LPR) did not have a statistically significant impact on vehicle theft CFSs relative to controls during the treatment period. However, although LPR hot routes do not see a significant change during the post two-week period, the manual group witnessed a statistically significant decline. Manual hot routes in the post two-week period after treatment had decreased odds of having a call-for-service for vehicle theft by 75% (1 minus the odds ratio of .25) compared to the control group. As with the UCR data, subsequent modeling (not shown) revealed that this effect was temporary.[29]

[29] As in the UCR analysis, we tested whether this effect persisted throughout the observed post-intervention period and found that this was not the case.

TABLE 4

Phase 1: Poisson (Count Model) Regression for Calls-for-service (CFS) Vehicle thefts Incidents

	Odds Ratio	Std. Err.	Z	P>|z|
LAG CFS Vehicle theft	1.10	0.02	3.76	0.000
Biweekly Time Trend	0.96	0.01	-5.35	0.000
LPR Treat Period	1.13	0.23	0.52	0.600
Manual Treat Period	1.11	0.28	0.39	0.700
LPR Post 2 Weeks	1.15	0.24	0.57	0.568
Manual Post 2 Weeks	0.25	0.58	-2.35	0.019
Mid-length Hot Route	0.52	0.22	-2.97	0.003
Long Hot Route	1.01	0.25	0.06	0.956
Good Visibility	0.98	0.12	-0.17	0.867
Adjacent Treated	0.97	0.11	-0.33	0.742
Intercept	4.45	0.49	3.08	0.002
/ln_r	9.00	0.26		
/ln_s	1.40	0.19		
r	8111.52	2.35		
s	4.06	0.26		

Likelihood-ratio vs. pooled: chibar2(01)= 205.8 Prob>=chibar2 = 0.00;
N. observations= 1,734; N. groups=102, Per group observations= 17;
Wald $X^2(10)$= 61.1; Log likelihood= -1,417.972; Prob > X^2= 0.0000

5.4. Assessment of Potential Displacement and Diffusion of Benefits

To conclude this section we assess if vehicle theft crime displacement or diffusion of benefits occurred from our targeted routes to areas adjacent or near these routes. Given the general lack of effects in the models above, particularly for the LPR treatment, displacement and diffusion seem unlikely. The statistical non-significance of the indicator for treatment in adjacent routes also provides some indication that neither displacement nor diffusion occurred. As an additional check, we also examine changes in the areas adjacent to our study hot routes that are beyond the 500 foot buffer of the hot route but also within

2500 feet of the respective hot route. If displacement or diffusion occurred, we would expect there to have been statistical changes in these areas immediately adjacent to the hot routes from the two week period before the intervention to the intervention period and possibly to the two weeks post-intervention. Table 5 presents the results for the area immediately adjacent to the route. We observed no statistically significant differences for any of the three conditions in these areas from the pre-period to the intervention period or two-week post period. For example, our data on CFS for the LPR route revealed little change from the period prior to LPR treatment (3.05 CFS) to the period of LPR treatment (2.44 CFS) to the period two-weeks post treatment (2.46 CFS). Also, the reduction in post-intervention incidents and calls in the manual check routes does not seem to have produced clear displacement or diffusion patterns; UCR incidents in areas adjacent to the manual routes went up during these weeks, while CFS went down.

TABLE 5

Phase 1: Visual Assessment of Potential Crime Displacement and Diffusion of Benefits

		Areas adjacent to hot routes beyond the 500 foot buffer of hot route but within 2500 feet of hot route	
Randomly Assigned Treatment	Period	UCR Vehicle theft	CFS Vehicle theft
Control Route	2 Weeks Pre-Treatment	.82	1.82
	Treatment Period	1.13	1.72
	2 weeks Post-Treatment	1.38	2.80
LPR Route	2 Weeks Pre-Treatment	1.68	3.05
	Treatment Period	1.49	2.44
	2 weeks Post-Treatment	1.36	2.46
Manual Route	2 Weeks Pre-Treatment	1.44	2.47
	Treatment Period	1.37	2.71
	2 weeks Post-Treatment	1.46	2.29

6. PHASE 2 RESULTS

The first sets of analyses for Phase 2 (see Tables 6 and 7) describe the key analytic variables and summarize the nature of the distribution of our Phase 2 data. Table 6 includes means and standard deviations for continuous/interval-level variables (with statistically significant analysis-of-variance results noted on the left side of the table). Table 7 presents counts, percentages and chi-square results for data with more limited distributions.

TABLE 6

Phase 2: Means (standard deviations) for Three Study Conditions and Entire Sample

Variable	MEAN (SD)				N
	LPR	Manual Plate Checking	Control	All cases	
Number of CFS (911) for vehicle theft					
Before txt period	1.06 (1.3)	1.39 (1.9)	1.39 (1.3)	1.28 (1.6)	54
During txt period	1.72 (1.6)	1.33 (1.9)	0.94 (1.5)	1.33 (1.6)	54
2 weeks after txt	1.28 (1.4)	1.89 (2.3)	1.50 (1.9)	1.56 (1.9)	54
Number of vehicle theft offenses (UCR)					
Before txt period	0.56 (0.8)	0.33 (0.6)	0.61 (0.8)	0.50 (0.7)	54
During txt period	0.72 (0.8)	0.67 (1.1)	0.67 (1.2)	0.69 (1.0)	54
2 weeks after txt	0.39 (0.7)	0.78 (1.6)	0.72 (1.0)	0.63 (1.1)	54
Number of plates checked for criminal activity $F = 30.95$ $(1,36)$ $p \leq .000$	16,342.50 (9,412.9)	1,692.06 (735.1)	---------	9,017.28 (9,924.2)	
Average area of zone in square miles	1.21 (0.5)	1.17 (0.4)	1.12 (0.3)	1.16 (0.4)	54
Percent of Zones near or contains a Freeway	50.0%	44%	44%	46%	54

6.1. Analysis of Pre-Treatment Differences across the Three Study Conditions

As seen in Table 6, no pre-treatment differences emerged in our three study conditions based on the size of the zones, presence of highways in the hot zone, pre-treatment UCR crime levels, or pre-treatment CFS levels. The evidence from Table 6 suggests that our random assignment process worked as planned and created comparable intervention/control conditions.

Next, we examine whether the zones covered by the specialized vehicle theft unit with the LPR had more “hits” (positive detections of a vehicle theft crime), more arrests for vehicle theft crimes (stealing of vehicles and/or plates), and more recoveries for stolen vehicles than the zones covered by the specialized vehicle theft unit with manual plate checking. These results are followed by tests of whether the zones covered by the specialized vehicle theft unit with the LPRs had reductions in vehicle theft compared to the zones covered by the specialized vehicle theft unit with manual checking and compared to standard patrol (no specialized unit and no LPR).

6.2. Bivariate Models

6.2.1. Effects of the LPR, Compared to Manual Checking, on "Hits," Arrests, and Recoveries

The vehicle theft unit when using the LPR (294,165 total plates checked or 5,550 on average across the LPR covered zones) conducted statistically more ($F=30.95$; $df=1,33$; $p<.001$) license plate checks (9.65 times more) than when the same unit (see Table 6 above) did manual plate checking (30,457 total plates checked or 574 on average across manual zones). The zones with the LPR had 6 times more total hits for stolen cars crimes (see Table 7 below) than the manual zones (12 versus 2; $X^2= 4.7$, $p<.05$). The zones with the LPR had seven hits for stolen plates (see Table 7) compared to statistically fewer (zero) hits for stolen plates for the manual zones ($X^2= 8.3$, $p<.019$). The zones with the LPR had five hits for stolen cars (see Table 7) compared to fewer (two) hits for stolen cars for the manual zones (X^2=n.s.).

The zones with the LPR had zero arrests for stolen cars (see Table 7) compared to zero arrests for stolen cars for the manual zones. The zones with the LPR had one arrest for stolen plates (see Table 7) compared to zero arrests for stolen plates for the manual zones (a non-statistically significant result). The zones with the LPR had four recoveries for unoccupied stolen vehicles compared to two for unoccupied stolen vehicles for the manual zones, but this difference was not statistically significant ($p = .658$).The zones with the LPR had zero recoveries for occupied stolen vehicles (see Table 7) compared to zero recoveries for occupied stolen vehicles for the manual zones. Thus, by at least some of our measures, as in Phase 1, the productivity of the vehicle theft unit was several times higher when using the LPR devices.[30]

[30] In addition, the auto theft unit obtained 3 hits for other matters (e.g., matches to the license plates of vehicles belonging to people wanted on warrants) when using the LPRs and 1 such hit when doing the manual checks. Arrests for crimes not related to auto theft (e.g., arrests for warrants or other crimes witnessed by the officers) numbered 5 in the LPR zones and 2 in the manual check zones.

TABLE 7

Phase 2: Comparison of Counts/Percentages for Key Analytic Variables

Variables	LPR	Manual Plate Checking	All cases	Fisher's Exact Test	N
Number of arrests					
Vehicle theft arrest	0 (0.0%)	0 (0.0%)	0 (0.0%)	----------	36
Stolen plate arrests	1 (5.6%)	0 (0.0%)	1 (2.8%)	P = .999	36
"Hits" for crimes					
Stolen cars	5 (27.8%)	2 (11.1%)	7 (19.4%)	P = .402	36
Stolen license plates	7 (33.3%)	0 (0.0%)	7 (16.7%)	P = .019	36
Number of recoveries for stolen vehicles					
Occupied stolen vehicles	0 (0.0%)	0 (0.0%)	0 (0.0%)	----------	36
Unoccupied stolen vehicles	4 (22.2%)	2 (11.1%)	6 (16.7%)	P = .658	36

6.2.2. Effects of LPR on Levels of Vehicle Theft: Intervention Weeks

Table 6 shows the average level of vehicle theft, as defined by 911 calls and UCR reports, for the LPR and manual check groups during three successive periods: the two weeks prior to the intervention, the two intervention weeks, and the two weeks following the intervention. To provide a comparator for the treated hot zones, control zones were also randomly assigned a "treatment" bi-weekly period (from among the nine bi-weekly periods during which the interventions were implemented). Thus, we compare changes in vehicle theft in the treated zones during their intervention and post-intervention weeks (which were selected randomly) to changes in the control zones during randomly selected weeks.

No statistically significant differences were observed (see Table 6) across the control, LPR and manual groups based on CFS (control= 0.94, LPR= 1.72, and manual= 1.33; F= 1.00, df=2, 51; p= 0.374, n= 54) or UCR crime reports (control= 0.67, LPR= 0.72, and manual= 0.67; F= 0.02, df=2, 51; p= 0.983, n= 54) for vehicle theft during the intervention weeks.

6.2.3. Effects of LPR on Levels of Vehicle Theft: Post-Intervention Weeks

In addition to vehicle thefts during the treatment period, we also examined vehicle thefts based on CFS (see Table 6) during the two week post-intervention period. The LPR zones had somewhat fewer calls on average during this period (1.28) compared to the manual check zones (1.89) and the control group zones (1.50), but this difference was not statistically significant (F= 0.47, df=2, 51; p= .626, n= 54). We also observed a similar non-significant difference (see Table 6) across the control, LPR and manual groups based on UCR crime reports (control= 0.72, LPR= 0.39, and manual= 0.78; F= 0.61, df=2, 51; p < .549, n= 53) for vehicle theft during the two weeks post-intervention period. Although the LPR group had a lower number of UCR vehicle theft reports in the two week period post intervention compared to the manual plate checking group and the control group, this result was non-significant.

6.3. Multivariate Models

To follow is an examination of the effectiveness of the LPR equipment in reducing vehicle theft (UCR) incidents and CFS for vehicle theft using a count model approach (in one case Poisson regression and the other case negative binomial regression based on the distribution of the data). Using the same general approach as for our Phase 1 models, we created a panel database pooling data from all zones over the nine bi-weekly intervention periods, the two weeks before the experiment, and the two weeks after the experiment.[31] This yielded a total of 54 * 9 = 486 data points.

6.3.1. Impact of LPR on Vehicle Theft (UCR) Incidents Based on Count Modeling

In Table 8 we present the results of the impact of the randomly assigned treatment on UCR vehicle thefts within a Random Effects Poisson count model, controlling for time trends, treatment of adjacent hot

[31] As explained in Phase 1, for Phase 2 we also included data points for the weeks before and after the experiment in order to examine pre-post changes and lagged effects for routes that were treated during the first and last periods of the experiment.

zones, the presence of a freeway(s) in the zone, the size of the zone, and levels of vehicle theft in the zone during the same two-week period of the prior year. Statistically significant predictors of vehicle thefts were freeway coverage and the biweekly time trend. Hot zones that had freeways/highways had lower rates of vehicle theft (IRR= 0.55, p< .05) relative to areas that had no freeways/highways. The biweekly time trend indicates that as the experiment progressed the incidence rates of auto thefts increased (IRR= 1.05, p< .05). Impacts of the LPR and manual check treatments were statistically non-significant during both the treatment weeks and the post-intervention weeks.[32]

TABLE 8

Phase 2: Poisson (Count Model) Regression for UCR Vehicle thefts Incidents

	Incidence Rate Ratio	Std. Err.	Z	P>|z|
Lag UCR Auto theft	1.01	0.04	0.28	0.782
Biweekly Time Trend	1.05	0.02	2.13	0.033
LPR Treat Period	1.05	0.31	0.16	0.873
Manual Treat Period	0.92	0.28	-0.28	0.777
LPR Post 2 Weeks	0.62	0.24	-1.21	0.225
Manual Post 2 Weeks	1.08	0.31	0.26	0.793
Adjacent Treated	0.97	0.11	-0.22	0.825
Freeways in hot zone	0.55	0.15	-2.15	0.032
Area of Hot Zone (in sq. miles)	0.61	0.22	-1.37	0.170
/lnalpha	-0.15	0.28		
alpha	0.85	0.25		

Likelihood-ratio vs. pooled: chibar2(01) = 71.43 Prob>=chibar2 = 0.000
N. observations= 486; N. groups=54, Per group observations= 9;
Wald $X^2(9)$= 13.42; Log likelihood= -515.044; Prob > X^2= 0.14

[32] Although there were no statistically significant changes in the intervention areas, it is notable that auto theft reports dropped by 38% in the LPR zones during the two-weeks following intervention. With a larger sample size, this change may have proved statistically significant. However, this pattern was not mirrored in the calls-for-service data (see below).

6.3.2. Impact of LPR on Vehicle Theft Calls-for-Service (CFS) Based on Count Model

The impact of assigned treatment on vehicle theft CFS is presented in Table 9. As in Table 8, treatment impact is assessed through two variables, one for the period of treatment delivery and the other corresponding to the two-week period post-treatment. Hot zones that contained freeways/highways had lower rates of vehicle theft (IRR= 0.49, $p < .05$) relative to areas that had no freeways/highways. The biweekly time trend indicates that as the experiment progressed the incidence rates of auto thefts generally increased (IRR= 1.06, $p < .05$). The assigned treatment (either manual or LPR) does not have a statistically significant impact on auto theft calls relative to controls during the treatment period or two-weeks post-treatment.

TABLE 9

Phase 2: Negative Binomial (Count Model) Regression for Vehicle theft Calls-For-Service (CFS)

	Incidence Rate Ratio	Std. Err.	Z	P>|z|
LAG CFS Vehicle theft	0.97	0.02	-1.31	0.191
Biweekly Time Trend	1.06	0.02	3.44	0.001
LPR Treat Period	1.36	0.29	1.43	0.152
Manual Treat Period	0.89	0.22	-0.47	0.640
LPR Post 2 Weeks	0.98	0.24	-0.07	0.941
Manual Post 2 Weeks	1.14	0.26	0.59	0.558
Adjacent Treated	1.05	0.10	0.51	0.610
Freeway	0.51	0.14	-2.40	0.016
HZ Area (in sq. miles)	0.55	0.21	-1.54	0.123
/ln_r	2.04	0.41		
/ln_s	0.18	0.25		
r	7.68	3.15		
s	1.19	0.30		

Likelihood-ratio vs. pooled: chibar2(01) = 86.92, Prob>=chibar2 = 0.000
N. observations= 486; N. groups=54, Per group observations= 9;
Wald $X^2(9)$= 24.31; Log likelihood= -697.65; Prob > X^2= 0.004

6.4. Assessment of Potential Displacement and Diffusion of Benefits

For the Phase 2 analysis, we assess potential crime displacement and diffusion of crime control benefits based only on the indicator for effects from treatment in an adjacent zone(s).[33] This variable

[33] As noted earlier, this indicator shows, for each zone (i) and time period (t), whether officers were intervening in an adjacent zone(s) with either LPR or manual patrols

provides a gauge of possible displacement and diffusion to surrounding areas of comparable size and type, as is common in studies of interventions in areas such as patrol beats or neighborhoods.[34] The adjacent route treatment indicator was statistically non-significant in both the UCR and CFS models. This pattern and the lack of direct effects in the target areas leads us to conclude that neither the LPR nor the manual check patrols produced displacement or a diffusion of benefits into surrounding areas.

7. DISCUSSION

Our paper focuses on a relatively new innovation for use by law enforcement in addressing vehicle theft. In general, the police have struggled addressing vehicle theft with only about 10% of vehicle thefts resulting in an arrest nationwide (FBI, 2010). LPR technology has been advanced as an innovation which could serve as a useful tool for law enforcement in addressing this serious problem. While it is a promising technology, that seems to be growing in use (Koper et al., 2009), other than a study by Lum and colleagues (2010) there has not been much research on the effectiveness of LPR systems in addressing vehicle theft. Beyond basic descriptive/pilot research with LPR systems in the United Kingdom and United States, none of these or other auto related evaluations (other than Lum et al., 2011) applied randomized experimental designs or at least rigorous quasi-experimental methods. Our study was designed to advance the field of policing research through a large-scale randomized experiment in Mesa, AZ, grounded in a hot spot policing framework and the "journey-after-crime" literature. More broadly, our study also adds to the rather limited evaluation literature on technology and policing (see Koper et al., 2009).

The hypothesized benefits of the LPR system are expected to be realized by law enforcement because of the large number of plates that the system is supposed to be able scan. Therefore, the first test

[34] Otherwise, the selection of a smaller displacement area around each zone would have been highly uncertain and arbitrary. For the Phase 1 hot route analysis, in contrast, the considerations were somewhat different; using the adjacent route indicator and looking at other small displacement/diffusion areas enabled us to look for displacement/diffusion in other surrounding micro areas.

we conducted was to see if this first premise was true. We compared LPR scanning to manual plate checking, controlling for the use of a special vehicle theft unit in both Phase 1 and Phase 2. We found that the LPR achieves its most basic purpose of increasing the number of plates scanned compared to manual plate checking in both phases, about 8 times more plates scanned with the LPR in Phase 1 and about 10 times more in Phase 2. The tests that followed examined whether the police could achieve a variety of benefits associated with this additional plate scanning.

Our Phase 1 results suggest that the routes with the LPR had more total "hits" for vehicle theft crimes (stealing of vehicles and/or plates) than the manual checked routes, more "hits" for stolen plates, more arrests for stolen cars, and more recoveries involving occupied stolen vehicles. In Phase 2, the zones with the LPR had statistically more total hits for stolen cars and license plates than the manual zones. While the LPR was associated with more arrests for stolen cars in Phase 1, no differences existed on arrests for stolen cars in Phase 2. As in Phase 1, the zones with the LPR in Phase 2 had significantly more recoveries for stolen vehicles compared to the manual zones. However, instead of the difference emerging for occupied stolen vehicles, the difference emerged for unoccupied stolen vehicles in Phase 2. Thus, by most of our measures the productivity of the vehicle theft unit was several times higher when using the LPR devices in both phases.[35,36]

Our next set of results explored whether the LPR was associated with reductions in vehicle theft crime, as measured by CFS and UCR crime reports. Also, for these tests, we were able to collect data for our additional control group of standard patrol. When examining the weeks of the interventions and a two-week period immediately after the interventions, we first observed only one bivariate statistically significant

[35] It is also worth emphasizing that these analyses compare LPR use to the use of extensive manual license plate checks conducted by a specialized unit. In comparison to normal patrol operations (with sporadic license plate checks), the productivity gains from LPR use would almost certainly be greater.

[36] The small number of vehicles recovered during the experiment precluded us from doing a rigorous analysis of whether LPR use leads to faster recoveries of stolen vehicles. However, based on our small number of cases, we did not find indications that vehicles detected by LPR were recovered more quickly than other vehicles.

difference across the control, LPR and manual groups based on CFS or UCR crime reports (and only in Phase 1). That is, we observed that the LPR group had a slightly higher (but statistically significant) number of vehicle thefts (based on UCR data) in the two week period post intervention compared to the manual plate checking group or control group. To improve the precision of the treatment comparisons for our vehicle theft outcome measures, we examined these results through multivariate modeling. In our later multivariate models, where we control for pre-intervention levels of vehicle theft and other route characteristics, we no longer observe a difference between the LPR route and the control group on this measure in Phase 1. However, the manual group does emerge as having lower two-week post intervention vehicle theft levels (based on UCR data) than the control group in Phase 1. No treatment effects were observable in Phase 2 based on the UCR or the CFS data.

Also, using the Phase 1 data, the multivariate test of the randomly assigned treatment revealed a significant decline in CFS for vehicle theft in the two weeks after treatment in manually treated hot routes compared to the control group. Also, we found no vehicle theft crime displacement or diffusion of benefits from our targeted routes and zones to areas adjacent or near these locations related to any of our analyses in either Phase 1 or 2. Our results, at least based on Phase 1, suggest that a specialized vehicle theft unit can have an effect on reducing vehicle theft compared to the control group, but only when this group does manual checking of plates as opposed to using the LPR equipment. This would appear to be an illustration of "residual deterrence" associated with short-term "crackdowns" at hot spots (Sherman, 1990).[37] Why this occurred in the manual check routes but not in the LPR routes is not entirely clear, nor is it clear why this was not replicated in Phase 2. Based on our discussions with the officers in this specialized unit, we believe the vehicle theft unit possibly had a more visible presence when they were doing manual checking as opposed to when they were operating the LPR equipment. The vehicle theft unit spent more time

[37] The lack of effect during the treatment period itself may suggest that it took several days of repeated treatment to change potential offenders' perceptions of risk at these locations.

roaming the streets and parking lots (both residential and commercial) of their respective routes—often at slow speeds and with frequent pauses—when they were doing manual checks. This was especially evident in Phase 1 when the study areas were smaller, but perhaps less the case in the Phase 2 zones (which might have been too large to create this same effect). When using the LPR in Phase 1, in contrast, they were more likely to make quick passes through side streets and parking lots and then remain at fixed positions. The additional roaming with manual checks may have created more of a preventative effect on vehicle theft by being more noticeable and unpredictable and by making it more obvious to onlookers that the officers were checking cars. The greater use of fixed surveillance points with the LPR equipment may have been less threatening to vehicle thieves because it was easier to avoid.

7.1. Limitations

Like other randomized control trials, our study has a number of strengths related to the strong counterfactual we created. We have good evidence that our random assignment process worked as planned (we detected no pre-treatment differences and experienced no misassignments connected with the random assignment process) and created comparable intervention/control conditions. We have a high degree of confidence in our ability to describe what would have happened to the treatment group if it had not been exposed to the treatment. However, the downside of our experimental assignment process was the creation of somewhat artificial conditions under which we asked the Mesa Police Department to operate. While the officers in our study carefully followed the assignment pattern dictated by the experiment, the resulting “hit” rate appears to have been constrained by the fact that the officers had to confine their efforts to pre-assigned places and times rather than target their operations based on current crime analysis and daily traffic patterns.[38] Despite their expressed strong dedication to the project, the officers did not seem to like being confined to our designated locations, particularly during the Phase I hot route operations. While our approach is not very different from other hot spot policing strategies used by the MPD and other agencies, the officers would have preferred to move more naturally through the city's high crime areas (e.g., work many more hot areas in a given shift and move away from hot areas that happen to be very slow on a given night).

After the Phase 1 study was completed, MPD wanted to assess how the same unit could perform on any given shift without the constraints of confining the officers to specific routes or zones on the shift. During an 8-day period (spread over 2 weeks) between Phase 1 and Phase 2, the unit conducted "freestyle" operations guided by recent auto theft and traffic patterns. During this time, the unit was able to recover 6 cars, or 0.75 per shift, based on using the LPR in any area throughout the whole city. The unit conducted another such freestyle operation for 6 weeks after Phase 2 and recovered 15 cars for 0.63 recoveries per shift. In contrast, the auto theft unit recovered a total of 14 vehicles when using the LPRs across Phases 1 and 2 combined. Considering that the unit used the LPRs half-time during the 48 weeks of Phases 1 and 2, this amounts to a recovery rate of approximately 0.15 per shift. This does not invalidate our findings, for all of the hot routes (LPR and manual) were similarly constrained; hence, our study provides valid estimates of the extent to which LPRs improved the officers' productivity. However, it does provide some evidence that more vehicle recoveries and other "hits" could potentially be achieved by law enforcement agencies not constrained by following research protocols (i.e., under normal operating conditions).

In this regard, Phase 2 of the experiment, which allowed officers to roam throughout larger hot zones, provided a test of the LPR equipment in a more typical operational context than did Phase 1, though

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[38] As we note below, results obtained with LPRs will also be affected by the volume of crime in a jurisdiction, the general difficulty of catching auto thieves in possession of stolen vehicles (e.g., due to delays in reporting of thefts), and the types of data fed into the LPR system.

still through the framework of a randomized experiment that required the officers to work the zones according to a predetermined schedule. However, it is worth noting that the productivity gains from using the LPRs were no greater in Phase 2 than in Phase 1. Consistent with research on hot spots policing more generally, this supports the merits of focusing LPRs on well defined micro places (in this case, high-risk road segments).

Another potential limitation of our study is the number of routes included in our research. Even in a city such as Mesa, AZ that has a fairly high vehicle theft rate (within the top 10 in the U.S.), we struggled to identify 117 hot routes for vehicle theft in Phase 1 and only 54 hot zones in Phase 2. While a sample size of 117 for Phase 1 is not a small study, especially in this context, it does provide some limitations in statistical power. For example, while this study had a sample size comparable to or larger than that of many prior "hot spot" experiments (Braga & Bond, 2008; Braga, Weisburd, Waring, Green-Mazerolle, Spelman, & Gajewski, 1999; Mazerolle, Price, & Roehl, 2000; Sherman & Weisburd, 1995; Weisburd & Green, 1995), it is not very large (especially Phase 2) compared to other experiments in criminal justice, which can have hundreds of cases (e.g., see Davis & Taylor, 1999, for a review of batterer treatment experiments). With only 117 or 54 cases and relatively low base rates, our statistical power was limited to finding medium (not small) effect sizes. In future research of this type, researchers may need to consider using multiple cities.

The intensity of our intervention was also fairly modest. In both Phase 1 and 2, each LPR and manual hot route received eight days of "treatment" for each route for one-hour per day for a total of eight hours of intervention. With the level of resources available for this project, a greater amount of intensity was not an option. However, it is possible that if the "treatment" dosage were higher that greater crime prevention effects might have been uncovered.

Another point worth considering is that we conducted our study (both Phase 1 and 2) during a 10-year low in vehicle theft in Mesa. In 1999 there were 2,851 vehicle thefts in Mesa, which increased for three successive years until reaching a high of 5,089 in 2002 and these numbers ended up dropping to 2,047 in year 2008 (the time frame of our study). While both the experimental and control routes were subject to the same general conditions that led to this drop in vehicle thefts and this does not impact the comparability of our groups (i.e., internal validity of our study), this may affect the generalizability of our findings. To date, there have been no explanations for this drop (e.g., demographic shift in population, waning of drug problem or introduction of new policing program). However, Mesa has had a general reduction in crime over recent years across most of their crime categories. At this point, it is an open question what results we would have seen during times of greater criminal activity. As pointed out to our team by an anonymous reviewer, the historically low auto theft rates might have also led to a plateau effect. That is, while LPR was associated with vastly more plate checking than the manual mode of checking, the identification and recovery rates for the LPR areas were only a few times greater which might have been due to the fact that the recovery rates were suppressed by the generally fewer number of auto thefts in Mesa.

Another issue is the relatively recent introduction of LPR equipment to policing. Over time, as law enforcement grows in its experience with the LPR, new strategies may emerge that will improve the "hit" rate of the LPR equipment. Also, this might also help with officer morale. Given the relatively infrequent level of "hits" associated with vehicle theft surveillance work, the officers can get bored or lose their focus.

Finally, there are still technological advances that are needed to make sure that the most current data on vehicle thefts are being sent to the LPR equipment. In addition to the traditional delays associated with vehicle theft reporting (e.g., victims may be unaware for many hours that their vehicle is missing and/or delay reporting their car stolen because they think someone may have legitimately borrowed the vehicle), there may be further delays in the entry of reports into the LPR system if it does not have wireless connectivity to receive reports in real-time (this was a limitation to the LPR system used in this study). The value of LPR will also be affected by the types and volume of data fed into the system (e.g., incorporation of warrants, inclusion of data from other jurisdictions, etc.). There are also other technological issues that still need to be resolved. For example, false positives can still be a problem (e.g., out of state plates that are similar to a plate stolen in another city), and misreads of dirty license plates or misreads from scanning plates across multiple lanes of traffic can present difficulties. There are also technical failures associated with the LPR equipment (e.g., due to extreme heat).

7.2. Policy Implications for Policing

Despite some of the issues outlined in our limitations section, we believe our results demonstrate that LPR technology holds a limited amount of promise for law enforcement. Some of the benefits include increasing the number of plates that the police can scan, increasing the number of "hits" for vehicle theft and "hits" for stolen plates, increasing the number of arrests for stolen cars, and increasing the number of recoveries involving occupied stolen vehicles. However, we did not find evidence that the LPR reduced actual vehicle theft rates for our targeted areas. Instead, we found that the same special vehicle theft unit conducting manual plate checks was able to reduce vehicle theft rates, but only in Phase 1. The fact that we did not lower vehicle theft rates with the use of the LPR equipment is in some ways not too surprising. First, our results are similar to Lum and colleagues' experimental study (2010) that recently demonstrated that LPR equipment was not associated with reductions in auto theft. Also, in our study the specialized vehicle theft unit operating the LPR equipment consisted of only four officers and a supervisor and each LPR route received only a modest "dosage" (8 hours, in the afternoon or evening, of intense surveillance by four officers over a two week period). Given that level of intensity (the Lum et al., 2010, study was also implemented at a modest intensity rate), and the newness of the LPR system (both in terms of officer familiarity with the technology and some technological limitations with the technology itself), we believe that the positive findings that did emerge (i.e., more plates scanned, "hits," arrests and recoveries) are notable, especially in a field where so little research-tested interventions exist. We now have evidence that at least one strategy, LPR use, can achieve some demonstrable benefits in addressing vehicle theft.

However, given the cost of each device (about $20,000) and our use of four LPRs that is an investment of nearly $80,000. Regardless of potential impact, cost alone is likely prohibitive in the current economic climate, where many police departments (especially in Arizona) are under such budgetary pressure that layoffs of personnel are being considered. And the other side of the cost question is return on investment. If a police chief asks, "what do I get in return for my $80,000 investment?;" the response from this study (based on Phase 1 data) is a hit rate of 24 hits divided by 457,368 plates scanned or a hit rate of .00005 (or in terms of hours: 45 LPR routes * 8 hours each= 360 hours and this produced 24 hits; or 1 hit every 15 hours of use of the device). This is even less compelling given the outcomes produced by the special unit manual condition (8 hits in Phase 1), and the evidence of a deterrent effect with this condition. It could be reasonable for a police chief to conclude that his or her agency might be able to achieve a reasonably high hit rate and greater deterrence of auto theft simply by re-assigning a small number of officers to the auto unit and increasing the rate of manual checking or perhaps by requiring patrol officers to do extensive manual checking in designated hot routes (thereby saving $80,000).

We also learned that another strategy, a specialized vehicle theft unit (even under modest dosage levels) can achieve actual reductions in vehicle theft, at least on smaller hot routes (as opposed to the Phase 2 hot zones). That is, in Phase 1 the specialized vehicle theft unit conducting manual plate checking (on as many plates as possible in a shift) was associated with lower vehicle theft compared to standard patrol that typically only conducts a limited amount of plate checking (and usually only when there is some evidence that warrants a check). Our work, at a minimum, demonstrates that focusing law enforcement resources on vehicle theft reduction at hot routes can potentially achieve quantifiable positive results. That is, broad based license plate checking, as opposed to the approach used by standard patrol of situational checking (e.g., a rear window of a car is down indicating a possible break-in), is associated with a number of benefits if done through LPR scanning (i.e., more plates scanned, “hits,” arrests and recoveries) or manual checking (lower vehicle theft rates).

The implications for future law enforcement applications is to figure out a strategy that maintains the documented benefits of LPR use by a specialized unit in both phases of our study (i.e., more plates scanned, “hits,” arrests [phase 1 only] and recoveries), but also achieves the benefits associated with manual checking by a specialized unit (i.e., lower vehicle theft rates) on smaller hot routes. More research will be needed to determine the best strategies to be used by officers operating the LPR equipment, including which elements present in the manual checking approach can and should be adopted by officers using the LPR. For example, by necessity officers doing manual checking need to use more roaming strategies (as opposed to fixed point scanning) to be able to view the license plates of fast moving cars. They also need to move slowly through parking lots and apartment complexes and make frequent stops to scan plates. This stands in contrast to the LPR approach used by the MPD in our study, and by other law enforcement agencies, which involves more fixed point scanning on roadways and quick sweeps through parking lots and apartment complexes. The fixed point scanning approach was adopted to maximize the number of plates scanned with the LPR equipment. However, by sacrificing some of the number of plates scanned with the LPR, in favor of more roaming surveillance and other strategies to increase the officers’ presence, perhaps more vehicle theft reduction may occur. One strategy to consider is to have less expensive non-sworn officers operate the LPR equipment and have sworn officers do the more intensive and more visible manual plate checking, which seems to reduce vehicle thefts. Under this scenario, when non-sworn officers get a “hit” for stolen vehicles they could then call it in to nearby patrol officers. Another possibility is that sworn officers using LPRs could adopt some of the methods used for manual check strategies—i.e., more slow roaming through parking lots, apartment complexes and side streets and fixed surveillance at prominent intersections where it is easier to view plates and be seen. These adjustments might both improve scans and generate greater deterrent effects.

As pointed out to our team by an anonymous reviewer, another issue law enforcement will have to attend to are adaptations made by auto thieves in response to their awareness of the existence of LPR equipment. Auto thieves may well develop strategies to counter LPR technology, for example using decoys with stolen plates (a lesser offense) to tie up law enforcement while other confederate thieves steal more expensive vehicles.

7.3. Implications for Future Research

There are some important next steps for researchers and funding agencies. First, our research demonstrates the ability of researchers to implement randomized experiments with law enforcement technology. Aside from being one of two randomized experiments with LPR equipment (the other being Lum et al., 2010), this is one of the few randomized experiments with any law enforcement technology. Our use of a randomized experiment led to rigorous results and was implemented with little disruption to police operations. Especially in the case of a scarce resource (we only had four LPRs for the whole city of Mesa and could not use the technology across the entire city at once), the random assignment element of the experiment can be justified to law enforcement and city officials. That is, large portions of the city are not going to receive the benefits of the technology with or without the experiment. In this case, the experiment simply allocates the resource in a way that all portions of the city in need of the technology have an equal chance of receiving it.

Second, additional replication research is needed. Our study was only of one city. While Mesa, AZ is a relatively large city, among the top 50 in the nation, evaluations should also be undertaken in the very largest urban centers of the U.S. and also in some of very small jurisdictions to confirm our findings in different contexts. Combined with the Lum and colleagues study (2010) (which was implemented in smaller urban communities, Alexandria, VA and Fairfax, VA, outside of Washington, DC), the mid-level cities are fairly well covered with LPR research data. Also, the Mesa, Alexandria and Fairfax police departments are widely considered to be very progressive and innovative agencies. It is not clear how well other agencies not possessing those characteristics would do with the LPR equipment.

Third, additional testing and research should also be undertaken on other methods of deploying LPRs. For example, the LPR equipment could be mounted to a standard patrol car or fixed to a toll booth or city lighting pole. Future researchers should consider studying different methods of deploying LPRs (e.g., comparing fixed vs. mobile LPR). As pointed out by an anonymous reviewer, target selection might also be a worthwhile variable to study, including whether LPRs are most effective when used in traffic, scanning plates of other vehicles in the flow of traffic, or is trolling parking lots and street side parking more effective? While these strategies may not lead to reductions in vehicle theft, they may yield other benefits associated with the LPR equipment. Future work should also extend to assessing the benefits of LPR use beyond recoveries of stolen cars, apprehension of vehicle thieves, and the reduction of vehicle theft. While technology limitations restricted our study to assessing only vehicle theft-related crime, other jurisdictions have the capability to use the LPR equipment to aid in apprehending fugitives, probation and parole violators, and those not paying court fines. These can be potentially important additional benefits associated with the LPR equipment that also need to be tested.

Fourth, more research is needed to understand the why the “hit” rates in our study were so low. Was it solely because of the low dosage (8 days of intervention for one-hour each day by four officers)? Or perhaps there are limitations to the use of LPR with vehicle theft due to the natural delays in reporting vehicle theft to the police. Combining these factors with detection avoidance efforts by thieves (e.g., switching license plates) may suggest that there is a very small window of effectiveness for LPR. Future researchers should consider whether the future deployment of LPRs should be publicized more through a media campaign. If potential vehicle thieves were made aware of the technology and its deployment, perhaps a deterrent effect could be generated.

Fifth, as pointed out by an anonymous reviewer, future research should explore the possibility that the pool of stolen plates and vehicles decreases with time, as the efficiency of recoveries increases. Also, the next line of research will need to assess whether most of those recoveries using the LPR would inevitably occur anyway, without the use of LPR. If LPR only increases the speed with which stolen vehicles are recovered, rather than the volume, the benefit would be reduced.

Finally, over time we might also expect the cost of this technology to lower substantially from the current pricing scheme (in the $20,000 to $25,000 range) and lead to greater adoption of this technology by law enforcement. However, with the greater adoption is also likely to include greater legal scrutiny of the privacy rights of citizens associated with this equipment or charges of the invasion of "big brother." As with any law enforcement equipment or strategy, the law enforcement community should look for careful empirical research to help provide guidance and insights into the effective and ethical use of this and other technology.[39]

[39] Lum et al. (2010), for example, surveyed community residents about LPR use and found that attitudes vary depending on the ways in which the data are used.

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LICENSE PLATE RECOGNITION TECHNOLOGY (LPR)

IMPACT EVALUATION AND COMMUNITY ASSESSMENT

September 2010

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"?

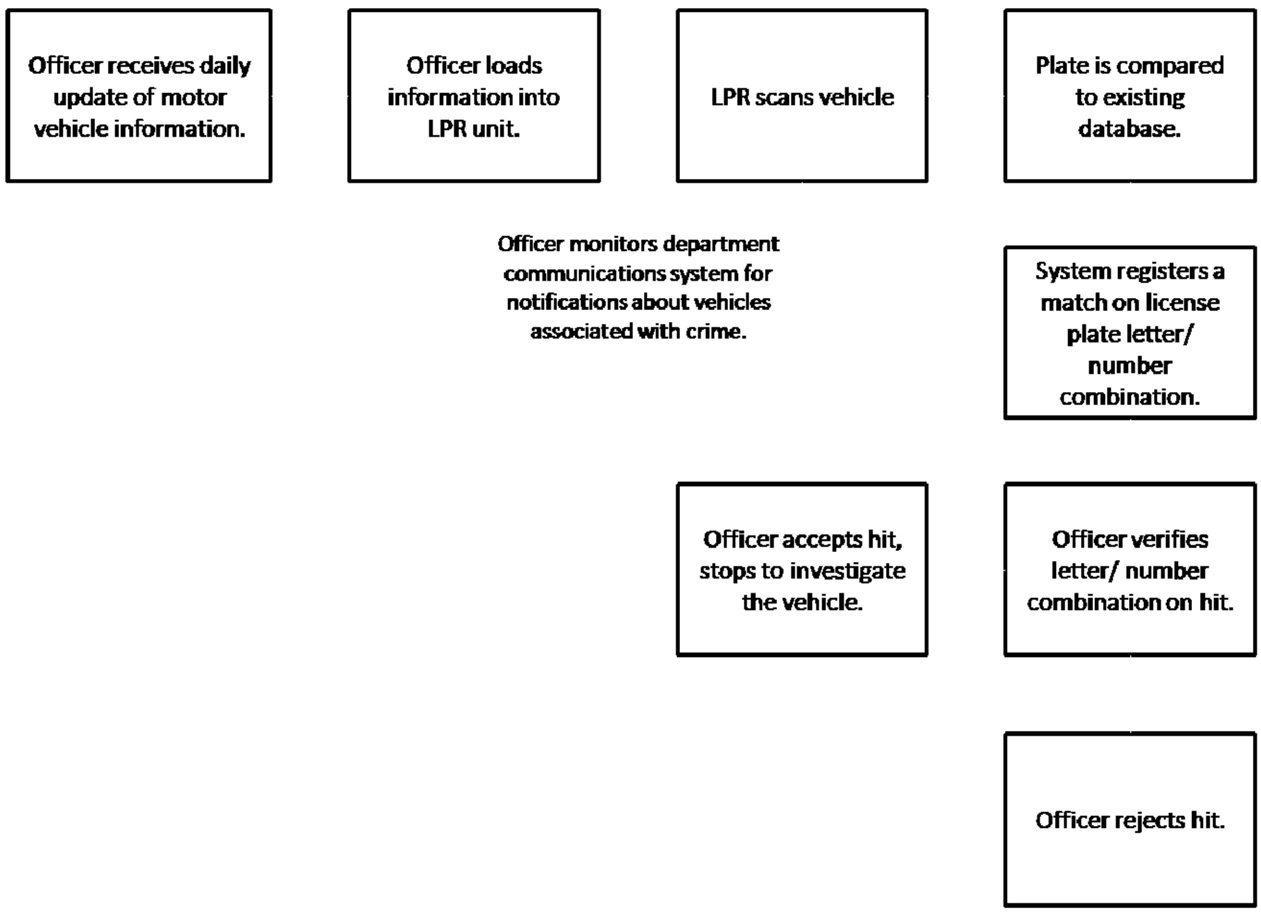
Overview: *George Mason University's Center for Evidence-Based Crime Policy was tasked by SPAWAR and the National Institute of Justice to carry out three tasks to strengthen the evidence base of license plate recognition (LPR) technology. These tasks included (1) determining the extent of LPR use across 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

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[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.

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[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,

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[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.campbellcollabaration.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";

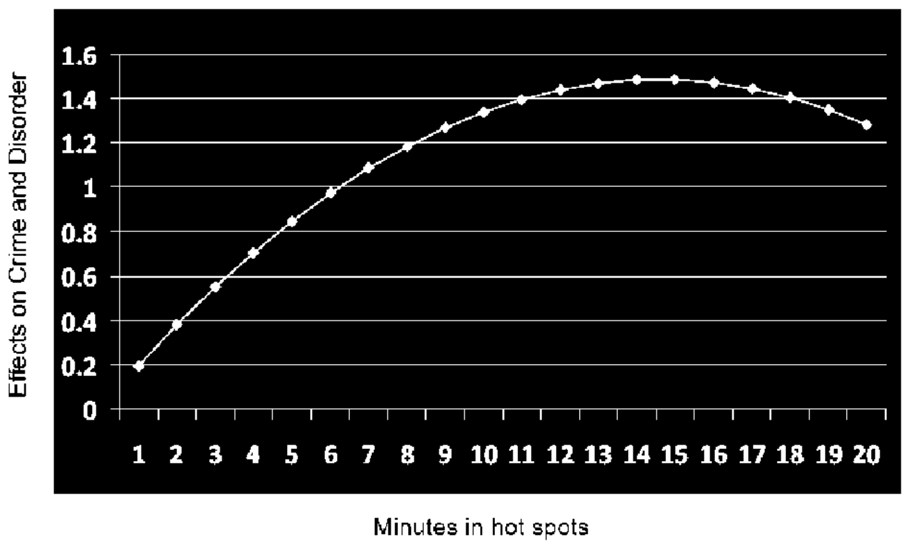
(2) tactics that are more proactive in nature, which use data and information to develop strategies to anticipate and prevent future crimes, or to address underlying causes of crime; and

(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

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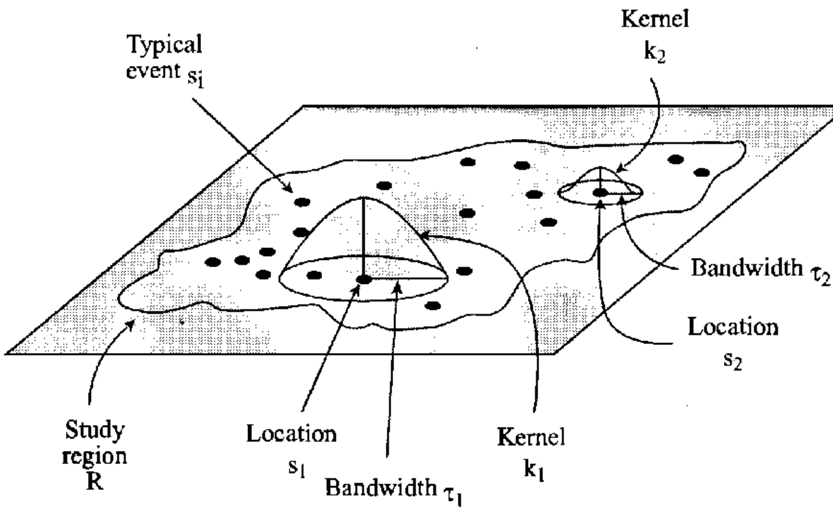
[16] ArcGIS is a product of the ESRI Corporation (see www.esri.com).
[17] The lower match rate for FCPD could reflect a number of factors, although we suspect it is due to FCPD's relative newness to crime analysis, mapping, and a new records management system. It may also be due to the varied and expanded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

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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 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.

"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."

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

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[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

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

Model 2: Modeling the Post-Intervention Period

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

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

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

Model 2: Modeling the Post-Intervention Period

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

[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

	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

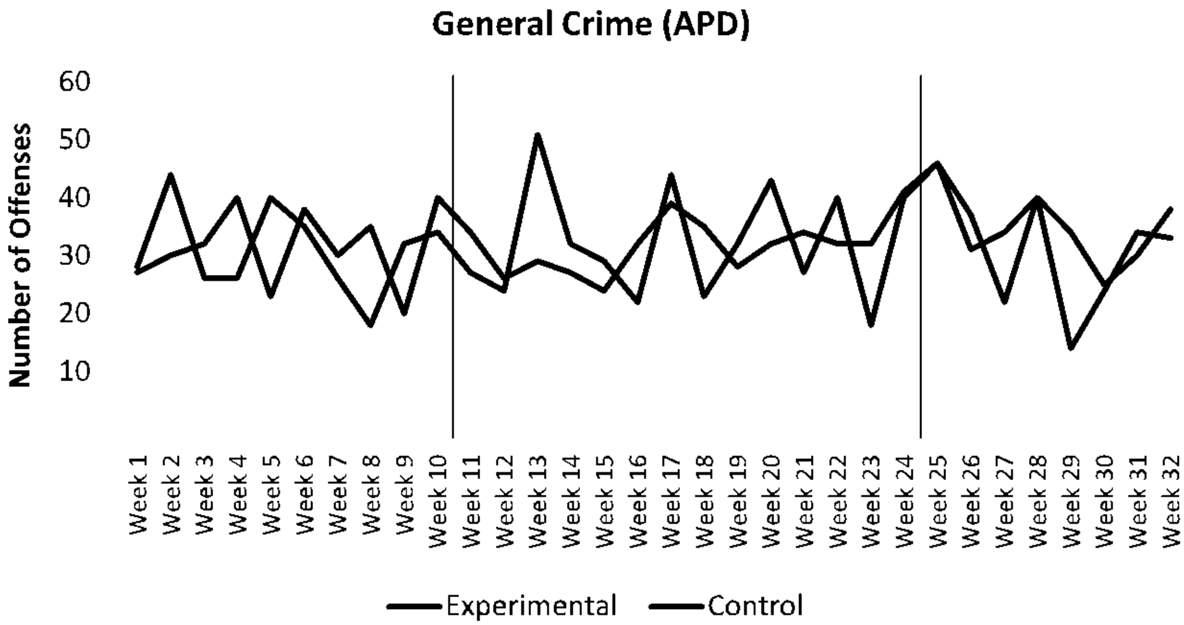
8.46	10.19 *
(7.600)	(4.730)
10.19	-.26
(7.998)	(4.486)
.71 ***	.06
(.152)	(.073)
.44 **	.62 ***
(.132)	(.121)
-8.33	-12.803*
(9.174)	(5.772)
-13.28	.44
(11.866)	(6.861)
.87	.62
(15.722)	(12.713)

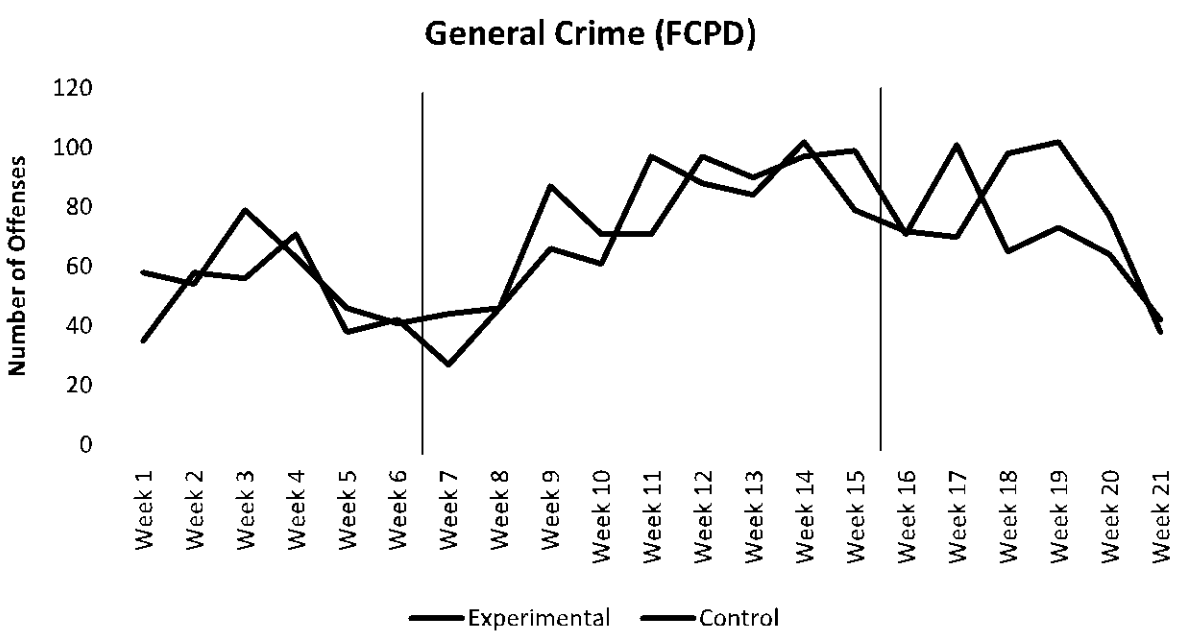
Unstandardized β coefficients reported, with standard errors in parentheses.
* $p<.05$, ** $p<.01$, *** $p<.001$

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

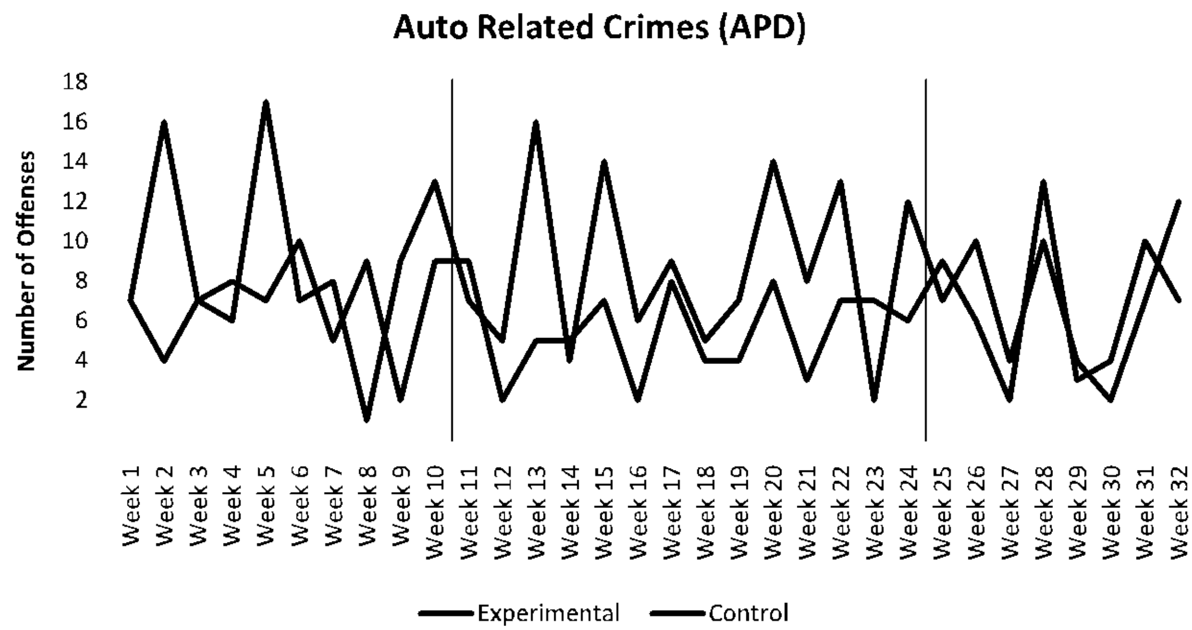
-2.39 ***	-3.03 ***	-2.76 ***	-3.90 ***
(.544)	(.556)	(.448)	(.561)
.37	.32	.03	.60
(.532)	(.557)	(.525)	(.577)
.04	.03	.04	.04
(.023)	(.030)	(.022)	(.030)
.04	.04	.05	.08
(.041)	(.053)	(.045)	(.120)
-.70	-1.03	-.52	-.70
(.550)	(.641)	(.615)	(.689)
-.49	-.50	-.07	-.96
(.817)	(.852)	(.796)	(.894)
4.031	7.495	6.108	12.715
-111.145	-80.677	-93.096	-62.902

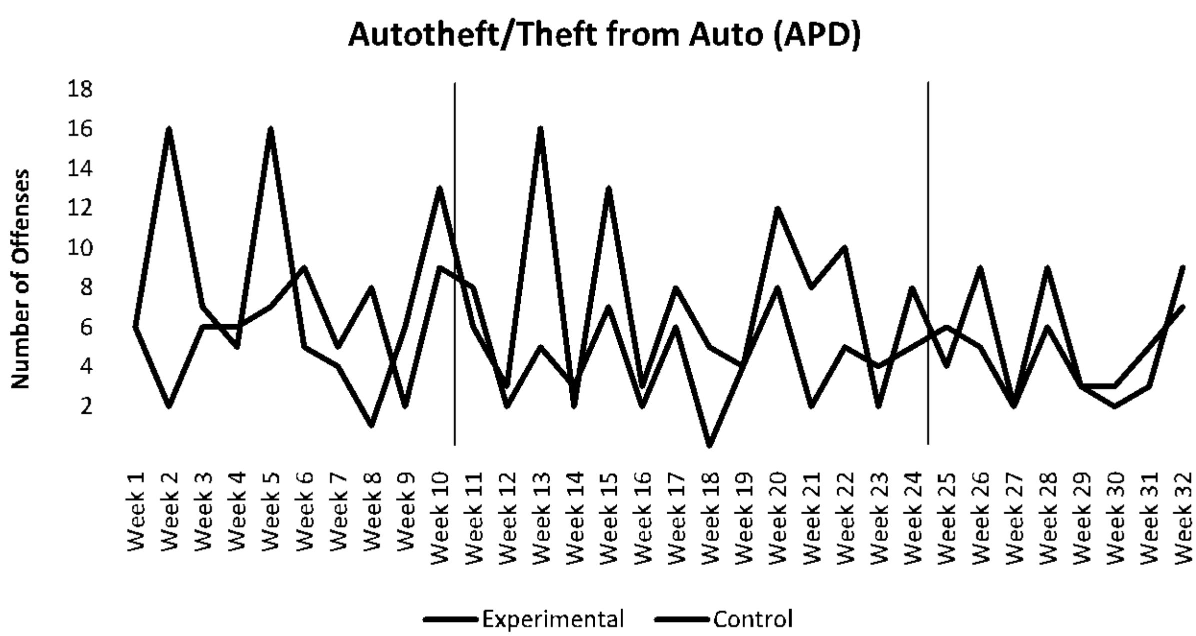
Unstandardized β coefficients reported, with standard errors in parentheses
* p<.05, ** p<.01, *** p<.001

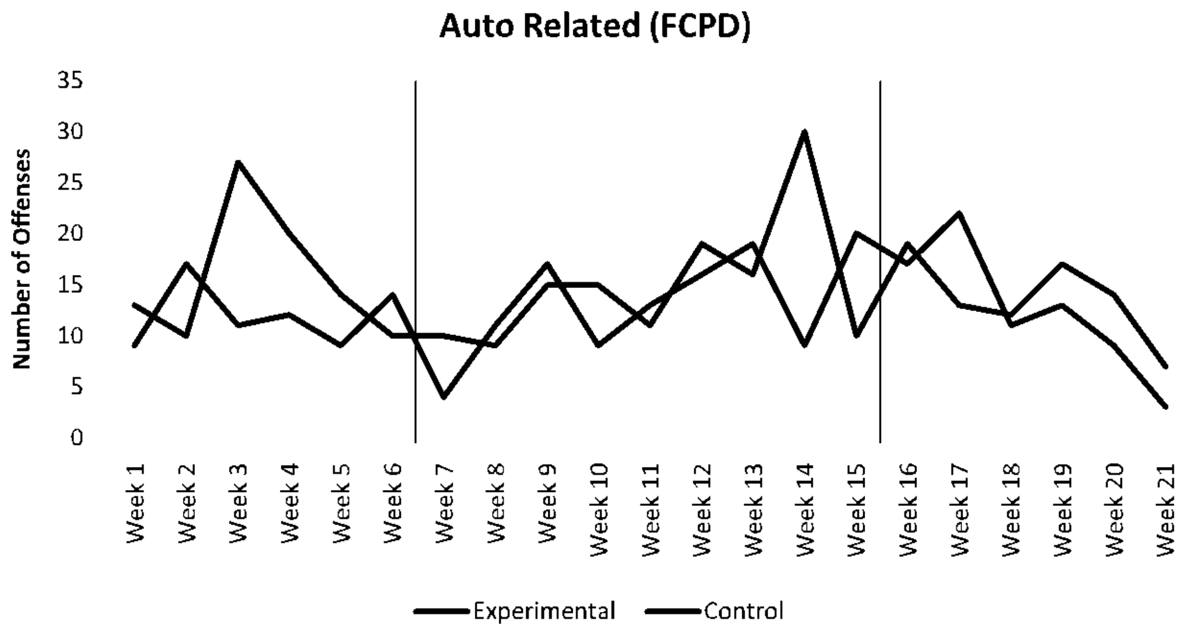
Figure 3.11 shows the weekly counts of auto-related crimes and auto theft/theft from auto for Alexandria Police Department (APD) and Fairfax County Police Department (FCPD) during the pre-intervention, intervention, and post-intervention periods for each jurisdiction respectively.[26] No clear pattern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

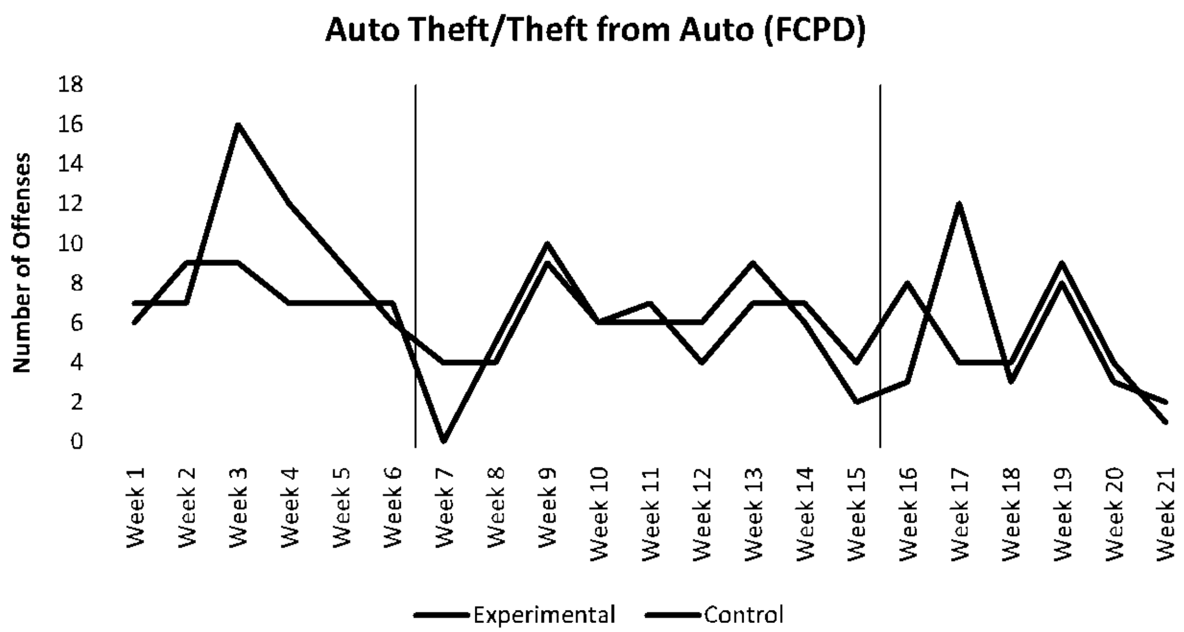
[26] Again, weekly trends of all crimes for Alexandria are from the week of November 15, 2009 ("Week 1") through the week of June 30, 2010 ("Week 32") and for Fairfax County from the week of December 26, 2009 ("Week 1") through the week of May 20, 2010 ("Week 21").

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.

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[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.

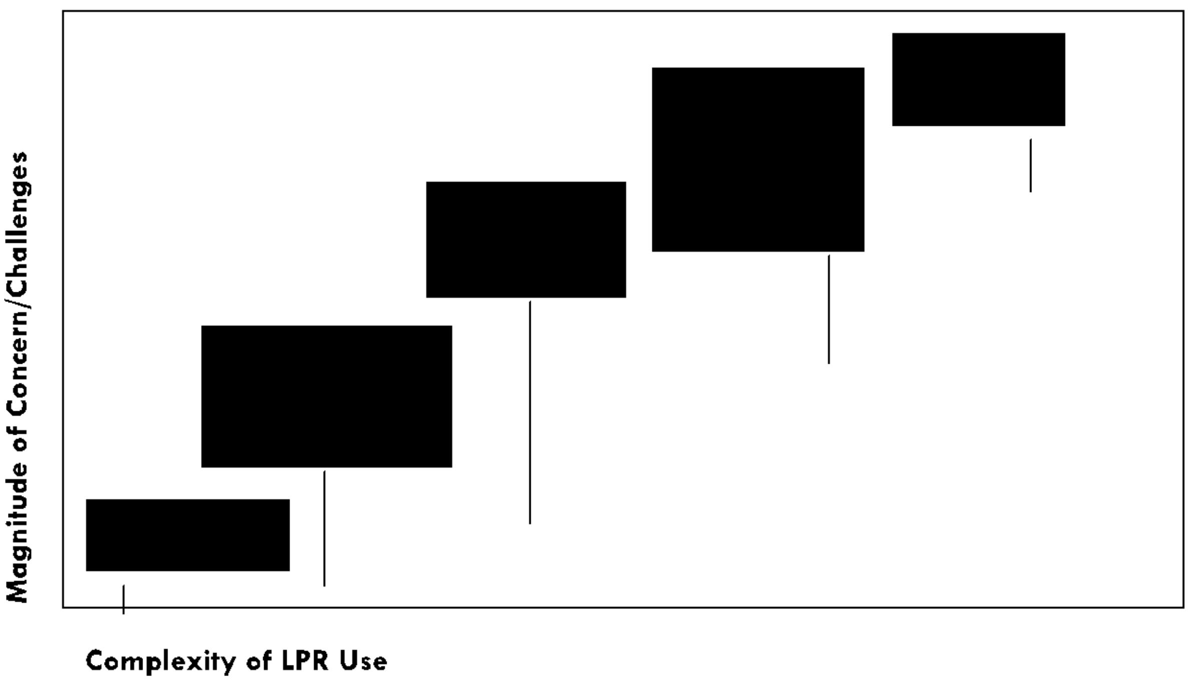
The Continuum of LPR Uses as a Framework for Analysis

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.

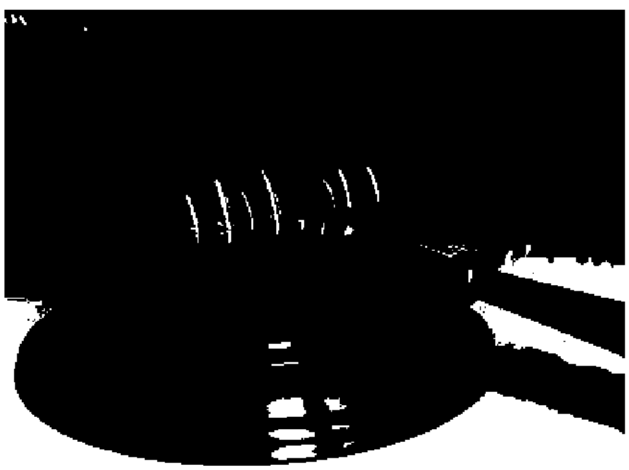
This type of analysis may offer special challenges to the legitimacy and legality of police actions. On the one hand, large amounts of data, combining information from many incidents and individuals, would be examined for overall patterns of behavior. This type of procedure is commonly used in intelligence 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.

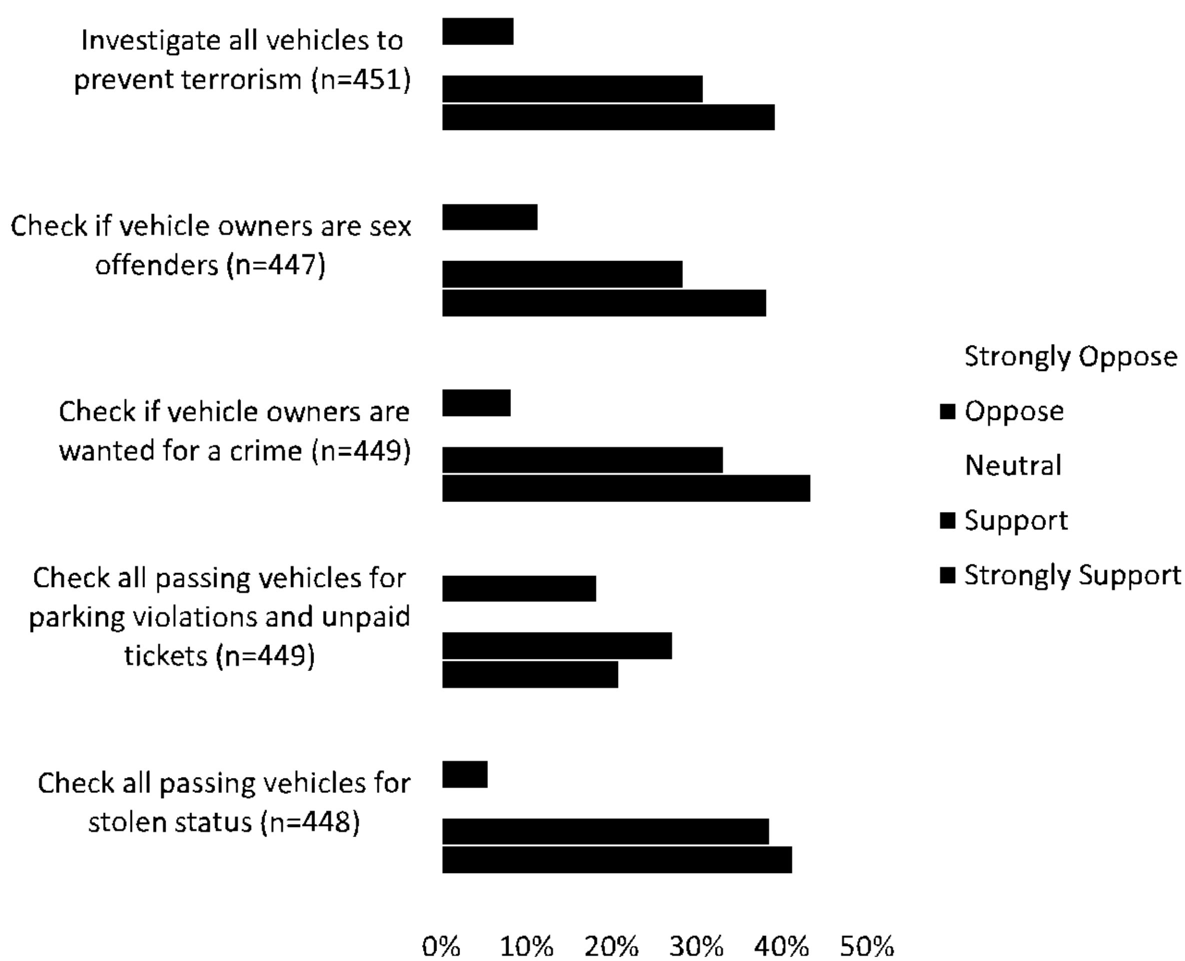
FAMILIARITY WITH LICENSE PLATE RECOGNITION

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.

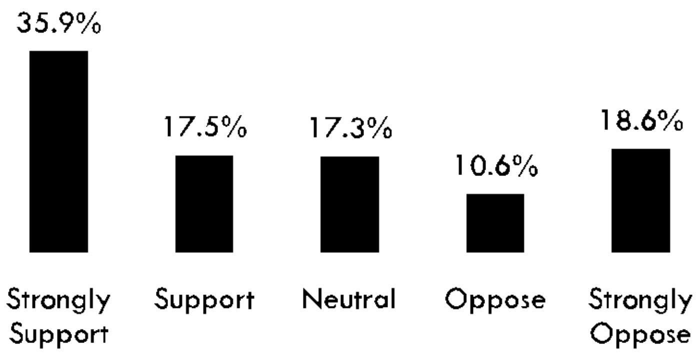
Community support for the other immediate uses of LPR is also generally high, though not as high as for those uses previously discussed. The remaining scenarios detailed in Figure 4.4 reflect more tertiary uses on the LPR continuum. Specifically, 66.7% of respondents either "strongly support" or "support" 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

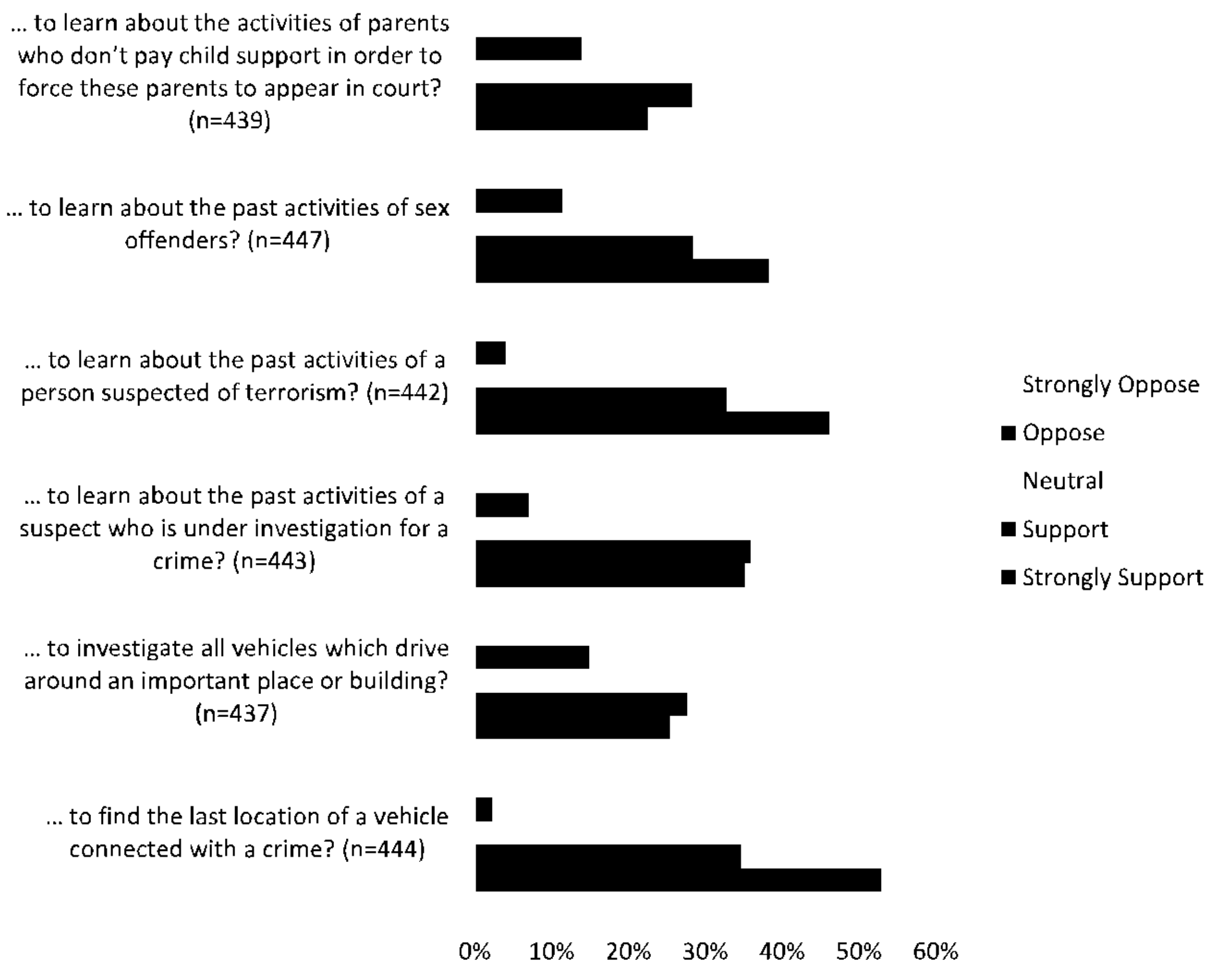
	Yes, the data should be saved until the police want to erase it.	Yes, the data should be saved for about six months.	Yes, but only for a short period of time (for example, one month)	No, the data should not be saved
Do you think that your local police should save the LPR data? (n=226)	53 (23.5%)	69 (30.5%)	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…"



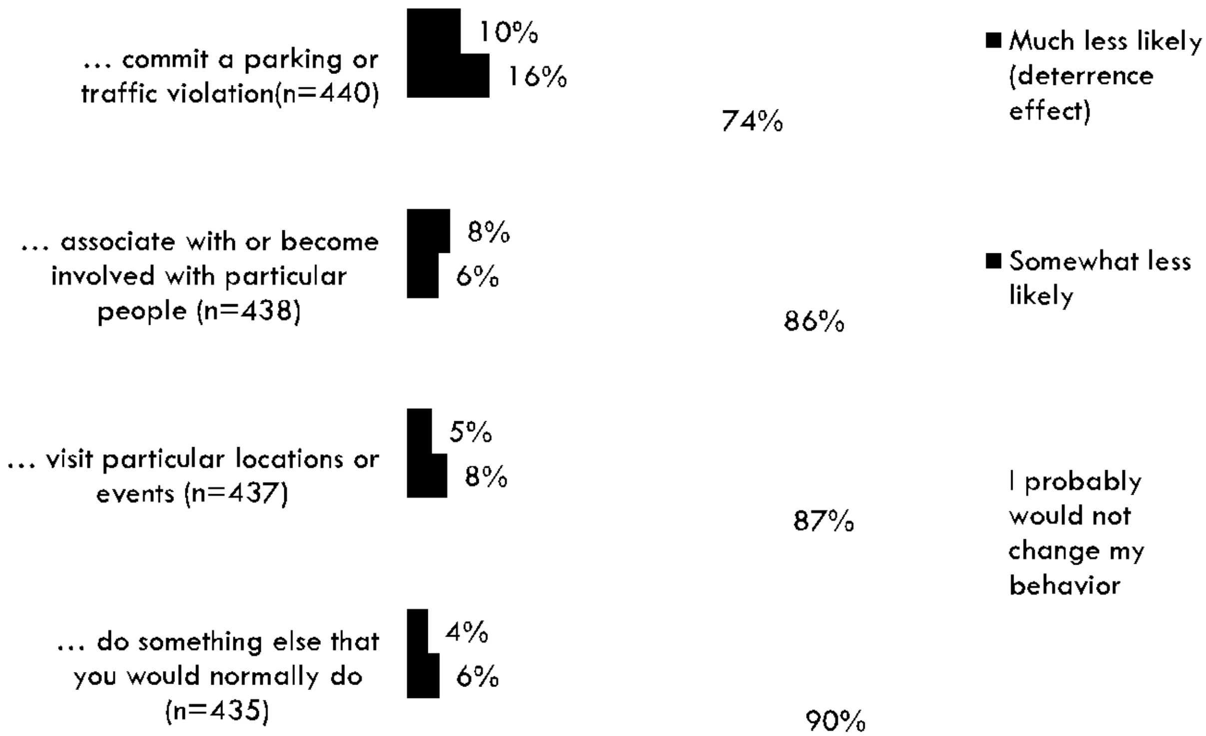
Additionally, it seems that support was again predicated on whether or not respondents felt that a particular use of saved LPR data might impact "average" or "innocent" members of the community. The uses of saved LPR data that would clearly impact "average" members of the community (as opposed to "criminals" 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).

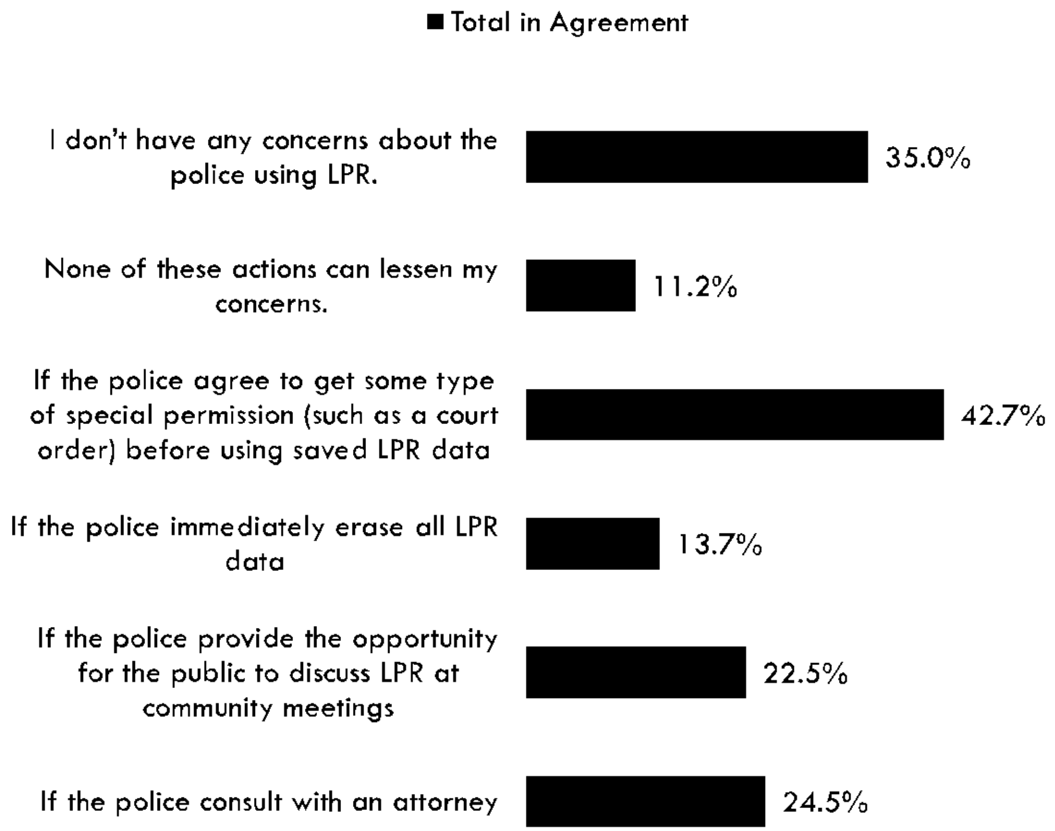
However, when asked if LPR data storage would stop them from "associating with or becoming involved with particular people," a minority (14.4%) of the community said that they would be "much less likely" or "somewhat less likely" to do so. Similarly, when asked if LPR data storage by the police would 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.

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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

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 neighborbood? 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)? _______

Mayor Ashcraft and City Council Members
clerk@alamedaca.gov

I support the Police Department's request for installation of License Plate Readers at the entrances and exits to Alameda, and in high crime areas within our city.

I have lived in Alameda since July 1998 and my spouse has worked in Alameda since 1991. We have seen and experienced a major increase in crime in Alameda, and want our Police Department to have the manpower and tools necessary to prevent and deter crime.

I agree with several community members that:

1. Mounting cameras at all our entrances and exits to Alameda has been a request for many years by various Police Chiefs, yet Council Members have dragged their feet to implement technology aimed at keeping Alameda safe.

2. The cost of this equipment has gone down from the initial request from approximately $500,000 to about a tenth the cost, according to the Police Department.

3. Auto theft and auto burglaries have dramatically increased. We know of neighbors who've had catalytic converters stolen multiple times as well as cars broken into multiple times. There has also been a dramatic increase in shoplifting and theft from our treasured retail establishments – so much so that they have been forced to close and leave.

4. Having both the Police Department head count trimmed as well as experiencing the nationwide challenge of hiring and training new officers to fill existing vacancies, APD needs to employ such data driven tools for them to more readily solve, better yet – prevent and deter the sorts of crimes mentioned above, and those more violent in nature.

5. Not employing such technology when jurisdictions bordering us have done so, is a message that says to non-resident criminals that it is easier to get away with crimes committed in Alameda.

6. Privacy is a concern to all of us, but hearing that the Police Chief is advocating that the City must exclusively control data collected; outside agencies such as Homeland Security should not have unfettered access to our data; the Chief will set narrow and documented standards for releasing data for APD criminal investigations; and data collected is destroyed in a year or less; these are all factors that make the use of this technology the right balance between protecting our civil rights while keeping us safe from criminal activity.

7. Only those who have dishonest and criminal intentions would be against this type of technology. There are some people who do not respect other's property or lives and Alamedans are afraid and concerned for their own safety as well as family members and neighbors. Alamedans used to be able to safely walk, drive and shop all over town, day or night, without fear of being assaulted in our own driveway, while walking to our car while shopping, even going to the movies or eating at many of our favorite restaurants. Alameda was a very safe city – not any more. When you hear your neighbors talking about selling their house and moving to a safer area, this is not a good thing for our community as a whole. If installing ALPRs makes us feel safer, it should be used. Let's be proactive against crime.

Thank you for your consideration,
Deanna Stoia
129 Nottingham Drive - 94502

From:	susansbriggs@gmail.com
To:	City Clerk
Cc:	briggs.ron2@gmail.com
Subject:	[EXTERNAL] License Plate Readers
Date:	Friday, January 21, 2022 9:31:39 PM

To the Mayor and City Council of Alameda:

We are long-time residents of Marina Drive and, as such, are very aware of the need for license plate readers at the entrances/exits to Alameda.

We and our neighbors frequently fall prey to people coming into Alameda to commit theft of automobiles or anything else that might catch their attention. We have neighbors who have had catalytic converters removed, cars broken into multiple times and garden ornaments and holiday decorations stolen from their yards. Sometimes we feel as if Marina Drive is under siege.

It is essential that APD employ all available tools to solve crimes and deter criminals. Although privacy is a concern to all, the right balance should be maintained between keeping us safe from criminal activity and protecting our civil rights. It appears that APD will control the data collected and use it for its intended purpose.

We strongly support the installation and use of license plate readers.

Ron & Susan Briggs
2913 Marina Drive
Alameda, CA 94501

From:	Patricia Gannon
To:	John Knox White; Tony Daysog; Marilyn Ezzy Ashcraft; Malia Vella; Trish Spencer
Subject:	[EXTERNAL] License Plate readers
Date:	Friday, January 21, 2022 9:05:37 PM

Honorable Marilyn Ezzy Ashcraft
Mayor, Cityof Alameda
Honorable Members of the Alameda City Council

Dear Mayor Ashcraft and City Council Members

Your City Council will be voting on the installation of license plate readers at several entrances to our city. I wholeheartedly support this proposal for the following reasons:

This has been recommended by several police chiefs'
The cost of the equipment has been significantly reduce;
Auto theft and burglaries have significantly increased especially the East End and Bay Farm Island;
APD needs these tools to readily solve these crimes as well as more violent incidents;
Lack of this new technology sends a message that Alameda is soft on crime;
Our Police Chief advocates that the City must exdlusigely control data collection and that such data be destroyed within a year;
The installation of these devices would make our city a safer place to walk, shop without fear.

For all the above reasons, please vote to approve the use of these devices.

Thank you.

Patricia . Gannon
1019 Tobago Lane 9402

From: Al & Li L
To: City Clerk
Subject: [EXTERNAL] ALPRs
Date: Friday, January 21, 2022 8:03:04 PM

Alameda City Clerk,

Please forward this message to each city council member and police chief.

We have lived in Alameda for over 15 years. We have seen how violent crime and property crime have significabtly increased within the city. We expect the full city council and police department to effectively address these threats to public safety.

This message is to clearly express our support for the use of technology such as ALPRs and the mounting of cameras at all high-traffic public spaces to the City, including city entrances. The use of such has consistently been demonstrated to be an effective tool in detering and solving crimes. But it can also be used to help our community in other ways. If a missing, eldery person walks away from home or a care facility, city-mounted cameras can be used in real-time to search public areas in an effort to locate the person.

Case law says there is no expectation of privacy in public places and digital images can be taken without prior consent. How often have we walked past people in public taking pictures with strangers in the background? Did anyone ask them for permission? The news media regularly shows amateur videos of crimes and other incidents with the intent of seeking the public's help. Again, there is NO EXPECTATION OF PRIVACY..

We trust that the City and Alameda PD will use captured images for legitimate, lawful purposes. A policy can be drafted that clearly explains when the data can be used which will include regualr audits.

As for costs, the City and the APD can apply for state and federal grants to off-set the costs of such technology.

We expect each city council member to support the use of ALPRs and city-mounted cameras at strategic locations to assist the APD in making A-Town a safer place to live, work and play. For everyone!

Al & Li, Alameda

I

From: Gig Codiga
To: City Clerk
Cc: Marilyn Ezzy Ashcraft; Tony Daysog; Malia Vella; Trish Spencer; John Knox White
Subject: [EXTERNAL] For the Safety of Our Neighbors and Businesses Re-Support Fixed APLicense Readera
Date: Tuesday, January 18, 2022 4:19:49 PM

For the betterment and safety of all our neighbors and businesses, to discourage crime in our community we must re-**support a proven tool and our new Police Chief's recommendation to purchase and place fixed AP License Reader cameras at every entrance and exit to Alameda**.

Best Regards
Be Well

Gig Codiga

From:	Patrick C
To:	City Clerk
Subject:	[EXTERNAL] ALPRs
Date:	Monday, January 17, 2022 10:05:40 PM

To whom it may concern,
My name is Patrick and I live on bayfarm island. I was told that Alameda is considering license plate reader cameras. I wanted to reach out and voice support for the ALPR as a deterrant to the increasing crime hitting our city. It feels like, and maybe it's due to social media, there are more and more brazen crimes occuring in Alameda. From the shootouts on park street to the catalytic converters on bayfarm, it feels like we need to do something.

Thanks
Patrick

From:	Claudia Charette
To:	City Clerk
Subject:	[EXTERNAL] improve safety in Alameda
Date:	Monday, January 17, 2022 11:26:03 AM

To City Council

Support the purchase of Automatic License Plate Readers.

1. Mounting cameras at all our entrances and exits to Alameda has been a request started in our community and requested by various Police Chiefs.
2. The cost of this equipment has gone down from the initial request from approximately $500,000 to about a tenth the cost, according to the Police Department.
3. Auto theft and auto burglaries have dramatically increased, particularly experienced in the East end and Bayfarm. We know of neighbors who've had catalytic converters stolen multiple times as well as cars broken into multiple times.
4. Having both the Police Department head count trimmed as well as experiencing the nationwide challenge of hiring and training new officers to fill existing vacancies, APD needs to employ such data driven tools for them to more readily solve the sorts of crimes such as mentioned above, and those more violent in nature.
5. Not employing such technology when jurisdictions bordering us have done so, is a message that says to non-resident criminals that it is easier to get away with crimes committed in Alameda.
6. Privacy is a concern to all of us, but hearing that the Police Chief is advocating that the City must exclusively control data collected; outside agencies such as Homeland Security should not have unfettered access to our data; the Chief will set narrow and documented standards for releasing data for APD criminal investigations; and data collected is destroyed in a year or less; these are all factors that make the use of this technology the right balance between protecting our civil rights while keeping us safe from criminal activity.
7. The opposition to ALPRs have relied upon the lack of any definitive study to show the efficacy of ALPRs. Many departments have released data to show many cases that have been solved with the use of the ALPRs, but these are not the same as conducting an efficacy study. *Maybe we should remove the firearms from a random sample of Police Officers in order to study the efficacy of unarmed Officers, all of whom work in communities where the criminals very often are better armed than they are. (No, America is not ready for this, nor should we be the first to test it out).*
8. Many folks are afraid and concerned for their own safety as well as family members and neighbors. Alamedans have become accustomed to being able to safely walk, drive and shop all over town, day or night, without fear of being assaulted in your own driveway, while walking to your

car while shopping, even going to the movies or eating at many of our favorite restaurants. And being or just looking elderly, Asian, Muslim, Jewish, or any other number of innocent groups being targeted, is very unsettling to many in what was a very safe city. When you hear your neighbors talking about selling their house and moving to a safer area, this is not a good thing for our community as a whole. If installing ALPRs makes us feel safer, it is a cheap investment.

From:	Victor M Robles
To:	City Clerk
Subject:	[EXTERNAL] In support of ALPR
Date:	Monday, January 17, 2022 11:06:29 AM

Mayor and city council,
I am in support of the Alameda license plate readers I am no longer happy with a spike in our crime rate please vote yes for these ALPR’s

Victor M.Robles

Sent from my iPhone

From:	kcboothby@aol.com
To:	City Clerk
Subject:	[EXTERNAL] Agenda Item - Automatic License Plate Readers
Date:	Monday, January 17, 2022 4:02:23 AM

Mayor Ashcraft
City Council:

What the heck has happened to our little city by the bay? I've lived here almost 70 years and cannot believe what I'm seeing and hearing.
The crime and the lack of human decency towards our fellow man is just unbelievable!!!! I know we're still short manpower with the police
department so having the license plate readers would greatly help in catching these thugs who think they can come into our city and
cause havoc. This seems like a no brainer!!!

Please give the go ahead to purchase the equipment as our lives and security are at risk!!!

Thank you!

Kathie Boothby
Life Long Resident
510-701-8173

From: Judy Huey
To: City Clerk
Subject: [EXTERNAL] ALPR
Date: Saturday, January 15, 2022 9:08:15 PM

Dear Mayor Ashcroft and the City Council,

I have lived in Alameda for over 49 years. As a child, we had no criminal activities as we've had in Alameda until the last 3 years or more. It has become unsafe to just leave a car parked outside, let alone walk by yourself in the day or night time. I am constantly looking over my shoulders or scanning for any possible criminal activities heading my way.

I currently live on Harbor Bay. Just this summer, my neighbor was violently knocked down and stolen of her phone and wallet. This happen just as she was rounding the corner near my house, which is Tillman Park across the street. A car pulled up along side her, the assailant jumped out of the car, knocked her down, took her belongings and jumped backed in the car that waited for him and fled the seen without a single eyewitness.

I remember when the Covid-19 pandemic started. I was searching for hand sanitizer, so tried going to the 3 Walgreens in Alameda. I first started with Walgreens on Park St in the morning, I witnessed a couple who tried to walkout with a cart without paying. The male cashier stood by a door and when he saw what they were trying to do, he grabbed their cart. Without a word the couple casually strolled out knowing they will not get arrested. Got in their car and drove towards the Park St bridge. The next Walgreens was on Webster St. I ended up at the back of the store and their was a man with a sweatshirt and hoodie on. I looked at him and he looked at me. He tried to turn away to conceal what he was doing. His pockets were bulging with Walgreen's goods. I knew he wasn't using his pockets as a shopping cart. I darted out quickly as to not be confronted by the shoplifter. After all that, I did not attempt to go to the third Walgreens. I had enough for the day and was terrified of how Alameda came to a place of shoplifters and violent criminals roaming and taking over Alameda.

Alameda use to be known as a safe place to raise a family and to walk around without fear. All I hear these days are did you hear about this and that happening in Alameda. Stolen catalytic converters and cars broken into seems like a regular subject in town these days. We are no longer that safe spot to live.

To deter criminals from coming to Alameda would be to install ALPRs around the entries into Alameda and Bay Farm, as well as a few ALPRs in between. Please be an advocate for Alamedans and install these for the safety of our present and future of the city. Criminals know we do not have a large police force, so let it be known that we have cameras be the eyes of Alameda and that we will not support thievery and violence. It will be an investment for the present and future of Alameda businesses and residents.

Please reconsider purchasing and implementing ALPRs.

Thank you for your time and consideration.

Sincerely,

Judy Huey

From:	Ann Ching
To:	City Clerk
Subject:	[EXTERNAL] Attention : Mayor Ashcraft and the City Council
Date:	Saturday, January 15, 2022 2:49:26 PM

Dear Mayor Ashcraft

Happy New 2022!
My name is Ann Ching from Ashby Bay, Alameda. I am writing in to give my full VOTE consent and support for the Police Chief’s request for installing ALPRs around the city. This is so necessary for the safety and security of us and the whole of Costa Brava residence.

Looking forward to an overall favorable votes to approved this.

Thank you
Sincerely
Ann Ching
Homeowner

From: Rick Mosher
To: City Clerk
Subject: [EXTERNAL] ALPRs
Date: Saturday, January 15, 2022 12:39:44 PM

To the Mayor of Alameda and the city council,

We wish to express our strong opinion that cameras and ALPRs around Alameda are important and a definite crime deterrent. Please proceed with this program.

Richard/Kathryn Mosher
Harbor Bay residents

From:	Jeff Henderson
To:	City Clerk
Subject:	[EXTERNAL] Support for Auto License Plate Readers
Date:	Friday, January 14, 2022 6:52:01 AM

Happy Alameda Morning Mayor Ashcraft and City Council,

Just a short email to express my families deepest support of APD Chief Joshi's request to have ALPR's installed in Alameda.

Crime, burglaries & homelessness have increased - please help us to improve our amazing city!

Thank you

Jeff and Jana Henderson

From:	Burny
To:	CityCouncil-List
Cc:	City Clerk
Subject:	[EXTERNAL] APLR"s, January 18 Council Meeting
Date:	Wednesday, January 12, 2022 9:59:52 PM

Members of the Alameda City Council:

On the January 18 regularly scheduled meeting of the Alameda City Council, I strongly encourage the five council members to approve the installation of APLR's within the city as a tool for the Alameda Police Department to utilize in maintaining a high level of safety within our community. The issue has been vetted numerous times and policies and procedures on its use have been authored and reviewed. It is time the council demonstrates strong leadership and support to make and maintain Alameda a safe and wonderful place to live. The use of this tool makes common sense which utilizes contemporary technology to support and aid the APD and its citizens.

I strongly encourage the entire council to approve of the purchase and utilization of the APLR.

Burny Matthews
Retired, Alameda Police Chief
556 Kings Road
Alameda

From: donnamarie ferro
To: City Clerk
Subject: [EXTERNAL] ALPR"s for Alameda
Date: Saturday, January 8, 2022 12:11:35 PM

Dear Mayor Ashcraft and Members of our City Council, as a family member of generations who have lived in Bay Farm Island for more than 100 plus years, I am requesting your consideration regarding the following: 1 Support the Alameda Police Chief for installing ALPR's only to be used for the specific use that he has addressed 2. Generations of my family lived in Bay Farm Island, and it has always been a safe environment with a strong community and now it is being threatened by those who come here to do damage to property, steal catalytic converters and other crimes 3. I have experienced as well as many others the threat to our homes by those who come here to do harm. 4.We all know that crime is pervasive and skyrocketing and we must impose some sort of technology to provide us assistance to deter this increase in crime 4. As a Senior Citizen I do not want to feel that I am being threatened nor having to peer out my bedroom window at 1:00 in the morning when a car is shining a light into my bedroom, which has been a reoccurring activity. My saving grace is that I have two dogs which bark loudly! I am asking you to vote to install ALPR's,,as recommended by our Police Chief, which includes the guidelines proposed in the use of this technology. Thank you, Donna Marie Ferro, granddaughter of the Antonio Ferro Family of BFI.

From:	Judy Lee
To:	City Clerk
Subject:	[EXTERNAL] Attn: Mayor Ashcroft and City Council re: rising crime in our city
Date:	Friday, January 7, 2022 8:47:11 PM

Mayor Ashcraft and the City Council,

I am writing today in support of the Police Chief's request for installing ALPRs around the city. I have been a resident for almost 3 decades and have lived in central alameda for majority of my time here. I moved to bay farm late last year and have already had my car burglarized right in front of my new house. I have two young baby girls and I fear that the criminals will get more brazen if we don’t try to do something here.

I appreciate your time,
Judy

From: Eve Bazo
To: City Clerk
Subject: [EXTERNAL] Request to Install ALPRs (Automatic License Plate Readers) in Alameda
Date: Thursday, January 6, 2022 4:59:04 PM

Dear Mayor Ashcraft & City Council Members:

I wanted you to note my support & consider the Police Chief's request to install the ALPRs around Alameda. I live on Bay Farm, Normandy HOA near Mecartney & Aughinbaugh. I've lived here since 2009, my husband & I raised our girls in this beautiful city. We have one attending Alameda High & one that recently graduated. We chose to purchase a home here because of the community & its schools.

We would like you to insure our family's safety as well as the safety of those that are our family, friends, neighbors, & broader community. We've had thefts around the Bay Farm area over the years, but with the recent pandemic it seems more cars are being broken into more often.

We understand there is a reduction in police staffing & I think by installing ALPRs it will help to both deter crime as well as help our hardworking officers identify those that are committing crimes. Our family asks that you consider installing the ALPRs to help bring added security to Alameda & its residents.

Regards,

Eve Bazo
Resident, Bay Farm

From:	Rich Sherratt
To:	City Clerk
Subject:	[EXTERNAL] APLR
Date:	Thursday, January 6, 2022 4:11:34 PM

Dear Mayor and members of the City Council,

I have a very difficult time understanding your extended deliberation on the license plate readers. It is not an invasion of anyone's privacy or a right wing conspiracy but a matter of better protection for our citizens. As one of the silent majority, enough is enough, and time you protect our property and families. Stop playing political games with our community and support our police department. Even Oakland has taken this very simple step on APLR.

Dr. Richard H. Sherratt

From:	Hilary Menendez
To:	City Clerk
Subject:	[EXTERNAL] Installation of ALPR"s
Date:	Thursday, January 6, 2022 12:03:21 PM

To Mayor Ashcraft and the City Council

I am writing to support the proposal of our police chief to install ALPR's in and around Alameda. I really feel we should respect the advice of the professionals who are tasked with keeping us safe, and this is one more tool to do so.
I am from the UK and cameras are a way of life there. It gives everyone a little more security as they go around their day to day lives.
Respectfully,
Hilary Menendez
Bay Farm Island resident

From: C Charette
To: City Clerk
Cc: Claudia Charette
Subject: [EXTERNAL] ALPR's
Date: Thursday, January 6, 2022 11:38:01 AM

To Mayor Ashcroft and the City Council

Due to increased crime in Oakland and resulting overflow into Alameda, installing ALPRs makes sense. Use available technology to augment the loss of police services in our city.

A huge city like London has cameras everywhere and it is not considered a "police state". They are also used in small suburban communities. Their police don't even carry guns.

Why not join the modern world and use available technology to fight crime?

Claudia Charette
One Bordwell Ct
Alameda

From: Laura Shen
To: City Clerk
Subject: [EXTERNAL] In Favor of ALPRs
Date: Wednesday, January 5, 2022 7:09:37 PM

Dear Mayor Ashcraft and City Council,

As a resident of Alameda for 29 years, I am alarmed at the increase in the City's crime rate in recent years. I worry especially about my elderly mother's safety when she is out running errands on her own or simply on a walk. I am writing to support our police chief's strategies for reducing crime, including the use of ALPRs at the City's entry points. Keeping residents safe should be top priority.

Please vote to implement this system, which has proved to be effective in other cities as a crime deterrent.

Thank you for your consideration,
Laura S.

From:	Lorraine Robles
To:	City Clerk
Subject:	[EXTERNAL] Yes For ALPRs!!!!
Date:	Wednesday, January 5, 2022 6:41:21 PM

Dear Mayor Ashcraft and the City Council,
I'd like to express my support for the Police Chief's request for installing ALPRs around the city. We have lived in Harbor Bay for many years. Never before have we witnessed crime rising like this. We know times are different and we don't have a full staff of police officers but it makes us seniors feel unsafe even in day light. Personally, I have witnessed people stealing from the grocery store while the clerk is just watching him walk out. It is frustrating! Cars are speeding, not stopping at stop signs stalking neighborhoods etc. I think by installing ALPRs the bad guys will be less willing to commit their crimes here. I remember years ago the word was "Don't even think of driving more than 25 miles per hour in Alameda!" It was a known no no! ALPRs can be the new message to law breakers. Please CONSIDER installing them for everyone's sake.

Thank you!
Lorraine Robles
Citizen and Tax Payer of Alameda

Have a blessed day!

From:	agustin garcia
To:	City Clerk
Subject:	[EXTERNAL] I am pro Camera
Date:	Wednesday, January 5, 2022 5:42:49 PM

Dear Mayor, I do understand what this means to our town, to our residents and the people who visit Alameda.
I don't know, I was born in 1970 so this type of technology can be used for good and bad. But I have faith in our law enforcement agencies to do the right thing ... When no one is looking.
We can try it. If we don't like it we pull the plug. It's not etched in stone, as we control our society.
Best Agustin Garcia

From:	HENRY CHING
To:	City Clerk
Subject:	[EXTERNAL] Installation of ALPR cameras
Date:	Wednesday, January 5, 2022 5:08:57 PM

Dear Honorable Alameda Mayor Ashcraft,

I am a resident/home owner of Bay Farm Costa Brava, I totally support our Police Chief's request for installing ALPRs around the city and in our neighborhood. We hope to reduce the crimes in our wonderful city of Alameda.

Thank you for your attention.

Regards
Henry CHING
135 ASBY BAY, ALAMEDA

From: sharrese Dekock
To: City Clerk
Subject: [EXTERNAL] License Plate Readers
Date: Wednesday, January 5, 2022 3:33:45 PM

Dear Mayor Ashcraft and City Counsel Members,

My husband and I have lived in Alameda for 30 years. The last several years there has been a huge surge in crime. This is not the same safe Alameda where we have raised our kids. Please install license plate readers at every entry/exit to Alameda.

Sincerely,

Sharrese and Pieter Dekock

From: Sandra Marder
To: City Clerk
Subject: [EXTERNAL] License plate readers
Date: Wednesday, January 5, 2022 2:00:17 PM

Please help make seniors in Alameda feel a little safer with license plate readers! This is coming from a Alameda resident that lived here for over 30 years and now is a little bit worried when I go out.

Sent from my iPad