Micro-Level Policing for Preventing Near Repeat Residential Burglary

Monograph (Technical Report)

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Final Monograph (Technical Report)

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The Police Foundation is America's oldest non-membership, non-partisan police research organization. Founded in 1970 by the Ford Foundation, the Police Foundation's mission is to advance policing through innovation and science. To this end, we conduct rigorous research evaluations of policing strategies, organizational assessments, and critical incident reviews all the while bringing researchers into lasting, constructive partnerships with law enforcement. Unconstrained by partisan imperatives, the Foundation speaks with a unique and objective voice, working to disseminate the findings of our work to practitioners and policymakers.

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Acknowledgements

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1. Part 1: The Micro-Level Near Repeat Experiment

1.1 Purpose

> Apprehending criminals, prosecuting them successfully, and sentencing the guilty
> fairly and efficiently are, of course, critical goals of any criminal justice system. But
> the real prize in crime strategy must be effective crime prevention. Preventing
> crime means fewer criminals for the overworked criminal justice system and,
> more importantly, fewer victims. (Pease & Laycock, 1999, p. 2)

In 2016, there were over 1.5 million burglaries in the United States, 69.5% of which were residential (FBI, 2017a). Combined, the victims of burglary suffered over $3.6 billion in lost property with an average loss of $2,361 per burglary. Looking at national Uniform Crime Report (UCR) clearance data, only 13.1% of burglaries reported to the police in 2016 were cleared (FBI, 2017b). Although burglary rarely generates the headlines and attention of violent crime, the sense of violation and vulnerability common among residential burglary victims is considerable. The impact of residential burglary is experienced more widely than violent crime because there are more victims. The monetary and emotional toll on victims coupled with the low clearance rate make prevention an especially good strategy for residential burglary. Prevention, as noted by Pease and Laycock above, results in fewer victims and thus fewer crimes to be dealt with by the entire criminal justice system.

The biggest challenge facing crime prevention in policing is the need to correctly anticipate where and when crime will occur (Pease & Laycock, 1999). Deployment of police can err in two different but equally problematic ways; when a crime occurs with no police officer present or when a police officer is present, but no crime occurs (Bowers, Johnson, & Pease, 2004). Complicating matters even further, in the latter type of instance, it is difficult to know whether no crime occurred because the officer was in the wrong place and time or **because** the officer was present.

Three known patterns in crime are available to assist with police deployment: hot spots, repeat victimization of the same household, and near repeat victimization.[1] Hot spots concentrate on the locations where crimes occur frequently. Consequently, they offer an excellent means of identifying *where* crimes occur, but more attention is needed on identifying *when* (Johnson, Bernasco, et al., 2007). A repeat victimization (RV) occurs when the same target is victimized multiple times. Near repeat (NR) victimization occurs when targets that are near an original target are victimized soon after. Empirical research has clearly identified the existence of both a repeat (same target, subsequent offense) and a near-repeat burglary phenomenon (same or nearby target, subsequent offense). In other words, when one home is burglarized, for a particular time period, homes nearby are at an elevated risk of being burglarized. The exact spatial and temporal extent of increased risk varies by the place; however, we know the increased risk level that occurs after a burglary is transient (Johnson, Bowers, & Hirschfield, 1997) suggesting police must act quickly to maximize the potential for reaping crime prevention benefits.

This knowledge of the near repeat phenomenon provides police with a way to "shorten the odds of being in the right place at the right time to deflect or detect crime" (Johnson, Bernasco, et al., 2007; Pease & Laycock, 1999, p. 2). Burglary interventions that target specific areas and occur soon after a burglary provide important benefits (Pease & Laycock, 1999). Such interventions require that additional

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[1] Predictive policing models also seek to proactively inform police deployment. These models are largely based on hot spot, repeat, and near-repeat victimization.

police resources be sent to the homes in the area most likely to be targeted and they not only address the crime that has been committed but work to prevent subsequent victimizations. In this way, agency leaders are able to leverage scarce police resources to maximize potential crime prevention benefit.

Some research (reviewed below) using NR and RV patterns to prevent residential burglary has been conducted in other parts of the world. However, we uncovered no published evaluations of such activity in the United States. This is especially surprising given early funding by the National Institute of Justice to develop a publicly available Near Repeat Calculator to allow researchers and law enforcement agency personnel to easily calculate the space-time risk profile for their jurisdictions (Ratcliffe, 2007).

To address that deficiency, this research translates empirical and theoretical knowledge about near-repeat patterns of residential burglary into actionable information for use in a geospatial policing strategy emphasizing the co-production of community safety. Specifically, we developed, implemented and evaluated a micro-level geospatial crime prevention strategy that attempted to interrupt the near repeat pattern in residential burglary by creating a NR space-time high risk zone around residential burglaries as they occurred and then using uniformed volunteers to notify residents of their increased risk and provide burglary prevention tips. The research used a randomized controlled trial to test whether high risk zones that received the notification had fewer subsequent burglaries than those that did not.

1.2   Background

The study of victimization is broad and has many facets. This monograph focuses on one of those - near repeat residential burglary victimization. However, the background section is purposely broader. It traces the development of knowledge about RV first (section 3.1). The rest of the background discusses NR victimization, its development (section 3.2), determining the spatial extent of near repeats (section 3.3), addressing near repeats (section 3.4) and remaining gaps in our knowledge about near repeats (section 3.5). To reiterate, repeat victimization (RV) occurs when the same target is burglarized more than once. Near repeat (NR) victimization occurs when targets near a burglarized target are subsequently burglarized within a relatively short time period. These definitions have been applied to different crimes but here we restrict our discussion to residential burglary. The vast majority of previous near repeat victimization studies have examined residential burglary. In fact, the strength of evidence supporting the existence of near repeat residential burglary is a major reason we used it as the outcome variable of an experiment to test whether focusing police efforts on nearby potential targets of residential burglary could interrupt the near repeat pattern.

1.2.1   *Repeat victimization*

The systematic study of near repeat victimization has its roots in the study of victimization which began in earnest in the 1970s (Hindelang, Gottfredson, & Garofalo, 1978; Johnson, Kerper, Hayes, & Killenger, 1973; Sparks, Genn, & Dodd, 1977; Ziegenhagen, 1976). As data on victimization improved, researchers discovered that a relatively small proportion of all victims accounted for a large proportion of victimizations. Analysis of the British Crime Survey data for 1984, 1988 and 1992 indicated that about 4-5% of victims accounted for roughly 43% of victimizations (Farrell & Pease, 1993; Pease, 1993). Johnson and colleagues (1997) analyzed crimes recorded by the police and also found a concentration of victims, specifically that 12.7% of all burglaries in Merseyside that were repeats occurred in .2 percent of the households. The term repeat victimization is used to describe a situation in which the same target is burglarized more than once. Researchers have conducted several excellent reviews of the repeat

victimization literature over the last 20 years (Farrell, 1995, 2005; Farrell & Pease, 1993; Gottfredson, 1984; Kleemans, 2004; Pease, 1998). The vast majority of the repeat victimization work has taken place in the United Kingdom (UK).[2]

One methodological issue associated with counting repeat victimizations concerns the window of time for which data are available for analysis. Where the time period is too short, some repeat victimizations that occur after the time period will be missed. The time period should include dates prior to the beginning of study since victimizations may occur before the window of time for which data are analyzed. This can lead to the undercounting of repeat victimizations. A study of residential burglary in Saskatoon, Canada revealed that the risk of re-victimization was highest immediately after a burglary and that it decayed over time (Polvi, 1990; Polvi, Looman, Humphries, & Pease, 1991). Specifically, the observed risk was over 12 times higher than that expected within one month but decreased to being 2 times as high after six months. Subsequent studies in West Huddersfield (Anderson, Chenery, & Pease, 1995) and Merseyside, United Kingdom (Johnson et al., 1997), have also found that the risk of repeat victimization is highest one month after an initial offense. This discovery and its potential for crime prevention led to a great deal of attention being paid to repeat crime generally, and repeat burglary more particularly.

Another aspect involves identifying the number of events that are part of a RV pattern. This "time window effect" refers to the fact that the number of burglaries against the same or nearby targets will vary based on the length of time data are collected (Farrell & Pease, 1993; Farrell, Sousa, & Weisel, 2002). Specifically, both the study period and the time period (i.e., 1 day, 1 week, 1 month) could affect the number of repeats identified. This issue was first noted by Farrell and Pease (1993) who suggested that longer time windows of several years would virtually eliminate undercounting that occurs at both the front-end and the back-end when short time windows are employed. At the front-end, a study period may start mid-repeat pattern and earlier events would be lost. At the back-end, a short period may miss later events that occur. Picking up on this theme, Farrell et al. (2002) examined repeat victimization rates in Baltimore, Dallas and San Diego using official data over a variety of periods of varying lengths from one month to three years. They found that, on average across the three cities, a one-year window captured 42% more events than a six-month interval and a three-year window captured 57% more events than a one-year window. So, the longer the time window used, the higher the rate of repeat victimization. They also examined the monthly data graphically and discovered that near repeat events continued to occur so that longer periods of follow-up time would produce greater numbers of repeats.

Research has also shown the frequency of repeat victimization varies by locality examined, time window for measuring RV, and the type of data used (crime incidents versus self-report victimization data). A study conducted in the United States using UCR data, a one-month temporal window, and a year's worth of data found that the rates of repeat burglary in Baltimore, Dallas and San Diego were 33%, 38% and 38%, respectively (Farrell et al., 2002). Another study, which used data collected using victimization surveys, compared repeat victimization rates in the United States and the United Kingdom and found significant differences, with the overall rates being 17.5% and 37% respectively (Farrell, Tseloni, & Pease, 2005). A more recent Canadian study which used reported crime data and a one-year time window in Vancouver found that 20% of burglaries were repeats (Frank, 2012). Regardless of the specific rates found, these studies clearly demonstrated that repeat victimization occurs sufficiently frequently to inform crime prevention activity.

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[2] For a complete review of the historical development of repeat victimization research in the UK consult Laycock (2001).

1.2.2 Near repeat burglary phenomena

Later, scholars found that as well as increasing risk to the victimized home (repeat victimization), a burglary event temporarily increases the risk to those nearby – a pattern that Morgan (2001) termed near repeat victimization. The risk decays as distance and time from the original victimization increases. One early exploration using one year of official data in Scotland looked at the spatial pattern within street segments and found that 30 percent of burglaries occurring on the same street (excluding same address repeats) were within 6 numbers of an address that was previously victimized (Shaw & Pease, 2000). The same study found that 80% of burglaries tended to occur on the same side of a street. Similar patterns were found in Merseyside, UK. Using 6 years of data to examine patterns of burglary victimization along streets, (Bowers & Johnson, 2005) found that the risk of being burglarized increased at immediately neighboring homes but declined as the number of doors from the victimized home increased. Moreover, the elevation in risk wasn't limited to the first day after an offense but was high throughout the first week. Risk dropped the week after, but still showed some elevation. These findings suggest that the elevation in risk decayed in both space and time. Importantly, the increased space-time risk of burglary remains even after controlling for the number of opportunities present (i.e., along any street, there will be more homes that are one door apart than two doors apart, and so on). Homes were also found to be at the greatest risk when they were on the same side of the street as the burgled home, when they were similar to the burgled home, and when the street on which they were located was straight rather than curvy. Subsequently, scholars have conducted studies using data from a variety of international contexts and have confirmed that the risk of (near) repeat victimization decays as the time elapses, and the distance from a burglary event, increases. However, these studies look at patterns in Euclidean space and do not consider the street network (for a recent exception see Rosser, Davies, Bowers, Johnson, & Cheng, 2017).

Since the discovery of the near repeat pattern in burglary, scholars have attempted to develop the measurement of near repeat risk. Noting the potential similarity between the spatio-temporal pattern found in re-victimization and the transmission of a communicable disease (Bowers & Johnson, 2004, 2005; S. D. Johnson, Birks, McLaughlin, Bowers, & Pease, 2007; S. D. Johnson & Bowers, 2004a; Townsley, Homel, & Chaseling, 2003), researchers have used epidemiological methods first created by Mantel (1967) and Knox and Bartlett (1964) to study the transmission process. Results from these studies have confirmed a space-time interaction in the pattern of burglary incidents (S. D. Johnson & Bowers, 2004a; Townsley et al., 2003). Overall, the findings observed across the majority of studies conducted reveal that risk tends to be elevated at short temporal and spatial intervals. In the East Midlands, UK (for example) the risk was highest at 400 meters (1,312 feet) and within one month (S. D. Johnson, Birks, et al., 2007).

The Knox and Mantel statistics have been implemented in two easily accessible, free programs. Using funding from the National Institute of Justice (NIJ), Jerry Ratcliffe (2007) implemented a collectively developed approach (S. D. Johnson, Bernasco, et al., 2007), in a software program to automate the identification of the space-time clustering of crime and to estimate the distance and time over which patterns persist. The NIJ also funded the development of CrimeStat software which contains many different spatial analysis techniques, including both the Knox and the Mantel statistics (Levine, 2015). One issue in these types of space-time statistics is how to measure whether the observed level of space-time clustering is statistically significant (Mantel statistic). The two pieces of software take different approaches to this issue in the technical implementation of the Mantel statistic. [3] One other

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[3] The CrimeStat version assumes complete spatial and temporal randomness in computing the expected distribution (for a complete discussion see Chapter 12 documentation in Levine, 2015). The Near Repeat Calculator uses the observed distribution. A detailed explanation is beyond the scope of this document.

important aspect is that the Knox/Mantel test is a global statistic; a single number that captures space-time clustering across an entire study area. In the context of NR burglary, this means that some residential burglaries will have additional events within the space-time window but others will not. Despite this drawback, the existence of these software programs increases the ability of local law enforcement to identify, analyze, and act upon NR patterns.

The question of whether NR patterns are more prevalent in certain types of areas has received some attention. Researchers have examined whether pairs of events that are close in both space and time (100 meters/328 feet and 1 month) are found in the same areas over time (S. D. Johnson & Bowers, 2004b). Working in Merseyside, UK, the researchers aggregated near repeat burglary events to Census Enumeration Districts (EDs) for each of the twelve months in a year and examined bivariate correlations. They found significant correlations in successive months but not between periods separated by a month or more. Moreover, that adjacent ED's tend to have similar rates of repeat burglary from one month to the next but that similarity dissipates over time. The authors suggest this is a result of burglars who hunt in an area for a couple of months and then move on to another area because they have stolen most of the attractive goods and the risk of apprehension has gotten too high. Those burglars tend to stay away for approximately 6 months. Johnson and Bowers (2004b) characterize this movement to nearby areas as 'slippery' and view proximity as the grease that facilitates the observed pattern. In conclusion, they hypothesize that an optimal foraging behavior pattern represents burglars who target more profitable homes, whereas burglars who identify and attack targets impulsively when the opportunity is right tend to do so in poorer areas typified by less fortified homes and a lower likelihood of bystander intervention.

The results of studies conducted to date demonstrate a significant near repeat pattern across a wide-variety of study sites. One study focused on several suburbs of homogenous housing in Brisbane, Australia and using 34 months of police recorded residential burglary data found a significant near repeat pattern within 200 meters (656 feet) and two months (Townsley et al., 2003). Another conducted in Merseyside, UK, examined 1 year of data using a lens of 1-month time periods and 100-meter distance bands and found increased risk over the next one to two months and the surrounding 300 to 400 meters (984 to 1,312 feet) of the home that was victimized (S. D. Johnson & Bowers, 2004a). A cross-national study of residential burglary in Australia, The Netherlands, New Zealand, United Kingdom and the United States found varied patterns, but all had increased risk for 200 meters (656 feet) and 14 days Johnson (S. D. Johnson, Bernasco, et al., 2007). Most relevant to the United States context, Pompano Beach, Florida exhibited a near repeat pattern of 200 meters (656 feet) and 14 days. Philadelphia's contagion was spatially similar but temporally longer – 200 meters (656 feet) and 8 weeks. A NR pattern was also discovered in Long Beach, CA using a similar test to the Knox-Mantel (Short, D'Orsogna, Brantingham, & Tita, 2009).

In sum, previous research has shown that there is a limited space and time for which households near to a victimized home are at an elevated risk of being burgled. The space and time profile varies but is most often within 200 to 400 meters (656 feet to 1,328 feet) and 2 to 4 weeks of the initial burglary incident, after which the risk declines to its pre-burglary level (Bowers & Johnson, 2005; S. D. Johnson, Bernasco, et al., 2007; S. D. Johnson & Bowers, 2004a). The greatest risk for near repeat burglaries is between one to two weeks after the initial incident, particularly for immediately neighboring properties (Bowers & Johnson, 2005; S. D. Johnson & Bowers, 2004a). However, burglary clusters do not remain stable over time and space-time clusters are only predictable for about one month, eventually shifting to nearby areas in successive time periods (S. D. Johnson & Bowers, 2004a). These studies provide important information regarding the time period over which near repeat victimization is likely to occur, in other words, the high-risk period. Several other aspects of near repeat victimization deserve more attention. First, the vast majority of studies used data from outside the United States. Second, unlike research into repeat victimization, there has been little emphasis on quantifying the frequency with

which near repeat victimization takes place (i.e., how many burglaries end up having follow-on burglaries). Third, more attention is needed on how much the method for measuring distance affects the number of burglaries that are counted as near repeats (see section 3.3).

1.2.3   *Quantifying the spatial extent of increased risk for near repeats*

One important component of identifying near repeats involves measurement of the distance between burglary events. With one exception, existing studies have paid little attention to the type of distance measurement used to identify the spatial extent of the increased risk. Bowers and Johnson (2005) examined how the risk of burglary changed within a particular street as the number of houses away from the original burglary increased. The most frequently used distance measures are Euclidean, Manhattan, and Street distance. Euclidean distance is measured using a straight-line from the origin to the destination and represents the shortest distance between two points. It is often called "as the crow flies" distance and it does not account for the transportation network or other barriers that might arise in local environments such as rivers, interstate highways, airports, and large parks to name a few. Manhattan distance, also known as right-angle distance, is often referred to as taxicab distance because it reflects how cars travel in downtown New York where the streets are laid out in a grid pattern. Manhattan distance produces a distance measure that is always greater than Euclidean and less that Street distance. Street distance is the most recently developed method and its calculation has been made possible by advances in geographic information systems (GIS) software functionality. Street distance takes into account features of the transportation network when measuring distance and thus, the distance produced is the longest but also the most accurate for the purpose of describing human travel (see Appendix A: Measuring Distance Illustration).

Early studies that implemented the Mantel test used Euclidean distance. This is likely because of the period in which they were conducted and the fact that traditional epidemiological methods of identifying the space-time window of high risk measured used Euclidean distance. The Near Repeat Calculator (Ratcliffe, 2007) offers the analyst a choice of either Euclidean or Manhattan. The newer Repeat and Near Repeat Analysis tool in ArcGIS[4] uses geodesic distance which is the shortest distance between two points on a spheroid. Under this methodology, the spatial bands produced are circular and cover the area around an originator burglary in all directions. An originator burglary is one that is followed closely by additional burglaries on the same or adjacent streets, what Johnson and Bowers term "short-run outbreaks or spates of burglary" (S. D. Johnson & Bowers, 2004a, p. 242). At the scale of a city, there is very little difference between geodesic and Euclidean. At a world scale, using a geodesic measure produces values that are smaller than Euclidean distance (Witek, 2017).

The method used to measure distance between burglary events is important because it changes the size and shape of the spatial extent that is identified as having a near repeat burglary problem.[5] This, in turn, can create challenges when deploying personnel to deliver crime prevention to places. One problem that arises is that the same distance band setting (e.g., 123 meters/400 feet) under Euclidean distance includes more physical territory than one using Manhattan distance. One using Manhattan distance will typically include more physical territory than one using street distance. This is important because it affects which burglary events are considered in the near repeat calculation (Euclidean distance considers the most and street distance considers the fewest). Another problem is that the outcome units do not 'fit' with how people move through space or how police patrol. Consider that

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[4] For more information on the Near Repeat Analysis Tool in ArcGIS see (http://solutions.arcgis.com/local-government/help/repeat-and-near-repeat-analysis/get-started/determine-incident-patterns/)

[5] The use of different sized band widths, by definition, creates different sized spatial units of analysis and thus, is subject to the Modifiable Areal Unit Problem (MAUP) (Openshaw, 1983; Wong, 2009).

Manhattan and Euclidean distances can be comprised of segments that are not connected or accessible to each other (e.g., a barrier such as a bridge or highway may mean two streets that are close to each other are not connected in a practical sense). To be truly actionable, geospatial information must be provided in a format that fits with the workflow in policing (Groff, 2009; Rosser et al., 2017). Since police officers typically patrol along streets, this translates into the identification of street blocks (both sides of a street between two intersections) that are part of a high-risk zone. If a high-risk zone consists of a set of street blocks, it is much easier to deploy the crime prevention strategy in the field than if it consists of a similar sized area that comprises fragments of many more street blocks.

1.2.4   *Preventing repeat and near repeat burglary*

The potential of using patterns in repeat victimization to prevent burglary has been recognized and tested. Indeed, even in 1997, researchers noted that "[t]he question is not now whether policing should take account of repeat victimisation, but how." (Chenery, Holt, & Pease, 1997, p. v). Interventions have almost exclusively targeted repeat victimization and only two specifically mentioned near repeats. This section examines crime prevention strategies targeting repeat victimization first before turning to near repeats. Several reviews of repeat burglary prevention initiatives reveal a mixed record of effectiveness (Farrell & Pease, 2007; Grove, Farrell, Farrington, & Johnson, 2012). Probably the best-known crime prevention program targeting repeat victimization was conducted in Kirkholt, a housing estate located in West Yorkshire, UK. In the original program (Anderson et al., 1995), as well as successive refinements, residential burglary was dramatically reduced. A subsequent study in the same location documented a 75% reduction in burglary (Forrester, Chatterton, Pease, & Brown, 1988). Another initiative in Huddersfield, UK achieved a 30% reduction in burglary (1997). Twelve of 18 studies in a systematic review reduced repeat victimization and another 15 studies reduced burglary more generally (Grove et al., 2012).

A few studies targeting repeat victimization used a graded response that incorporated a variety of different crime prevention techniques. The specific intervention depended on the number of repeat victimizations experienced. Responses ranged from Bronze (1 victimization) to Silver (2 victimizations) to Gold (3 victimizations) (Anderson et al., 1995; Chenery et al., 1997). The techniques ranged from a letter to victims with crime prevention suggestions to increased police patrol frequency. The interventions, which are transferrable to other sites, included: 1) improved physical security, such as window locks and deadbolt door locks; 2) a team of individuals who went out to talk with victims; and 3) cocoon watch that involved notifying neighbors to help watch out for the initial victim (Chenery et al., 1997). In addition to the direct benefits of the crime prevention activities, the increased visible, uniformed presence was hypothesized to have additional benefits such as: 1) reduced officer response time for incidents; 2) increased intelligence gathering potential; 3) improved opportunity for crime prevention and detection; and 4) greater victim assurance.

The studies described above used multiple crime prevention strategies at the same time. This approach makes it impossible to identify which of the strategies were effective and which were not. The authors noted this issue from the start but chose to prioritize maximizing the possibility of reducing crime over testing the efficacy of specific strategies. They knew previous research had demonstrated that multiple interventions had a greater likelihood of being effective (Chenery et al., 1997; Forrester et al., 1988). Since their goal was to achieve an effect, they decided to employ a number of crime prevention strategies. Following this example, most successful programs to prevent repeat residential burglary victimization have used a variety of tactics.

The most frequently used burglary prevention tactics were the provision of crime prevention information to the victim, target hardening, and increasing guardianship. The crime information provided included crime prevention tips as well as the offer of a security audit to highlight dwelling

vulnerabilities. Security audits/assessments by police were often used to identify vulnerabilities in homes to residents (Budz, Pegnall, & Townsley, 2001; Morgan & Walter, 2002). Programs diverged by whether they offered free target hardening devices to residents. Programs where the provision of crime prevention information was not accompanied by additional money for physical changes to discourage future victimizations were less successful (Budz et al., 2001; Weisel et al., 1999).

The most successful programs used security audits accompanied by focused security upgrades that emphasized addressing the method of entry used by the original burglar and that were paid for by someone other than the resident (Birks, Donkin, & Wellsmith, 2008; Bowers, Johnson, & Hirschfield, 2003; Forrester et al., 1988; Matthews & Trickey, 1994; Sturgeon-Adams, Adamson, & Davidson, 2005; Webb, 1997). Target hardening often included window and door locks and property marking but occasionally included physical improvements to the property edge in the form of alley-gating (Bowers & Johnson, 2005; Bowers et al., 2003; Sturgeon-Adams et al., 2005). Others included some type of property marking, either traditional (Sturgeon-Adams et al., 2005) or newer, smart water property marking (Bowers et al., 2003).

Increasing both informal and formal guardianship proved effective in some programs. Some programs increased informal guardianship by enlisting the help of immediate neighbors (Budz et al., 2001; Forrester et al., 1988). Termed Cocoon Watch (Forrester et al., 1988), neighbors were notified of increased risk and asked for greater vigilance. Cocoon Watch utilizing nearby neighbors was more effective than more dispersed efforts such as Neighborhood Watch. Efforts to increase formal guardianship involved more frequent security patrols in the areas around repeat victims (Anderson et al., 1995; Chenery et al., 1997). Two studies examined whether increasing formal guardianship within high risk burglary areas would be an effective strategy. One strategy defined high risk areas by using a 400-meter Euclidean buffer around each residential burglary in the Trafford area of Greater Manchester, UK (Fielding & Jones, 2012). The other identified hot spots of residential burglary in Port St. Lucie, FL (Santos & Santos, 2015). Both produced burglary reductions, in Trafford they went down 26.6% (as compared to the previous year) and in Port St. Lucie, there were 1.15 fewer burglaries as compared to the control group, respectively. Neither focused on measuring NR burglary patterns specifically, but both discussed that NR patterns were likely to underlie their burglary hot spots.

There have been very few studies specifically targeting repeat AND near repeat victimization. Two studies examined whether providing information regarding or tools to implement crime prevention measures would reduce near repeats. One was undertaken in the West Midlands region of the UK (Wellsmith & Birks, 2008). Repeat victims were contacted and asked whether they would like to participate in a program which was free to them. The program consisted of a visit by an agency representative who would provide crime prevention advice and take appropriate actions such as conducting a home security survey, property marking and, if necessary, the installation of target hardening measures such as door and window locks, peep holes etc. (Wellsmith & Birks, 2008). Due to limitations in the data they could only conclude the program had been a success as compared to the rest of the jurisdiction. Another study took place in the city of Birmingham, UK (S. D. Johnson et al., 2017) and used block randomization to allocate 23 neighborhoods to treatment and 23 to control. Each time a burglary occurred in a treatment neighborhood, the victimized home and the eight neighbors on either side were each given a target hardening pack. Treatment consisted of a graded response. Burglarized residences received a "gold" pack that included an LED light that simulated an active television, electronic timers for lights, door and window chimes (that emit an audible alert if the door or window is rattled), window stickers to suggest a dog lived at the address, crime prevention information, and details of neighborhood watch schemes in the area. The four closest neighbors received a "silver" pack. The contents of the "silver pack" were the same as the "gold" but without the LED units and stickers that looked like a guard dog. The next four neighbors received the "bronze" pack, which was everything in

the silver except the door chimes. This approach cost substantially less (about $20£ per home) than traditional target hardening schemes that provide door and window locks and other physical security enhancements. Results indicated a slight reduction in near repeat burglary and an increase in satisfaction with the police absent an increase in fear of crime.

The third study of near repeats focused on whether increasing police patrol would put police in a better position to make arrests and/or reduce near repeat victimizations (Elffers, Peeters, van der Kemp, Beijers, 2018). It was conducted in three neighborhoods in Amstelveen, The Netherlands with considerable burglary problems. During the three months of the Amstelveen Near Repeat Patrolling experiment, each time a burglary occurred in one of those neighborhoods a "near repeat patrol" was established. Each near repeat patrol was staffed by two officers, based out of a mobile command post, between 7am and 11pm who patrolled in a 250-meter (820 feet) radius around the burglary location. During their patrol, they informed residents of their increased risk and attempted to collect intelligence related to the burglary. They did not find a significant crime prevention effect. There were several possible reasons for this. In many instances, the follow-on burglaries occurred the same day as the originator and thus, police cannot respond quickly enough to prevent near repeat burglary from occurring. This issue is exacerbated when burglaries are not discovered on the same day they occur, and this results in even greater delays in deploying police resources. The authors concluded that the low base rate of burglaries coupled with a low number of observations meant their design was not powerful enough to detect anything other than a large effect. A large effect was not present.

1.2.5 Theoretical foundation for using notification as a treatment

Public safety tactics have long focused on engaging the community to be the eyes and ears of law enforcement. We need only look at modern initiatives like "If You See Something, Say Something,"[6] "Is That Your Bag?"[7] and WeTip[8] to see the effects this focus has had on policing tactics. These efforts have a conceptual link with businesses that attempt to engage members of the public in crowdsourcing, a process that involves outsourcing problem-solving to a distributed group of often anonymous people. Within the sphere of law enforcement, we can think of these efforts as attempting to engage the public in the co-production of public safety (Innes & Roberts, 2008), a crime prevention initiative that rests on a foundation of community policing by engaging local community residents. Insofar as notification raises residents' awareness of crime in their neighborhood, we expect some residents to take steps to prevent themselves from being victimized. The mechanisms by which this type of intervention may work can be placed within several different theoretical frameworks.

To the extent that these steps help to promote territorial control (Taylor, 1988) by asking residents to take responsibility over their own property or to take appropriate action when suspicious circumstances dictate, we may expect to see a crime reduction effect. The actions of residents may also increase collective efficacy, perhaps through the formation or joining of a neighborhood watch program. The ability of an individual to act in the interest of the collective good is dictated by "mutual trust and solidarity among neighbors" (Sampson, Raudenbush, & Earls, 1997, p. 919). Some evidence questions the effectiveness of neighborhood watch programs (Sherman, 1997; Sorensen, 2003), and we do not suggest that neighborhood watch programs represent a crime prevention panacea (Bennett, Holloway, & Farrington, 2009). However, the evidence also indicates that mobilizing a citizen watch that is focused in space and time and occurring after a specific incident may be effective at reducing crime (Sorensen, 2003).

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[6] "If You See Something, Say Something," is a Department of Homeland Security initiative.
[7] "Is That Your Bag?" is a Metro Transit Police Department, Washington, D.C. initiative.
[8] For more information on WeTip see (http://www.wetip.com)

Within a Routine Activities (Cohen & Felson, 1979) framework, the actions of residents would likely increase the level of capable guardianship in an area, thereby making it riskier for a criminal to commit a burglary. Residents may also engage in actions that make committing the crime more difficult. Target hardening strategies, such as securing doors and windows, may reduce the suitability of target neighborhoods. The delivery of the treatment may also increase capable guardianship and reduce the opportunity for criminal action. The proposed treatment was implemented by uniformed members of the respective police departments. Their presence during the delivery of the treatment may have influenced offenders and altered their understanding of the risk associated with committing crime in those locations, thereby altering the risk heterogeneity of the neighborhood (see Figure 1).

Based on the co-production, territoriality, and routine activities, the provision of crime prevention information to citizens by uniformed officers has several advantages. The crime prevention tactic is low cost. It leverages existing volunteer and auxiliary officers to administer treatment. While present in the treatment area, the officers increase formal guardianship and through their message they encourage neighbors to increase informal guardianship. When such interventions are designed to 'fit' as closely as possible with information-action flows within police departments, it can improve acceptance by agency personnel. Thus, there was little downside to beginning with a test of micro-level strategies to interrupt burglary near repeat patterns at the micro level using improved information flow.

Figure 1. Conceptual Model of Treatment-Outcome Mechanisms
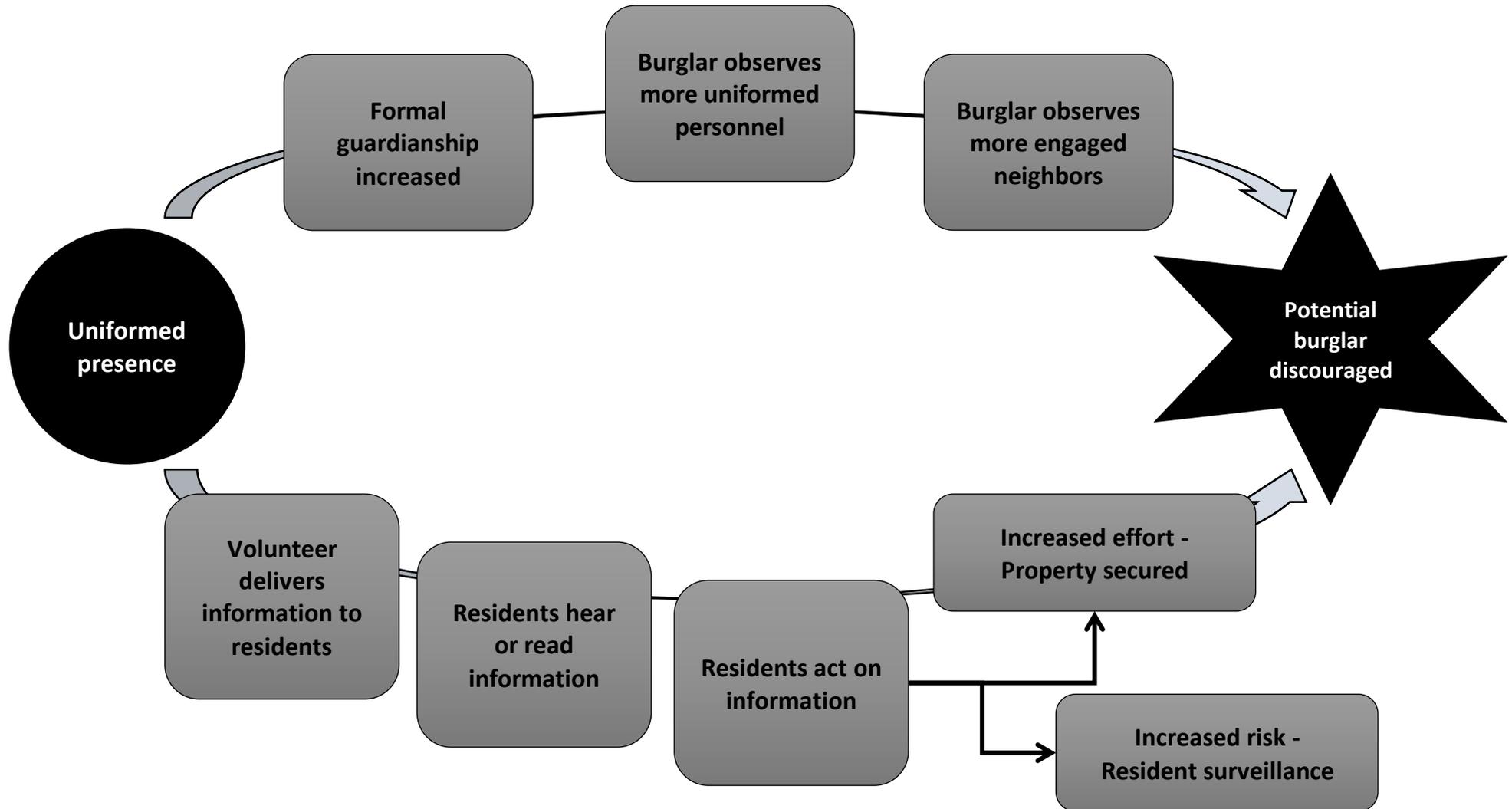
1.2.6   Gaps in what we know about preventing near repeat burglary

There is yet, much to be learned about how best to respond to near repeat burglary patterns. In particular, we need more studies that focus on near repeat burglary rather than solely on repeat victimization. There has only been one published evaluation of a crime prevention program that intentionally focused on near repeat burglary (S. D. Johnson et al., 2017). Repeat and near repeat burglary programs share many of the same tactics and thus, hold the same promise of ancillary benefits such as improving police-community relations, triggering the co-production of community safety envisioned by community policing, and targeting police resources to the places and times where they are needed the most. However, NR interventions target residents who have not yet been victimized and involve them in proactive activities that arguably may form the foundation for sustained community action. In this way, the potential reach of NR programs is broader.

It is unclear whether or to what extent the near repeat phenomena exists world-wide. The United Kingdom (UK) has led the charge and has demonstrated the potential of focusing on repeats and near repeats. It is time for other researchers and practitioners in other parts of the world to contribute also. While the vast majority of studies took place in the UK, some were conducted in Australia and only one program, focusing on RV, has been implemented in the United States context (Weisel et al., 1999).

Additionally, most studies have been conducted at the neighborhood level of analysis. There have been no studies conducted at the level of the individual, and micro level risk windows around burglary events. Most studies find significant near repeats about 1 block and 1 month or less. Yet previous research has concentrated on larger area units.

Existing research relies upon case studies and quasi-experimental designs to test whether interventions based on NR patterns are effective. With the exception of the recently published study by Johnson and colleagues (2017), no interventions have tested near repeat crime prevention using a randomized controlled field trial. **This research addresses the gaps identified by studying the problem of NR burglary in two very different US jurisdictions; creating units of analysis centered on originator residential burglaries; and using a randomized controlled field trial design.**

1.3   Methodology

This section describes the details of the randomized controlled field trial undertaken to test whether providing timely crime prevention information to neighbors of a residential burglary victim could interrupt the near repeat pattern. The study targets the delivery of crime prevention to the micro-level space-time window of significant risk rather than to an entire neighborhood. Four research questions guided the design (section 1.3.1) of the experiment that was implemented in two different jurisdictions (section 1.3.2). The first step was to identify the space-time window over which the risk of residential burglary was significant (section 1.3.3). The next step was to dynamically create near repeat high risk zones (NR-HRZs) around each burglary as they occurred (section 1.3.4). Custom designed software was written to randomly allocate the NR-HRZs to treatment or control (Section 1.3.5 describes the overall design of the randomized controlled experiment and section 1.3.6 the random assignment process). Details about the data used and the definition of the study areas within the jurisdictions appear in section 1.3.7. More information on the treatment is available in section 1.3.8. We also examined resident (section 1.3.9) and treatment provider (section 1.3.10) perceptions of the program. Section 1.3.11 describes operational differences between the sites and section 1.3.12 details overall weaknesses in the implementation of the experiment.

1.3.1   Research questions

Our four research questions were answered using several different methods, including a space-time analysis of near-repeat risk using the near-repeat calculator (Ratcliffe, 2007), a randomized controlled experiment involving the deployment of police resources, and surveys. The research questions were as follows:

RQ1: What is the spatial and temporal extent of near-repeat burglary in the jurisdictions?

RQ2: Does providing crime prevention material quickly after a burglary reduce the number of burglaries that occur in the near-repeat-high-risk zone over the near-repeat-high-risk period and beyond?

RQ3: What impact does notification of increased risk have on actions taken by residents and their perception of safety?

RQ4: What are the impacts of participating in the study on treatment providers?

RQ4a: How did treatment providers perceive the effectiveness of delivering crime prevention information?

RQ4b: What feedback did volunteers receive from residents with whom they interacted?

RQ4c: Did participation in the program increase satisfaction with volunteering?

1.3.2   Participating agencies

We created and implemented the burglary prevention strategy in partnership with the Baltimore County (MD) Police Department (BCoPD) and the Redlands (CA) Police Department (RPD). We selected those two agencies for three reasons. First, they each had a highly motivated volunteer or auxiliary police group. Volunteer and auxiliary police were used to deploy the crime prevention strategy primarily to keep the monetary investment in testing it low. We also hypothesized that volunteer and auxiliary officers might be more enthusiastic about interacting with residents than full time police officers juggling calls for service. Second, burglary data indicated that each had a statistically significant problem with near repeat burglaries over short space-time windows (as determined by the near repeat calculator. Third, the two cities were on opposite coasts, had very different crime rates overall and very different types of residential housing. These factors made them an interesting contrast.

The jurisdiction of Baltimore County, Maryland offers a variety of urban and suburban areas spread over 682 square miles. With a population of 805,029, it is part of the fourth largest urban area in the United States (US Census, 2010). As of 2010, the two largest racial groups were Whites at 64.6% and Blacks at 26.1%. Hispanics or Latinos of any racial category made up 4.2% of the population. In 2010, the median household income was $63,959. Baltimore County surrounds the city of Baltimore on three sides. The areas of the County that are adjacent to Baltimore City are more densely populated and have higher numbers of residential burglaries than those farther away from the boundary. Because of this residential burglary pattern, we designed the experiment with spatial edge effects in mind. Population density decreases quickly as distance from Baltimore increases. The BCoPD has an operating budget in excess of nearly $204 million and employs 1,918 full time sworn officers (2.31 officers per 1,000 population). BCoPD has been recognized by numerous agencies for its innovative approach to public safety. In 2010, BCoPD was the recipient of the Maryland Community Crime Prevention Institute Governor's Crime Prevention Award for outstanding proactive crime prevention programs.

In contrast, Redlands, California is a desert city about two hours east of Los Angeles, CA. There is a core downtown area that is surrounded by 36 square miles of predominantly suburban development. Most recent Census figures estimate the residential population at 68,747. As of 2010, the racial

breakdown of the population was 69.0% White, 7.6% Asian, 5.2% African American, 4.9% mixed race, and 13.3% identifying as other races. Hispanic or Latino of any race represented 30.3% of the population. The median household income for the City of Redlands was $67,651. Because of the smaller size and the relatively even population density, the entire jurisdiction was included. The RPD has an operating budget of over $19 million and employs 78 full time sworn officers (1.12 officers per 1,000 population). The RPD has gained a well-deserved reputation for innovative policing. As an agency, it has pursued technology, organizational change, community outreach, and has engaged research organizations to improve its delivery of service to the community and to reduce crime.

1.3.3   Identifying the space-time parameters of the near repeat pattern

We used the near-repeat calculator (NRC) (2007) with Manhattan distance selected to quantify the unique near-repeat burglary patterns for the study areas in Baltimore County and Redlands. We chose Manhattan distance because it more closely approximates street distance between an origin and a destination than does Euclidean distance (Chainey & Ratcliffe, 2005; Groff & McEwen, 2005). Measurement of Manhattan distance within the NRC "simply adds the difference between the x coordinates of two points to the difference between the y coordinates of two points. It is the same as travelling from point to point first horizontally and then vertically." (Ratcliffe, 2007, p. 9). We examined spatial bandwidths of 400 feet (122 meters) and temporal bandwidths of 7 days.[9] Results for both cities had a significant near-repeat pattern in residential burglary for 400 and 800 feet (122 and 244 meters) and 7 to 14 days.[10] In many American cities, 400 feet is approximately one city block.

The short time period of high risk meant it was essential to deliver the treatment to the areas as soon as possible after the burglary came to the attention of the police. Based on the output from the NRC we used 800 feet (244 meters) as our near repeat-high risk zone (NR-HRZ) size. We used an additional 400-foot (122 meters) distance as a buffer to monitor displacement.

1.3.4   Software to create actionable high-risk zones and track outcomes

A software company called Azavea[11] developed a computer program capable of tracking burglaries, identifying the near repeat-high risk zones and tracking outcome events. The Near Repeat-High Risk Zone (NR-HRZ) intervention tool was developed in R, an open-source software program. Because it is open source and free, we were able to install the NR-HRZ intervention tool at no cost to the agencies. Appendix B has more information on how to use the software. This software supported the randomized controlled experiment used to answer RQ2 (Figure 2).

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[9] Parameters used in NRC were as follows:
Iterations requested: 19
Spatial bandwidth: 400
Number of spatial bands: 5
Temporal bandwidth: 7
Number of temporal bands: 5
[10] Because of the differences in burglary volume we used 2013 residential burglary data in Baltimore County and January 2012-May 2014 residential burglary data in Redlands.
[11] For more information about Azavea see (https://www.azavea.com/).

Figure 2: Burglary Event Processing
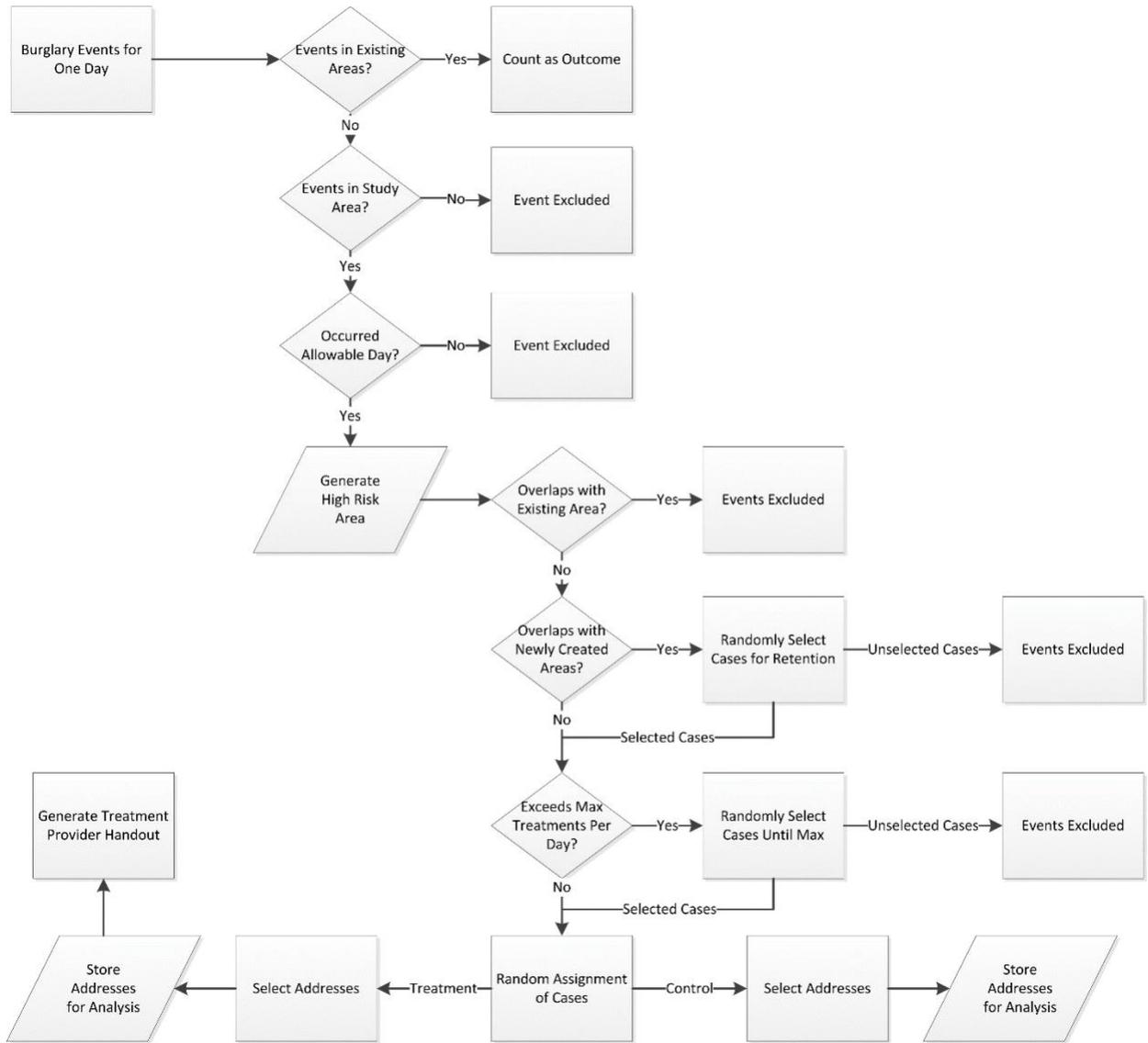
The development of a software utility allowed us to automate the creation of NR-HRZs, automate the allocation of NR-HRZ s to treatment or control, speed the delivery of treatment, and reliably track the outcome events. The NR-HRZs were 800 feet (244 meters) in size with an additional 400-foot (122 meters) distance as a buffer to monitor displacement. Both distances were measured along the street network (Figure 3). Each day, the tool examined the burglaries that had been reported the previous day. Each burglary was evaluated as follows:

1. Did it fall within an existing NR-HRZ? If yes, it was counted as an outcome.

2. Did it fall within the study area? If yes, it was evaluated further.

3. Could a NR-HRZ be created without overlapping an existing NR-HRZ? If no, it was discarded. If yes, it was held for random allocation. Figure 2 provides an example.

4. Could a NR-HRZ be created without overlapping a NR-HRZ created by another new burglary's NR-HRZ? (This question was important when there was more than one burglary the previous day.)

After all burglaries were evaluated, the software randomly assigned eligible burglaries and their NR-HRZs to treatment or control based on the trickle randomization scheme described previously. For the burglaries and associated NR-HRZs assigned to the treatment condition, the software generated a report that included a map and list of all the addresses to be treated. These addresses were then treated according to the process described in the following section.

Figure 3. NR-HRZ Illustration
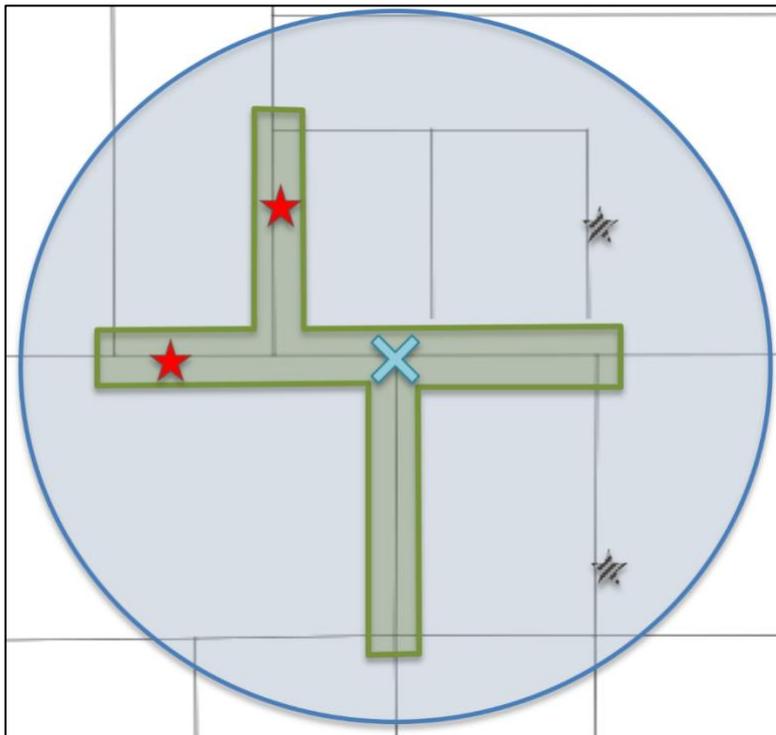
Note: The blue X was the burglary that generated the treatment area. With a network-based distance measure we could have counted two follow-on events (indicated with the red stars). Using a straight-line distance four outcome events would have been counted (two red stars and two grey stars).

1.3.5   Randomized controlled experimental design

The near repeat-high risk zone (NR-HRZ) intervention tool supported our use of a randomized controlled experiment to answer RQ2. The randomized controlled trial began on September 10, 2014 and ran until December 31, 2015. We tracked the burglaries in each jurisdiction over the period. As burglaries were reported, they were allocated to treatment or control conditions. Treatment NR-HRZs received a visit from uniformed police volunteers.

The NR-HRZs were the units of analysis in the study. Once designated, the NR-HRZs persisted for the duration of the experiment. That is, zones could only be treated once for the duration of the experiment. We did this to avoid increasing the fear of crime among residents that might result from repeated visits by police volunteers and to avoid contamination effects. Subsequent burglaries in the near-repeat-high-risk areas were tracked over the course of the experiment.

We assigned a total of 190 treatment NR-HRZs and 185 control NR-HRZs.[12] Baltimore County had 122-treatment and 120 control areas. Redlands had 68-treatment and 65 control areas. The lower number of sites in Redlands was due to its lower burglary incidence.

1.3.6   Random assignment

The design of this experiment presented a unique challenge because we could not identify the potential study participants in advance. Burglaries occurred daily and needed immediate evaluation and assignment to either treatment or control in order to allow time for them to be treated quickly. Accordingly, we used a computer-controlled trickle process randomization scheme (Braucht & Reichardt, 1993; Shadish, Cook, & Campbell, 2002). A Mersenne twister random number generator was used to generate a random sequence of 1,000 numbers. A flip of a coin decided that if the number was even, the burglary was assigned to treatment; if odd, to control. Using a computer to conduct the random assignment prevents interference from either practitioners or researchers (Braucht & Reichardt, 1993)

1.3.7   Study areas, dates and data

The study area represents the part of the jurisdiction from which burglaries were evaluated for inclusion in the study. We identified the study area for each jurisdiction based on its characteristics. In both jurisdictions we eliminated all housing units that were part of an apartment building. To create the study areas in Baltimore County and Redlands, we began with the county and city boundary respectively. The experimental study areas were defined to maximize homogeneity of population density and minimize spatial edge effects with adjacent jurisdictions. To reduce the variation in population density, we eliminated all housing units that were part of apartment buildings in both sites. Then, in Baltimore County only, we adjusted the study area to exclude the largely rural areas of the county. Senior Crime Analyst, Mike Leedy, identified the urban and suburban sections of Baltimore County (see Figure 4: Map of Baltimore County Study Area). Finally, in Baltimore County, we needed to address the boundary with the City of Baltimore. We could not provide the treatment in another jurisdiction, so we moved the study boundary inward by 800 feet (244 meters) to minimize edge effects by using an inverse buffer operation.[13] This ensured that none of the treatment or control addresses

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[12] An a-priori power analysis to compute required sample size was conducted with G*power 3.0 software (Faul, Erdfelder, Lang, & Buchner, 2007) using the given parameters: a one-tailed test an alpha of 0.05, power $(1 - \beta)$ of .080 returned a suggested sample size of 278 to detect a medium effect size (r = .3) and 156 to detect a large effect size (r = .4).

[13] This decision meant that burglaries occurring in the inverse buffer area were not considered for inclusion in the study as originators because their associated NR-HRZ would fall outside the study area. However, subsequent

would fall outside the BCoPD's jurisdiction. We did not use an internal buffer in Redlands because only 1.87% (374 out of 20,042 addresses) fell within 400 feet (122 meters) of the boundary.

The study relied on three different data sources to evaluate the crime prevention strategy. First, we used official crime data from each agency residential to establish the space-time near repeat pattern for each jurisdiction. The experiment used official crime data about residential burglaries in each jurisdiction over the period September 10, 2014, to December 31, 2015. [14] We also collected data on additional crime types that might plausibly been affected by the increased uniform presence in the high-risk zones. Second, we required the volunteers to collect and enter into an on-line data collection tool– this collated information about the number of treatments they administered, and any intelligence gathered. Third, we administered two surveys, one to the residents of the treatment high risk zones and the other to the treatment providers.

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burglaries that occur within a NR-HRZ that overlaps the inverse buffer area were counted as outcomes. This element of the design may have contributed to the low numbers of burglaries observed during the study period because the inverse buffer area has a relatively high rate of burglary.

[14] The intervention was originally scheduled to end after three to four months. However, the restrictions BCoPD placed on the number of treatments possible in one day reduced the rate of accrual for treatment and control sites and the experiment had to be extended multiple times. The research and practitioner teams agreed that when we reached the number of sites necessary to achieve the power to detect a large effect, we would end the experiment.

1.3.8   Description of the treatment

One of the key elements of this research was the use of volunteers to deliver the treatment in each site. In Baltimore County, volunteer Auxiliary Police Officers assist with crowd and traffic control as well as supplementing road and bike patrol. In Redlands, Citizen Volunteer Patrol officers assist with a wide range of duties from administrative to patrol. In both sites, volunteers wore uniforms (similar to but distinct from sworn agency personnel) and drove marked agency vehicles. For safety reasons, it was the policy of both agencies to deploy the volunteers as pairs as much as possible while conducting field operations.

It was essential to ensure consistency both in delivery and documentation of treatment and in the consistency of the crime prevention information. Accordingly, we held a 2-hour training session that covered the goals and logistics of the burglary intervention program at each site. The training alerted volunteers that their presence in the target areas served two purposes. The primary goal of these visits was to inform residents of their increased risk and provide them with actionable crime prevention information. Second, while fulfilling their primary mission, volunteers were also encouraged to ask questions related to the burglary and ask residents to assist the police in solving that case and in preventing further victimization. Each site tasked a supervisor (Lieutenant in Baltimore County; Sergeant in Redlands) to be the operational lead for the intervention. Additionally, in Baltimore County, we also had regular contact with both a Major and a Captain who stepped in when necessary to ensure adherence to the experimental design.

The treatment provided to each resident of a high-risk zone consisted of three components: 1) a notification of increased risk because a burglary had occurred nearby, 2) provision of crime prevention information, and 3) the offer of a security audit to identify specific steps a resident could take to make it less likely they would become a burglary victim. Upon assignment to the treatment condition, the output report from the NR- HRZ tool, which consisted of a map and a list of addresses (7. Appendix C), was sent to the volunteers. The uniformed volunteers attempted to contact a resident at each of the addresses. Residents who answered the door were informed that homes on their street were at significantly higher risk of being burglarized over the next week. They were also offered crime prevention tips and the opportunity to request a burglary prevention audit and receive a printed card with crime prevention suggestions. All agency volunteers followed a script when talking with the residents (8. Appendix D).[15] The script helped ensure consistency in basic information conveyed to residents.

Residents who did not answer the door had a hang card placed on the doorknob notifying them that a burglary had occurred within 400-feet/122 meters (i.e., 1 block) of their home and that they were at significantly higher risk of being burglarized over the next 4 days. The card suggested specific actions they could take (e.g., lock doors and windows) to safeguard their home. It also provided a number they could call to obtain a burglary prevention audit. This document contained Web links to other crime prevention resources. Taking advantage of contemporary technology, we incorporated Quick Response (QR) codes on the flyer that allowed individuals with smartphones to scan the code and quickly connect with Web content. Card/hang-tag text was in English on one side and in Spanish on the other (see 9. Appendix E for hang card text).[16] There were slight differences in the wording of the crime prevention

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[15] The authors are grateful to Spencer Chainey for sharing a script he created. The only changes to the script used here were to some of the wording to "Americanize" it for the United States context.

[16] Certified Spanish language translators at the Redlands Police Department translated the crime prevention materials.

materials provided to residents. The text was piloted to ensure it was easily understandable by a sample of residents in both cities.

In the case of residential burglaries, research suggests that law enforcement agencies can take steps to activate the local population in the co-production of public safety (Innes & Roberts, 2008). Given that risk is greatest immediately after a burglary and declines over time, preventive action should be implemented quickly (Kleemans, 2004). Accordingly, homes in the treatment group were supposed to receive notification of their higher risk level within 24 hours of when police became aware of the burglary.[17] The treatment combined in-person notification of increased risk with burglary prevention information and the physical presence of uniformed personnel and thus, represents a stronger dosage than other types of notification such as automated call back systems which will only include residents with land lines (estimated to be 75% or less, Blumberg & Luke, 2010). Consequently, if we did not find an effect with this treatment, it is unlikely we would have found one using weaker treatments.

Areas assigned to control received business-as-usual policing. No one in the police department was notified of their existence; therefore, it is highly unlikely that the control zones received any special attention.

1.3.9   *Understanding how the residents responded to the treatment*

The collection and analysis of differences in residential burglary data between the treatment and control areas and the near-repeat pattern during the intervention period provides critical information about the crime reduction effects of the program. However, using official crime data alone creates a treatment effect black box—a system where we can measure inputs (notification) and outputs (changes in burglary patterns) but have no knowledge of the intervening process. This is especially problematic because residents have a wide range of potential responses to the burglary notification. For example, residents may do something as simple as securing doors. Or they may do something much more intensive like forming or joining a neighborhood watch.

To address this issue, we created a survey of residents (10. Appendix F). The survey questions were designed by a team of researchers and some were loosely modeled after questions in a previous survey addressing fear of crime (Groff, Kearley, Beatty, Couture, & Wartell, 2005). Residents in the treatment areas were asked about experience with residential burglary, their actions in response to the notification and their perceptions about the intervention program and their local police department. We also asked basic demographic information such as race, gender, age, and income category. Importantly, the survey asked about whether the notification increased resident's fear of crime. Because we were primarily interested in the reaction to the notification and crime prevention information, we did not survey residents of control NR-HRZs since they would not have received a notification.

We originally anticipated surveying a sample of residents across five waves of surveys.[18] If no response to the survey was received within 1 month, a follow-up postcard was sent reminding them to

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[17] The exact time of a burglary is often unknown. For example, a resident may return home from a day at work and find that their home was burglarized. The reported time of the burglary may be 5 p.m. but the burglary occurred between the time the owner left in the morning and the time they returned. Techniques such as Ratcliffe's (2000) Aoristic Analysis have been used to address this issue in other contexts but are not appropriate here. Since this is a police intervention, the possibility of treatment can only begin once the agency has been made aware of the event. Thus, we use the time that the event is reported to the police as the benchmark for police action.

[18] A sample size calculator was used to estimate the number of respondents needed to provide robust estimates. With a 5% margin of error, 95% confidence interval, a population of 12,000, and a 50% response distribution, we estimate a sample size of 373. Assuming a response rate of 30%–50%, we expected to send out 686–1,244 surveys (Raosoft, 2012).

complete the survey. The survey identified the Police Foundation (not the police department) to reduce any pressure respondents might feel to answer positively. Responses could be submitted in hard copy or via a Web survey. Residents could respond in complete anonymity or provide their e-mail address to receive a $5.00 electronic Amazon gift card for completing the survey.[19] The first wave of the survey was sent to a random sample of addresses in the treatment zones (150 in Baltimore County and 65 in Redlands) two months after the survey began. Due to low response rates, we abandoned the sampling methodology and instead surveyed every address that was located in a treatment NR-HRZ. Five subsequent survey waves were conducted.

1.3.10 Understanding perceptions of the treatment delivery personnel

In an era when police agencies have fewer resources, volunteers are of increasing importance. The work conducted in Baltimore County and Redlands highlighted the positive effects that the intervention could have on the volunteer treatment providers. In our survey of these volunteers, most indicated that they believed the community reacted positively to their presence in the neighborhoods and they had a positive impact on the community's relationship with the department (11. Appendix G). Volunteers could respond in complete anonymity or provide their e-mail address and receive a $15.00 Amazon gift card for completing the survey. In both agencies, the volunteer coordinator supervisor sent an e-mail invitation to the volunteers encouraging their participation in the survey. Two reminder e-mails were sent a few weeks apart to encourage participation.

1.3.11 Operational site differences

There were several differences in the pre-treatment logistics for each site. These differences did not affect the treatment provided to NR-HRZs selected to participate in the experiment. However, they did impact which burglaries had the potential to be selected for participation in the study. Pre-treatment logistical steps were as follows: 1) evaluating burglaries for inclusion; 2) creating high risk zones; 3) tracking outcome burglaries; 4) allocating burglary originators to treatment or control; 5) generating a report; and 6) emailing the list of addresses and map to the volunteers for treatment within 24 hours. The NR_HRZ intervention tool created a report that included a map as well as a list of all the addresses to be visited.

There were three implementation differences between the two sites: 1) degree of automation; 2) continuity of treatment; and 3) availability of volunteer resources. The degree of automation varied dramatically between the two sites. In Redlands, a daily file package was generated that included the treatment zone maps (if any) and additional program files that would later be used in the analysis. This package was sent to one of the project investigators. The files were reviewed daily, generally within a few hours of generation, and if a treatment zone was present, the map was sent to the patrol commander and the sergeant in charge of the volunteer program. The sergeant would then ensure that the map was printed and available for volunteers.

In Baltimore County, before burglaries were inputted into the NR-HRZ intervention tool, a burglary crime analyst vetted each one. If there was already an arrest for the burglary suspect or if the burglary was related to a domestic issue, the burglary was excluded. Only the 'actionable' burglaries were manually loaded into the NR-HRZ intervention tool by the burglary crime analyst. The same crime analyst then sent an e-mail to the operations commander with the treatment report (i.e., the location of the treatment NR-HRZ). The operations commander had 2 hours to veto the treatment if other

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[19] The incentive was used to encourage a high response rate based on a sample of addresses that received the treatment. In a comprehensive meta-analysis, Edwards and colleagues (2009) found that a monetary incentive for survey completion more than doubled the odds of receiving a response.

operations going on in the area might be jeopardized by the presence of uniformed volunteers. A total of four treatments (3.3%) were canceled over the course of the experiment. These sites were analyzed as they were randomized. That is, since they were allocated to the treatment group, they were analyzed in the treatment group.[20] The only automated part of the process in Baltimore County was the steps handled by the NR-HRZIT (steps 1-5). On the positive side, burglaries evaluated by the NR-HRZIT in Baltimore County were restricted to only those that could have generated subsequent burglaries.

The continuity of treatment also differed between the two sites. Redlands was an active site each day of the week over the entire experimental period (i.e., the experiment ran 7 days a week over the entire study period). In Baltimore County, the crime analysts vetted burglaries, then ran those that were actionable through the Near Repeat-High Risk Intervention Tool (NR-HRZIT). Thus, on days when a crime analyst was not available to vet the burglaries (every Saturday and Sunday as well as holidays)[21], no burglaries were evaluated and no NR-HRZs created. This meant the experiment ran only Monday through Friday (addressing burglaries that were reported Sunday through Thursday). Additionally, Baltimore County suspended its intervention from November 21, 2014, until March 1, 2015, because of safety concerns over volunteers delivering the treatment after dark.

Finally, the agencies differed in their ability to commit resources. Redlands had fewer burglaries and more volunteers, so they committed to treat as many areas as were allocated. In Baltimore County, the volunteers had several areas of responsibility and they were only able to commit enough personnel to guarantee a maximum of one treatment per day. This meant that some burglaries that were eligible for participation in the experiment were not used. In Baltimore County, a total of 33 burglaries were not enrolled in the study because of limits on the ability to provide treatment.

1.3.12 Weaknesses in the implementation of the experimental design

The major weaknesses in the implementation of the experiment had to do with the burglaries that were evaluated for possible inclusion in the experiment. Events in both sites occurred over the course of the experiment that resulted in burglaries failing to be considered by the software program that should have been. In Redlands, the automated program failed to run for 27 days and 17 burglaries occurred on those days but were consequently not considered for inclusion as originators.

In Baltimore County, burglaries were excluded because of intentional design changes related to work flow and staffing constraints but there were also a few unexpected exclusion events. One workflow issue was that the crime analysts did not work on Saturday or Sunday. This meant that burglaries that were reported on Friday or Saturday were not considered for inclusion in the experiment. Another workflow issue involved the suspension of the experiment because early darkness that occurred between November and March interrupted the identification of near repeat patterns for a second time. During the first weeks of the restart, as with the first week of the study, burglaries that were actually follow-ons were counted as originators. Unexpected interruptions occurred on seven additional occasions because of holidays and one snow day when crime analysts did not work as well as one holiday during which auxiliary police were not available.

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[20] The reasons for canceling treatments included volunteer safety (reported house with Ebola in treatment area), jeopardy to an undercover operation (had a GPS on a suspect who was in that area, so they did not want uniformed people in the area; ongoing covert narcotic investigations) and having had an arrest already made on the burglary.

[21] Crime analysis was also closed on 6 days over the course of the experiment (10/17/2014 – Monday, 11/4/2017 – Tuesday, 3/5/2017 – Thursday (snow day), 5/25/2015 – Monday, 9/7/2015 – Monday, 10/12/2015 – Monday, 11/26/2015 - Thursday). In addition, the experiment did not run on 10/31/2014 (Halloween) because the auxiliary police were needed to keep order.

Finally, resource constraints in Baltimore County, limited the number of treatments that could be provided by auxiliary police to one per day. On days when more than two burglaries were reported to the police, only two could be used.[22] The burglaries were randomized and evaluated one-at-a-time to see if they qualified as potential originators for the study (i.e., they were not outcomes of an existing NR-HRZ and their own NR-HRZ, if created, would not overlap an existing zone). If so, they were randomized by the trickle process randomization. After a maximum of two burglaries were randomly assigned, any additional burglaries were not evaluated and never entered the study. To the extent these burglaries were originators of additional burglaries, the study would have undercounted the number of near repeats in the study area. To the extent the events did not have subsequent burglaries in a near repeat pattern, this issue had no effect on the outcome of the study.

In both sites, although we were able to manually add eligible burglaries that should have counted as outcome events prior to analysis of the experiment, we could not go back in time and use the potential originator burglaries that were missed. The potential issue arises when a burglary occurs on a missed day, since the program is unaware of that burglary any subsequent burglaries that are actually repeats might instead be counted as originators and spawn a NR-HRZ. If that 'follow-on identified as an originator' is not followed by additional repeat burglaries, it will appear as if that burglary was an isolated incident (not part of a near repeat pattern) when it actually was. By way of an example, Burg A is reported on Saturday and thus, is excluded from the study but on a follow-on burglary to Burg A is reported on Monday (Burg B) and becomes part of the study as an originator. Since we now are counting Burg B as if it is an originator, if no other burglaries occur within the space-time window, we think it was not part of a pattern, but it actually was. This would reduce the number of near repeat events captured by the study.

1.4   Data Analysis and Findings

The evaluation of whether swift citizen notification can reduce subsequent residential burglaries in NR-HRZs had four main components: 1) results of the randomized controlled experiment, 2) measures of treatment fidelity, 3) descriptions of the impact of treatment on citizen behavior, and 4) descriptions of the treatment providers' perceptions of the program.

Analysis of the burglary data collected during the randomized controlled experiment was conducted via an independent samples *t*-test for differences in the mean count of burglary in the areas surrounding events that were designated as originators. A buffer area surrounding the treatment areas was also analyzed to explore diffusion of benefits or displacement.

Several measurements were used to capture different dimensions of program fidelity, including the collection of data to describe specific components of the treatment delivery. To quantify how quickly the treatment was delivered, treatment providers logged the time they started the intervention and the time they finished. To quantify different dimensions of the treatment, providers documented the exact type of activity undertaken at each residence in the near-repeat-high-risk area (i.e., door tag left, conversation with resident and note card left, or safety audit performed).

A survey measured whether residents remembered receiving the treatment, how they perceived the treatment, and what, if any, action they took in response to the notification. Descriptive statistics were

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[22] If the first burglary in the daily file to qualify for the study was a control, then the next burglary would be considered. If the first burglary to qualify for the study was assigned to the treatment condition, then no other burglaries were considered. This step was taken to maintain the study balance between treatment and control sites.

used to quantify the effect of the notification and the materials on residents' actions taken and change in fear of burglary.

1.4.1   Treatment provision

Each time a burglary was assigned to treatment, a NR-HRZ treatment report was automatically generated and sent to the volunteers for treatment provision. After completing the treatment, the volunteers entered the data into an on-line tracking application (see 11. Appendix G). Using this data source, we verified that over 92% of the target zones in Baltimore County and 84% in Redlands received the treatment (Table 1). Treatments may have been delivered to NR-HRZs for which documentation was missing but in this section we only report data on the NR-HRZs for which data were submitted.

One aim of the treatment was to quickly provide the information about increased risk. The target goal was to provide treatment within 24 hours of the request made to the volunteers. The goal was met 91.8% of the time in Baltimore County (112 out of 122 treatments) and 79.4% of the time in Redlands (54 out of 68 treatments). The average time between the request for treatment and the provision of treatment was 1 day in Baltimore County and 2.6 days in Redlands.

Another aim of the treatment was to increase the amount of formal guardianship present in the NR-HRZ. The volunteer personnel conducting treatments were uniformed. Treatments involved two or more personnel about half of the time (49.2%, n=60) in Baltimore County and almost all the time in Redlands (95.6%, n=65). Baltimore County personnel spent over twice as much time on average in the treatment zones. This difference in average time spent per zone was likely due to the higher staffing and lower housing density in Redlands. Across both sites, the average amount of time spent in each NR-HRZ was 1 hour 16 minutes and uniformed agency representatives spent over 200 hours in NR-HRZs.

A final aim of this intervention was to gather intelligence from the community. Intelligence information included suspicious vehicles or people as well as any other information residents reported to the volunteers. This was more successful in Baltimore County where intelligence was gathered in 13.7% of the NR-HRZs than in Redlands (7.0%).

Table 1. Documentation of Treatment Provided

	Baltimore County	Redlands
Days between Tx area generation and intervention (min/max/mean)	0/2/1.04	0/12/2.64
Total amount of time in high risk zones	181 hrs. 50 min.	38 hrs. 15 min.
Average amount of time in high risk zones[3]	1 hr. 33 min.	41 min.
Total number of hang tags delivered	5,396	563
Number of conversations with residents	1,937	329
Percentage with documented treatment	93%[1]	84%[2]
Number with unresolvable date/time errors[3]	0	3

Notes:

1. In Baltimore County, 5 treatment zones did not have corresponding treatment provider forms and thus, were undocumented. Four additional sites were not treated because the operations commander decided they were too dangerous. Those events occurred on: 1) 10/17/2014 in District 9 (house with

Ebola in treatment area); 2) 10/29/2014 in District 6 (not treated because an arrest was already made on the burglary); 3) 3/17/2915 in District 6 (had a GPS on a suspect and the viable suspect was in that area so they did not want uniform people in the area); and 4) 8/7/2015 in District 12 (there were several covert narcotic investigations ongoing in the Berkshire neighborhoods on that day/time). Those 9 sites were analyzed as they were randomized. A total of 113 HRZs received documented treatment (92.6%).

2. In Redlands, 11 treatment provider forms were not submitted for their corresponding treatment zones.

3. A number of cases in both jurisdictions had incorrect values for date and time variables. In general, the issue arose from data entry inconsistencies (i.e., sometimes entering time in a 24-hour format and using a different format in the following fields). In most cases we were able to manually correct the values to produce accurate time values. In some cases, the data entry errors were not apparent, and no corrective action could be taken. Where the issue was not apparent we erred on the side of caution and removed them from the time estimates.

1.4.2   *Spatial distribution of treatment and control near repeat high risk zones*

We examined the spatial distribution of treatment and control NR-HRZs in each of the two sites. Baltimore County's 122 treatment and 120 control cases were distributed throughout the study area although there was evidence of clustering (Figure 4). The treatment NR-HRZs are blue and the controls are green. The smaller map in the left lower corner shows the extent of the entire study area. The larger map only includes the area in which at least one burglary occurred. The area where the legend is located is the City of Baltimore. The southeastern boundary of the County is adjacent to the Chesapeake Bay.

Figure 4. Treatment and Control Near-repeat High Risk Zones in Baltimore County, MD
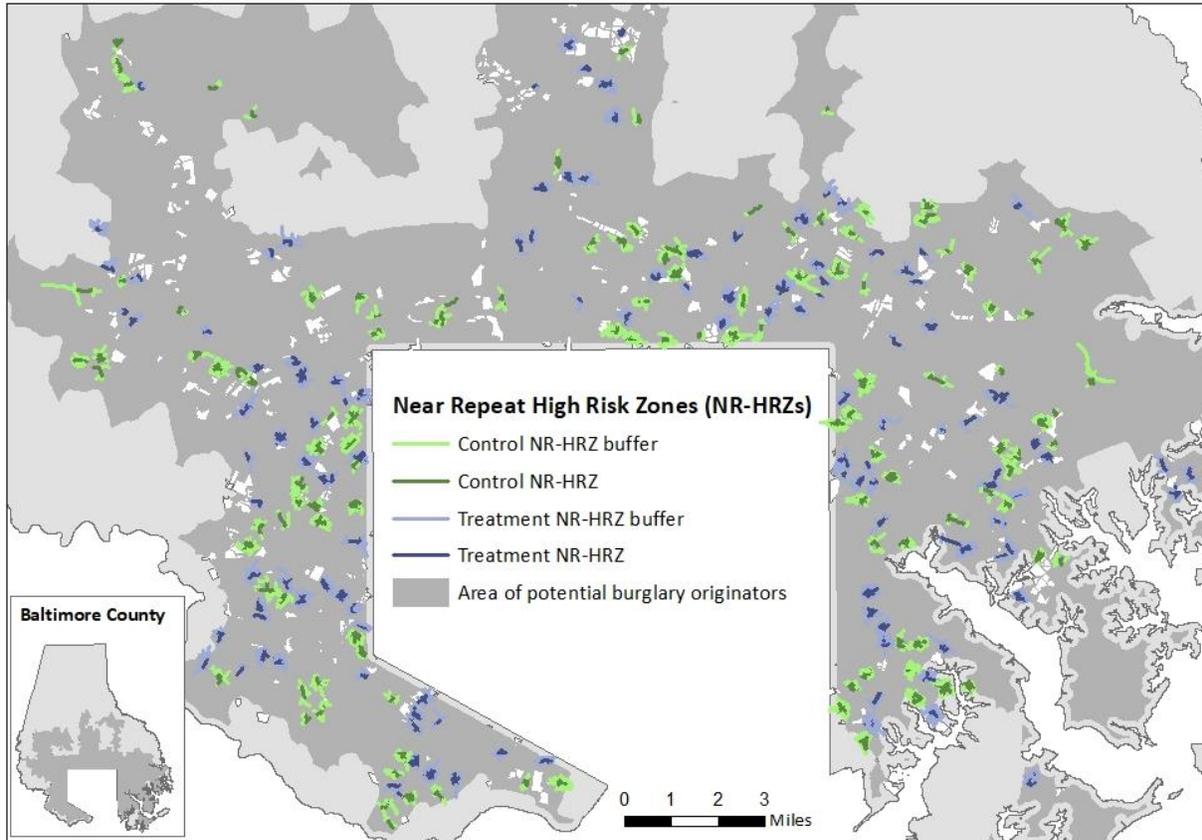
Figure 5 shows the distribution of 133 NR-HRZs Redlands, California (68 treatment and 65 control areas). Once again, the treatment NR-HRZs are blue and the controls are green. There is also some clustering of near repeat burglaries but generally they are dispersed across over two-thirds of the area in Redlands.

Figure 5. Treatment and Control Near-repeat High Risk Zones in Redlands, CA
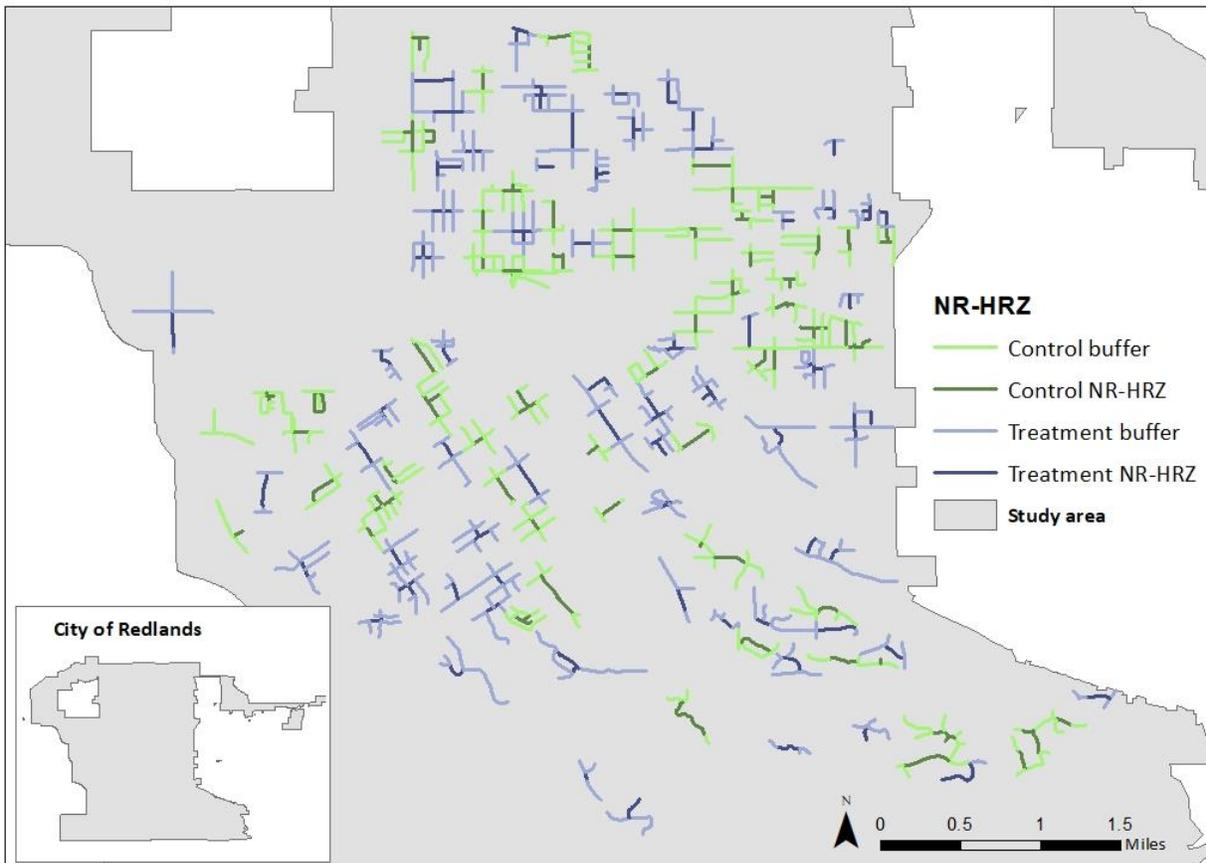
1.4.3   Effect of the treatment on near repeat burglary

Overall, the number of burglaries occurring after generation of the treatment and control areas was low in both sites (Table 2). In Baltimore County, only 7 follow-on burglaries occurred in the 120 control areas and only 1 occurred in the 122 treatment areas in the 2 weeks after the originator burglary. In Redlands, only 3 follow-on burglaries occurred in the 65 control areas and only 1 follow-on burglary occurred in the 68 treatment areas within 2 weeks of the originator burglary. The numbers of other property crimes in the treatment and control areas were also low.[23]

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[23] There were no significant differences between treatment and control areas for property crime either. Results available in 13. Appendix J.

Table 2. Burglary Counts in Baltimore County & Redlands

Response	Baltimore Co.		Redlands	
	N		**N**	
	NR-HRZ	**Buffer**	**NR-HRZ**	**Buffer**
Total burglaries during study period				
Number of follow-on burglaries[2]				
1 Week- Control	5	1	3	1
1 Week- Treatment	1	3	1	0
1-2 Weeks- Control	7	2	3	2
1-2 Weeks- Treatment	1	4	1	0
1-4 Weeks- Control	7	4	4	3
1-4 Weeks- Treatment	7	6	4	0
1-8 Weeks- Control	8	7	7	8
1-8 Weeks- Treatment	7	8	7	1
1-12 Weeks- Control	8	8	9	9
1-12 Weeks- Treatment	10	10	7	6
Number of follow-on other property crimes[1,2]				
1 Week- Control	5	10	0	6
1 Week- Treatment	7	7	2	2
1-2 Weeks- Control	11	18	1	9
1-2 Weeks- Treatment	14	15	4	8
1-4 Weeks- Control	31	34	6	14
1-4 Weeks- Treatment	40	37	9	17
1-8 Weeks- Control	53	61	10	25
1-8 Weeks- Treatment	62	62	14	32
1-12 Weeks- Control	73	85	15	37
1-12 Weeks- Treatment	84	87	24	44

Notes:
1. Follow-on burglaries were those that occurred in a treatment or control NR-HRZ or buffer area during the time period specified.
2. Property crimes included in analysis for Redlands and Baltimore County: all thefts including thefts from auto and vandalism.

We used *t*-tests to compare the crime counts in the treatment and control areas. Five time periods were considered: 1 week, 1–2 weeks, 1–4 weeks, 1–8 weeks, and 1–12 weeks. The temporal bands were overlapping (i.e., the 1- to 8-week band included weeks 1–4). To explore the potential for crime displacement, we conducted the same analysis for burglary events occurring in the buffer areas generated by the NR-HRZIT. Results in both Baltimore County and Redlands suggest that the treatment did not reduce burglary in the 4, 8, or 12 weeks after the intervention.

In Baltimore County the amount of burglary events after the treatment was lower in the 4- and 8-week buffers, but this difference was not large enough to be statistically significant (Table 3). The difference between treatment and control areas was most pronounced in the 1-2-week band where the results were significant at a slightly relaxed p-value (p=.08).

Table 3. Burglary Counts in Treatment/Control Areas—Baltimore County

		N	1 Week Mean (SD)	t (p)	1-2 Weeks Mean (SD)	t (p)	1–4 Weeks Mean (SD)	t (p)	1–8 Weeks Mean (SD)	t (p)	1–12 Weeks Mean (SD)	t (p)
NR-HRZ	Control	120	0.042 (0.272)	1.289	0.058 (0.298)	1.775	0.058 (0.298)	0.026	0.067 (0.310)	0.250	0.067 (0.310)	−0.371
	Treatment	122	0.008 (0.091)	(0.199)	0.008 (0.091)	(0.077)	0.057 (0.267)	(0.979)	0.057 (0.267)	(0.803)	0.082 (0.330)	(0.711)
Buffer	Control	120	0.008 (0.091)	-0.990	0.017 (0.129)	-0.804	0.033 (0.180)	−0.617	0.058 (0.235)	−0.233	0.083 (0.333)	−0.171
	Treatment	122	0.025 (0.156)	(0.323)	0.033 (0.179)	(0.422)	0.049 (0.217)	(0.538)	0.066 (0.249)	(0.816)	0.090 (0.288)	(0.864)

Results in Redlands were similar. Both NR-HRZs and buffer zones had lower burglary rates after the treatment than their control counterparts did. Follow-on events in the buffer zones were significant in the 1–8 week band and marginally significant in the 1-4 week band (Table 4)[24]. However, this finding is difficult to interpret as a diffusion of benefits since there were no significant burglary reductions in the treatment NR-HRZs as compared to the controls. In general, the potential for diffusion of benefits or its negative corollary, displacement of crime, are only considered if significant changes are seen in the intervention area. In this instance it is difficult to hypothesize why a crime reduction would be experienced in the buffer areas but not the target areas.

Table 4. Burglary Counts in Treatment/Control Areas—Redlands

		N	1 Week Mean (SD)	t (p)	1-2 Weeks Mean (SD)	t (p)	1–4 Weeks Mean (SD)	t (p)	1–8 Weeks Mean (SD)	t (p)	1–12 Weeks Mean (SD)	t (p)
NR-HRZ	Control	65	0.046 (0.276)	0.870	0.046 (0.276)	0.870	0.062 (0.300)	0.070	0.108 (0.359)	0.092	0.138 (0.390)	0.524
	Treatment	69	0.015 (0.120)	(0.386)	0.015 (0.120)	(0.386)	0.058 (0.291)	(0.944)	0.101 (0.425)	(0.927)	0.101 (0.425)	(0.601)
Buffer	Control	65	0.015 (0.124)	1.031	.0307 (0.124)	1.469	0.046 (0.211)	1.835	0.123 (0.415)	2.083	0.138 (0.429)	0.825
	Treatment	69	0.0 (0.0)	(0.305)	0.0 (0.0)	(0.144)	0.000 (0.000)	(0.072)	0.014 (0.120)	(0.039)	0.087 (0.283)	(0.411)

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[24] Given the large number of events with zero events in the 1, 1-2, 1-4, 1-8, and 1-12 week follow-on period, it is reasonable to question if the data meet the normality assumption that underlies t-tests. We explored these data further by re-specifying models into binary outcomes where 0 = no follow-on events during that temporal band and 1 = one or more follow-on events in that temporal band. Logistic regression models were used to predict this binary outcome; the only predictor in the model was a dichotomous variable for treatment or control condition. Results did not differ greatly from the t-tests presented in Tables 3 and 4. In Baltimore County, the marginally significant difference in the NR-HRZ for the 1-2 week time period was slightly more marginal (p=.08 versus p=.13). In Redlands, the 1-4 week buffer area model could not be fitted because all treatment buffers had zero follow-on events. In the Redlands buffer area for the 1-8 week temporal band, the p-value was reduced slightly (from .04 to .08).

1.4.4   Resident survey findings

Although we provided an incentive and followed up after the initial contact, the response rates for the survey of resident perceptions were low. We sent out five waves of citizen survey postcards over the course of the study period. Residents received the survey approximately two months after treatment. We sent a reminder for each wave. For the first wave, we took a random sample of all addresses that were treated. After an extremely low response rate to the first wave, we instead sent surveys to 100% of the addresses for the remainder of the study. We sampled a total of 6,100 residents in Baltimore County and 899 in Redlands. This strategy improved our number of responses although the response rate remained low (5.57% in Baltimore County and 7.23% in Redlands). The majority of residents who responded also claimed the incentive, 87.4% in Baltimore County and 69.23% in Redlands.

To begin, we asked about the existing level of burglary victimization in target areas and the likelihood that a respondent would report a burglary (Table 5). A much higher percentage of respondents in Redlands (36.9%) then in Baltimore County (18.9%) had been a victim of residential burglary at their current address. Additionally, a greater proportion of Redlands residents were victimized in the last six months (45.9%) than in Baltimore County (35.4%). In contrast, a greater percentage of Baltimore County residents reported their victimization occurred over a year ago (56.9%) as compared to Redlands respondents (25%) (Table 6). In line with expectations, more respondents who were past victims of a burglary reported being frequently or always worried about being victimized (45%) than respondents who were not past victims (17%). Additionally, almost three fourths of respondents in each site reported the burglary to the police (Table 5).

Table 5. *Have you ever been the victim of a residential burglary at your current address*?

Response	Overall		Baltimore Co.		Redlands	
	N	%	N	%	N	%
Have you ever been the victim of a residential burglary at your current address						
No	325	78.3	284	81.1	41	63.1
Yes	90	21.7	66	18.9	24	36.9
Total	415		350		65	
Did you report this burglary to the police?						
Yes	69	76.7	52	78.9	17	70.8
No	16	21.1	13	19.7	6	25.0
Don't remember	2	2.2	1	1.5	1	4.2
Total	415		350		65	

Table 6. *When did the burglary occur? (If you have been burglarized more than once, please think back to the most recent occurrence)*

Response	Overall		Baltimore Co.		Redlands	
	N	%	N	%	N	%
Less than a month ago	3	3.4	2	3.1	1	4.2
1 – 3 months ago	17	19.1	11	16.9	6	25.0
4 – 6 months ago	14	15.7	10	15.4	4	16.7
7 – 9 months ago	5	5.6	1	1.5	4	16.7
10 – 12 months ago	7	7.9	4	6.2	3	12.5
More than 1 year ago	43	48.3	37	56.9	6	25.0
Missing	1	1.1	1	1.5	0	0.0
Total	89		65		24	

Previous research has not been able to connect the provision of information to residents to what they do with it. In order to measure what actions were taken by residents, we first had to quantify whether the respondent remembered receiving the treatment. A majority of respondents (56%) did not remember receiving a notification that their home was at higher risk for residential burglary. Respondents in Redlands were slightly less likely to remember the treatment (60% did not) than respondents in Baltimore County (55.5%). Across both sites, of the respondents who remembered the treatment, 39% of said they were home and 8% said someone else in the household was home when the notification was delivered (Table 7). This is a plausible result considering that anyone in the household might have talked with the volunteer officers or discovered the hangtag, not necessarily the survey respondent. One encouraging result is that among the respondents who were home at the time of treatment delivery (*n* = 71), 76% conversed with the uniformed representative (*n* = 54). The fact that over three-quarters of residents answered the door to a uniformed representative of the police department demonstrates a general openness to talking with uniformed representatives of the police department.

Table 7. *In the last six (6) months, have you received a notification, via a door hangtag or a visit from a uniformed representative of the [AGENCY], stating that your home was at higher risk for residential burglary?*

Response	Overall		Baltimore Co.		Redlands	
	N	%	N	%	N	%
No	227	55.5	188	54.7	39	60.0
Yes	182	44.5	156	45.4	26	40.0
Was not home	97	53.3	81	51.9	16	61.5
Was not home, but another member of the household was home	14	7.7	9	5.8	5	19.2
Was home and spoke with the agency representative	54	29.7	50	32.1	4	15.4
Was home but did not speak with the agency representative	17	9.3	16	10.3	1	3.9
Total	409		344		65	

Historically, organizations have avoided notifying the public about risk of crime because they thought it would increase citizen's fear of crime. Respondents were asked whether the notification increased fear of crime and the answer was an overwhelming no. In Baltimore County, 86% felt about the same or less concern about burglary and in Redlands it was even higher, 88.5% (Table 8). This is consistent with a recent study in the UK that found residents could be informed of burglary prevention strategies without increasing their fear of victimization (S. D. Johnson et al., 2017).

Table 8. *Did your perceptions of burglary in your neighborhood change as a result of the notification?*

Response	Overall		Baltimore Co.		Redlands	
	N	%	N	%	N	%
Less	94	52.5	79	51.6	15	57.7
About the same	60	33.5	52	34.0	8	30.8
More	25	14.0	22	14.4	3	11.5
Total	179		153		26	

Another important facet of resident perceptions involved what actions the resident took after receiving the notification and whether it affected their perception of safety. The largest numbers of actions taken by respondents (*n* = 173) included 1) being more vigilant about locking doors/windows 82% (139); 2) being more likely to watch out for neighbors—71% (n=123); 3) being more likely to report a burglary to the police—42% (n=72), and 4) installing better exterior lighting—21% (n=36) (Table 9). If respondents reported taking any action, on average they took 2.9 actions in response to the notification. Redlands residents reported taking more actions (3.7 versus 2.8) than their Baltimore County counterparts.

Table 9. *Having received this notice/alert...*

Response	Overall		Baltimore Co.		Redlands	
	N	%	N	%	N	%
More vigilant about locking doors/windows	139	80	122	81	17	74
Was more likely to watch out for my neighbors	123	71	104	69	19	83
More likely to report a burglary to the police	72	42	63	42	9	39
Installed better exterior lighting	36	21	29	19	7	30
Visited www.crimemapping.com to learn about	26	15	18	12	8	35
Trimmed trees and hedges away from windows	24	14	20	13	4	17
Installed physical security devices	21	12	17	11	4	17
Installed a burglar alarm	17	10	12	8	5	22
Other	17	10	14	9	3	13
Visited the [AGENCY'S] website to learn about steps I could take to prevent crime	13	8	8	5	5	22
Signed up for email alerts about crime in my neighborhood	9	5	5	3	4	17
Formed or joined a neighborhood watch program	5	3	5	3	0	0
N unique respondents that took at least on action	173		150		23	
Average N actions taken (if any action was taken)	2.90		2.78		3.70	

Note: Question was "select all that apply". Percentages based on the number of respondents that selected at least one answer for this question; will not sum to 100. Table sorted by frequency of response (overall).

We also asked what kept the respondent from taking action following the notification (Table 10). The two most frequently offered reasons for why a respondent did not take action in response to the notification were that the suggested crime prevention actions were "Already in place" (61%; n = 70) and that they felt there was a "Low risk of victimization" (20%; n = 23). Responses showed some variation by income. A greater percentage (19%) of higher-income respondents reported they did not take action because the crime prevention improvements were already done than did middle- (11%) or low-income (13%) respondents. Most respondents across both sites provided only a single explanation for their lack of action.

Table 10*. If you received a notification and did not change your behavior or act on any of the burglary prevention suggestions, what kept you from doing so? Check all that apply.*

Response	Overall		Baltimore Co.		Redlands	
	N	**%**	**N**	**%**	**N**	**%**
Already in place	70	60.9	57	59.4	13	68.4
Low risk of victimization	23	20.0	20	20.8	3	15.8
Other	11	9.6	10	10.4	1	5.3
Did not want to spend money	9	7.8	9	9.4	0	0.0
Time constraints	8	7.0	5	5.2	3	15.8
Not effective	5	4.3	4	4.2	1	5.3
Lack authority	4	3.5	4	4.2	0	0.0
N unique respondents that provided at least one explanation	115		96		19	
Average N explanations (if at least one was given)	1.1		1.1		1.1	

Note: Question was "select all that apply". Percentages based on the number of respondents that selected at least one answer for this question; will not sum to 100. Table sorted by frequency of response (overall).

Finally, we asked about whether respondents knew about the burglary that sparked the intervention and whether the notifications increased their fear of crime. A greater proportion of respondents in Baltimore County (65%) knew about the burglary before notification than in Redlands (46%) (Table 11).

Table 11. *Prior to the notification, did you know that a neighbor had been burglarized?*

Response	Overall		Baltimore Co.		Redlands	
	N	**%**	**N**	**%**	**N**	**%**
Yes	114	62.6	102	65.4	12	46.2
No	65	35.7	52	33.3	13	50.0
Do not recall	3	1.7	2	1.3	1	3.9
Total	182		156		26	

The most common source of information about the burglary was from the victim or another neighbor (63% of Baltimore; 54% of Redlands) (Table 12). This indicates that informal neighbor networks exist and might be leveraged to improve the contribution of residents to neighborhood crime prevention. There were differences between the sites, however, with respondents in Redlands reporting higher rates of getting information from crime alerts and on-line sources than those in Baltimore County.

Table 12. *How did you learn about the burglary?*

Response	Overall		Baltimore Co.		Redlands	
	N	**%**	**N**	**%**	**N**	**%**
From other neighbor	27	41.5	24	46.2	3	23.1
From burglary victim	14	21.5	10	19.2	4	30.8
From officer or agency representative	7	10.8	7	13.5	0	0
Other	7	10.8	5	9.6	2	15.4
From online news	5	7.7	3	5.8	2	15.4
From crime alert service	3	4.6	1	1.9	2	15.4
From print news	2	3.1	2	3.9	0	0
Total	65		52		13	

Additionally, the vast majority of survey respondents indicated that if they were the victim of a burglary they would be likely or very likely to report it to the police (91.5% in Baltimore County and 93.9% in Redlands) and that most respondents would report suspicious activity occurring in their neighborhood (87.6% in Baltimore County and 83% in Redlands) (Table 13).

Table 13. *Reporting to the police…*

Response	Overall		Baltimore Co.		Redlands	
	N	**%**	**N**	**%**	**N**	**%**
How likely are you to report suspicious activity in your neighborhood to the police?						
Very unlikely	26	6.3	22	6.4	4	6.2
Unlikely	8	2.0	5	1.5	3	4.6
Neutral	19	4.6	16	4.6	3	4.6
Likely	85	20.7	71	20.6	14	21.5
Very likely	271	66.1	231	67.0	40	61.5
Undecided	1	.2	0	0	1	1.5
Total	181		155		26	
If you were the victim of a residential burglary, how likely would you be to report it to the police?						
Very unlikely	27	6.6	27	7.9	0	0
Unlikely	1	.3	0	0	1	1.5
Neutral	3	.7	1	.3	2	3.1
Likely	15	3.7	9	2.6	6	9.2
Very likely	360	88.2	305	88.9	55	84.6
Undecided	2	.5	1	.3	1	1.5
Total	408		343		65	

Respondents reported positive perceptions of the program with more than 82% stating they agreed or strongly agreed that the notification made them feel that the agency was being proactive in

preventing burglary (82% Baltimore County; 85% Redlands) (Table 14). An amazing 100% of respondents (N overall = 181; N Baltimore County = 155; N Redlands = 26) in both Baltimore County and Redlands would recommend that the agency continue this program.

Table 14. *To what extent do you agree or disagree with the following statement: "The notification made me feel that the [AGENCY] was being proactive in preventing burglary."*

Response	Overall		Baltimore Co.		Redlands	
	N	%	N	%	N	%
Strongly agree	52	28.7	47	30.3	5	19.2
Agree	97	53.6	80	51.6	17	65.4
Neither agree nor disagree	17	9.4	14	9.0	3	11.5
Disagree	7	3.9	7	4.5	0	0
Strongly disagree	5	2.8	5	3.2	0	0
No opinion	3	1.7	2	1.3	1	3.9
Total	181		155		26	

1.4.5   Treatment provider perceptions of the intervention

The findings of the treatment provider survey shed light on their perceptions about the effectiveness of the intervention and how participating in the intervention altered how they felt about their role within the police department. The department liaison to the volunteers distributed the on-line survey URL to all volunteers and sworn police officers who participated in the burglary intervention program (Baltimore County = 55, N Redlands = 76). The response rate for the survey was 31.3% (n = 41). Because of the relatively low numbers of respondents, we report only overall findings.

According to the treatment providers, the feedback from residents was encouraging, 95% thought the community responded positively to the program. One open-ended response captured the overall sentiment especially well:

> *Overall, I received very positive feedback from members of the community whose only previous interactions with the department were quite possibly negative or non-existent. There seemed to be a great appreciation of our efforts to not only educate the community on current trends, but also simply to engage residents in a community policing style, rather than only interacting during enforcement actions. I was humbled by the number of "thank you's" that I received or simply words of support for police officers overall.*

The response of the community to the intervention bodes well for efforts to co-produce public safety and have a positive impact on citizen perceptions of police legitimacy.

The treatment providers also perceived the effectiveness of the program positively. They thought the program was especially successful in terms of increasing uniformed presence in the community. But they also recognized the value of the program for stimulating a partnership with the community. Treatment providers were asked to identify what they perceived to be the goals of the program and then asked to report how successful they though the program was at achieving those goals. The treatment provider respondents thought the program was successful at engaging the community in crime prevention (96.8%) and at educating the community on burglary prevention (91.4%) as well as having a positive impact on police-community relations (89.5%), among those that believed those were the goals of the program (Table 15).

Table 15. Perceptions of Treatment Providers

Response	Overall	
	N	**%**
Engaging community in crime prevention		
Successful	15	39.5
Somewhat successful	16	42.1
Somewhat unsuccessful	1	2.6
Unsuccessful	0	0
Total	32	100%
Educating the community on burglary prevention		
Successful	14	36.8
Somewhat successful	18	47.4
Somewhat unsuccessful	1	2.6
Unsuccessful	35	100
Total		
Had a positive impact on police-community relations		
Strongly agree	15	39.5
Agree	19	50.0
Undecided	4	10.5
Disagree	0	0
Strongly disagree	0	0
Total	38	1

Given the apparently strong belief that the program was meeting its goals, it was surprising that just less than half of respondents (47.7%) thought the department should continue the program. There appeared to be a good deal of uncertainty; nearly 40% responded that they were undecided on recommending the program continue (Table 16).

Table 16. Treatment Provider Recommendations to Continue Program

Response	Overall	
	N	**%**
Strongly agree	10	26.3
Agree	8	21.1
Undecided	14	36.8
Disagree	3	7.9
Strongly disagree	2	5.3
Missing	1	2.6
Total	38	100.0

Additionally, we asked the respondents how participating in the burglary reduction program had affected their satisfaction with their volunteer experience. Respondents indicated that participating in the program made them feel that they were an important part of the department's crime prevention strategy (79%) and that they had meaningful impact on preventing burglary (58%). Participation in the program was viewed positively. A majority (58%) said it would make them more likely to volunteer in the future and 68% reported that this program improved their volunteer experience (Table 17).

Table 17. Effect of Program on Treatment Provider

Response	Overall	
	N	**%**
Felt they were an important part of department's crime prevention strategy		
Strongly agree	6	15.8
Agree	24	63.2
Undecided	2	5.3
Disagree	4	10.5
Strongly disagree	2	5.3
Missing	0	0
Total	38	100.0
Believed they had meaningful impact on preventing burglary		
Strongly agree	9	23.7
Agree	13	34.2
Undecided	15	39.5
Disagree	1	2.6
Strongly disagree	0	0
Missing	0	0
Total	38	100.0
Made them more likely to volunteer in the future		
Strongly agree	7	18.4
Agree	15	39.5
Undecided	9	23.7
Disagree	5	13.2
Strongly disagree	2	5.3
Missing	0	0
Total	38	100.0
Participation in program improved their volunteer experience		
Strongly agree	8	21.1
Agree	18	47.4
Undecided	7	18.4
Disagree	3	7.9
Strongly disagree	2	5.3
Missing	0	0
Total	38	100.0

1.4.6 Findings summary

Analyses between treatment and control zones in Baltimore County and Redlands found little differences between the two groups on residential burglary outcome. It appears that the quick intervention of the agencies was not sufficient to reduce follow-up burglary. In general, the amount of follow-up burglary in the treatment areas was lower than in the control areas. However, the count was low, so our ability to identify statistical differences was reduced.

The results of the community survey suggest that the treatment only reached a relatively small proportion of all the people who lived in the NR-HRZs. However, of the individuals who did remember the treatment (and responded to the survey), the most frequent actions taken were of relatively low cost and low effort. A positive finding was that relatively few respondents reported that they perceived

more burglary after notification, suggesting that the treatment should not increase fear of crime. In both sites, 100% of respondents said that the agency should continue treatment.

The treatment provider survey found that the program was effective at increasing the level of engagement between the volunteers and the agency. Most of the treatment providers indicated that their participation in the program had a positive impact on the community. The program appeared successful in engaging citizen volunteers and increasing the positive effects of their volunteer work.

1.5   Discussion of Experiment

This study translated a strong research finding into an actionable crime prevention program and tested it in two police departments. Strong evidence exists that when one burglary occurs, other homes on the same street and adjacent streets are at immediate risk of victimization. We used a randomized controlled experimental design to test whether the provision of information to nearby residents could interrupt the near repeat pattern from developing in the high-risk space-time window. Most previous studies examining burglaries were conducted in the UK or Australia and focused on specific housing estates or larger areas. We extended previous knowledge by conducting our study in the United States and by focusing on the high-risk space-time window for the intervention.

Our main research question investigated whether providing crime prevention material quickly after a burglary reduced the number of burglaries that occur in the near repeat high risk zone (NR-HRZ) over the high-risk period. The results of the experiment indicated there were no significant differences in residential burglary counts between treatment and control sites. To explore this finding further, we first examine salient characteristics of micro-level burglary patterns through the lens of implementing the crime prevention program. Then we discuss the resident and treatment provider perceptions of the intervention. Finally, we explore implications for practitioners and future research.

1.5.1   Explanations for lack of significant effect

There are a number of potential explanations for our finding that notifying neighbors did not significantly reduce subsequent burglaries in the treatment NR-HRZs. Six potential explanations are worth discussing: (1) delay in discovering, reporting, and responding to burglary; (2) low numbers of burglaries at micro places; (3) differences in measuring risk versus measuring outcomes, (4) permanency of the treatment/control areas, (5) unintended consequences of community notifications, and (6) treatment dosage.

Delays in discovery, reporting, and responding - One explanation for the finding has to do with the delay in the provision of treatment. The delay may have allowed a near repeat pattern to emerge which increased the number of burglaries in the treatment sites and resulted in similar numbers of burglaries to the control sites. Responding to the treatment areas in a timely manner proved more challenging than originally anticipated. Two challenges were experienced. First, there may be a limit to how quickly police can respond to time span crimes such as residential burglary where the burglary may not be discovered for hours, days or weeks. This line of reasoning suggests that using near repeat high risk windows may be more effective on person crimes such as robbery and aggravated assaults like shootings where the time of victimization is generally known and typically reported quickly after the crime occurs. Second, the use of volunteers as treatment providers was done with the intention of developing a law enforcement-based response to crime that minimized the need to divert efforts of sworn officers. Treatment logs from Redlands suggested that deployment of treatments was often difficult to arrange in a timely manner.

Low event counts at micro places - There are several potential explanations for the low numbers in both treatment and control zones. Two of them relate to the translation of a research finding to a crime

prevention program. One has to do with the number of burglaries that are preventable and the other with the calculation of the strength of the near repeat pattern. Identifying preventable burglaries is required for developing an appropriate evaluation of a prevention program. Specifically, the efficacy of a program should be evaluated based on its impact on future events. In terms of burglary prevention, the only preventable burglaries are those that have not yet occurred at the time of program deployment. In other words, the effectiveness of a burglary prevention program should be evaluated based only on those burglaries that might be prevented by police action. But in order to take action, police had to be aware the originator burglary had occurred. Thus, for this evaluation, burglaries that occurred on the same day as the originator burglary were not included since police could not have prevented them. Also excluded were burglaries for which an arrest was made the same day as the report since that burglary was unlikely to spawn a near repeat pattern. In these ways, the focus on preventable burglaries significantly reduced the number of burglary events that 'counted' toward the total number of near repeat burglaries occurring over the study period.

Risk versus outcomes - A related explanation for the low observed rate of near repeats lies in the differences between the calculation of space-time interaction in epidemiological statistics and the evaluation of an intervention. Epidemiological techniques such as the Knox-Mantel test evaluate each pair of events in a distribution based on their distance from one another in space and in time. In its simplest form, event pairs are allocated to one of four cells in a matrix: 1) close in space and time, 2) close in space but not close in time, 3) not close in space but close in time and 4) not close in space or time (see Chapter 9 in Levine, 2015 for a clear explanation). Each event is paired with every other event so that they 'count' more than once. However, when evaluating an intervention, the goal is to figure out whether a treatment provided to a target zone reduces subsequent crimes. The treatment zone is anchored by the location of the originator and only events that occur after an originator but still within the space-time window are 'counted' as near repeat events. So here again, restricting the burglaries that are counted in the evaluation to only those which are preventable events reduces the numbers of events that can contribute to the count of outcomes.

Permanency of treatment areas - A fourth possible explanation for the low observed counts stems from a methodological decision regarding the structure of the experiment. Namely, treatment and control areas persisted over the course of the experiment as did the buffers around them. This kept the treatment and control sites 'pure' and prevented residents from receiving multiple visits as new burglaries occurred near them. The design decision achieved both goals. However, the decision had follow-on implications. First, the time window of risk is fairly short so 'freezing' each zone and not allowing new repeat burglary patterns to develop there meant that we began to run out of area in the sites for the creation of new high-risk zones that did not overlap existing ones. Second, it meant that new burglaries that might have spawned additional near repeat patterns were not considered in the evaluation because they would overlap existing areas. This tension between implementation and evaluation concerns is present in all field research but was especially salient here. Given the temporally transient nature of near repeat risk, the permanency applied to the treatment and control areas was warranted methodologically but perhaps not theoretically. This characteristic of our research design, a strength or weakness depending on how you view it, optimized the defensibility of our units of analysis but hindered the statistical power and slowed progress of treatment/control allocation. This design is also unlikely to be how an agency would actually implement this kind of program outside of a research setting. In recognition of this concern, a revised version of the near repeat tool was developed that allows areas to return back to the treatment eligibility pool after a user defined period of time. Future implementation of this type of intervention should consider the practical and statistical impacts of allowing retreatment.

Unintended consequences[25]- A key goal of the intervention was to engage the community in the co-production of public safety. As a result, it would be reasonable to hypothesize that residents may be more likely to report victimization to the police. If this were true, then we may see higher levels of burglary reporting in treatment areas compared to control areas. This could result in the appearance of null findings when actual burglary levels had decreased.

Treatment dosage- We hypothesized that the intervention could potentially reduce residential burglary through a number of levers. One of those levers was an increase in uniformed police presence. We did achieve a significant increase in uniformed presence in over two-thirds of the treatment zones. Unlike hot spots policing experiments, however, volunteers conducted only a single visit (Telep, Mitchell, & Weisburd, 2014). It could be that more visits are necessary to achieve a crime prevention benefit. It is also unknown if volunteer presence, even in uniform, provides the same protective effect of police officers in this context.

1.5.2   Resident perceptions of and responses to the notification

We hypothesized that the act of communicating increased risk of burglary and providing concrete strategies for preventing it from occurring would reduce crime through the co-production of community safety (Bovaird, Van Ryzin, Loeffler, & Parrado, 2015; Innes & Roberts, 2008). Previous evaluations of burglary prevention programs have noted that providing information to residents is one of the less effective strategies for reducing burglary. At the same time, it is also one of the least expensive programs to for an agency to deliver. Our rationale in testing notification was that it might be more effective at micro areas because the threat was more immediate and the communication between an agency representative and the resident more personal.

Responses from our resident survey indicate that the notification had a positive influence on reported behavior. Indeed, among residents who remembered receiving the alert, the two most commonly reported actions were being more vigilant about locking doors/windows and being more likely to watch out for their neighbors. The most frequently reported actions to enhance physical security were the installation of better exterior lighting, trimming of trees and bushes away from windows and installation of other physical security devices such as burglar alarms. Those who said they did not change their behavior or act on any of the burglary suggestions reported that they already had suggested measures in place or that they felt they had a low risk of victimization. In sum, our results indicate that notification did spur resident action to prevent further burglary. We note, however, that many of the physical environment changes may be outside the scope of options for people renting or leasing properties. Implementation of changes to the physical environment when outside authority is needed may be more difficult or impossible for residents.

Another common argument against notification of increased risk is that it will increase fear of crime. Results from our survey of residents indicated that notification of increased risk did not increase their fear of crime. Only 14% of respondents who remember the notification reported that it increased their perception of burglary in their neighborhood. A majority of residents (63%) reported they were aware of the most recent burglary prior to the notification. Residents most frequently reported they had heard about it from another neighbor or from the burglary victim indicating that informal networks already existed and might be leveraged with additional effort by city or law enforcement personnel. Technology, such as automated crime alerts or web-based community forums (e.g., Nextdoor), can support and enhance this kind of neighborhood connectedness and are expanding rapidly. Additionally, the program was viewed extremely positively by residents in each site. Among respondents who

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[25] We thank Dr. Shane Johnson for this insightful potential explanation for failing to find meaningful outcome differences between treatment and control areas.

remembered the notification, 82 to 85% felt like the notification indicated the agency was being proactive in preventing burglary and all respondents thought that the agency should continue to carry out these kinds of notifications.

1.5.3   Treatment providers' perceptions of the program

Evaluations in policing seldom intentionally investigate the perceptions of the personnel tasked with delivering a treatment (for an exception see Wood, Sorg, Groff, Ratcliffe, & Taylor, 2014; Wood, Taylor, Groff, & Ratcliffe, 2015) let alone quantify them. Yet treatment providers have a front row seat for observing how treatments 'go over' with the 'treated'. Specific to this intervention, the program was designed to leverage volunteer resources and we hypothesized that volunteers may become more engaged with their work when given a specific and meaningful role in the agency's crime prevention activities.

Treatment providers overwhelmingly thought the community responded positively to the program. Further, an overwhelming majority thought that the program was at least somewhat successful at engaging the community in crime prevention and educating the community about burglary. However, just less than half thought their department should continue the program. Unfortunately, we were unable to explore this finding in greater depth. It may reflect pushback related to the strict guidelines of the randomized controlled experiment rather than a reaction to the core elements of the program. Treatment providers may have felt unexpected pressure due to the need for quick treatment delivery.

Treatment providers are themselves critical components of the treatment. Their understanding of and commitment to an initiative will affect whether it achieves its goals. Equally important, in the case of volunteers, these individuals provide much needed extra hands for policing agencies that are understaffed. To the extent they are satisfied with their volunteer experience, they will continue to volunteer and do so enthusiastically. Thus, the fact that most respondents said the program made them: 1) feel as if they were an important part of the crime prevention strategy (79%), 2) believe they had a meaningful impact on preventing burglary (58%) and 3) were more likely to volunteer in the future (58%) were all positive outcomes. These findings indicate that treatment providers, in particular volunteers, may view community crime prevention as a particularly satisfying aspect of the volunteer experience. It also indicated that interactions with the public they serve may increase satisfaction with volunteering. Finally, we asked treatment providers if they thought fielding the program had improved police-community relations. Approximately 90% of the treatment provider respondents felt the burglary prevention experiment had a positive impact on police-community relations.

1.5.4   Summary

Having uniformed personnel provide information about the increased risk of burglary soon after the initial burglary did not translate into detectable reductions in residential burglary. There are several possible explanations for this result, but the most likely cause was the low rates of near repeats in the two study sites. Future examinations of near repeat burglary should include an analysis of the number of preventable near repeat events before implementing a crime reduction program. Despite the lack of a significant crime reduction effect, there were follow-on benefits in terms of improvements to police-community relations and to volunteer job satisfaction. Recent guidance has suggested that policy-relevant evaluations should evaluate and report: (1) effect size and direction, (2) mediators, (3) moderators, (4) factors affecting success or failure of implementation, and (5) economic costs (S. D. Johnson, Tilley, & Bowers, 2015). The findings of this project suggest that evaluations of community crime prevention programs should avoid one-dimensional evaluations of their effectiveness in favor of a broader range of outcomes that more accurately reflect the holistic impact of the intervention.

1.6   Implications for Criminal Justice Policy and Practice

The findings of this experiment have several key implications for criminal justice policy and practice. The near-repeat pattern of crime has been found for numerous types of crimes in several settings. Despite this persistence, findings reported here and from other research suggest that it may be challenging to interrupt the pattern (Haberman & Ratcliffe, 2012). First, the actual time a burglary occurs is rarely known. The time span between when the crime is committed and when it is discovered can be hours, days, or weeks (e.g., consider the situation where a resident is away on vacation and only discovers the burglary when they return days later). While a burglary remains undiscovered (and unreported), there is a chance near repeats may be occurring that are not preventable through action taken to thwart a near repeat threat. In these situations, the delay in discovery/reporting is what makes it impossible to respond swiftly enough to interrupt near repeat patterns. Second, it is inherently difficult for police departments to respond quickly to crimes as they occur. Ability to respond to residential burglary is subject to considerable delay: (1) the crime must be reported, (2) entered into the records management system, (3) become available and undergo spatial analysis, and (4) agency representatives must be notified and mobilized into the high-risk areas. These characteristics make it difficult to quickly respond to increased risk.

Second, the relatively short window for intervention between originator event and a potential follow-on burglary makes fielding a police response that requires coordination with volunteers or other agencies/organizations more challenging. Volunteers have irregular schedules which makes it difficult to ensure that someone will be available to respond to burglaries as they come to the attention of the police. Of course, if a police agency made responding to near repeat crime a priority, they could allocate specific personnel to respond to all types of crime.

Advances in technology may be able to overcome some of these challenges and facilitate the collection of data necessary for proper evaluation. Electronic notices could be pushed to agency staff, bypassing the need for creating and routing hard copy documents. Information about treatment delivery could similarly be collected on a mobile device reducing the incidence of lost treatment provider logs.

It is critical that law enforcement agencies quantify the size of preventable near repeat problems before undertaking a program to address it. The findings of this experiment have clearly demonstrated that police agencies must go beyond checking to see if they have a statistical near repeat problem. They must also quantify the extent to which their near repeat problem is preventable. Because of how near repeat risk is calculated, even low base rate events can generate near repeat patterns. Although the near repeat pattern may be statistically significant, it is not certain that the pattern is actionable and that prevention of even all near repeat events could produce meaningful reductions in crime. In response to this finding, we developed another tool that can quantify the crime prevention potential in a near repeat pattern. We conceptualize the use of this tool as an intervening step between determining the significance of a near repeat pattern and developing, executing, and evaluating an intervention. Establishing the crime prevention potential of intervening in near repeat patterns allows for methodological (e.g., more accurate power analysis and subsequent study design) and practical improvements (e.g., setting proper expectations between research-practitioner partners).

Additionally, researchers and practitioners should expand the scope of evaluation beyond simple crime reduction to consider the impact on residents as well as agency personnel tasked with program delivery. Some researchers are already beginning to recognize the need to examine the impact on residents (S. D. Johnson et al., 2017). However, there is much still to be learned about how residents react to crime prevention information. Most importantly, what concrete changes do they make in response to learning about increased risk. In particular, how can the message of increased risk be

conveyed in a way that makes it more likely residents will take actions that are effective at preventing additional burglaries while simultaneously minimizing, or at least managing, fear of crime or victimization? Additional research should also investigate how long this kind of treatment affects residents. Our resident survey found that most respondents reported being more vigilant in securing their property and more observant of their surroundings. It is unknown, however, how long this kind of additional focus persists after treatment.

Volunteers are a valuable resource for law enforcement agencies. Efforts should be made to engage citizen volunteers in meaningful crime prevention and community outreach activities. The results of the treatment provider survey suggest that this deployment strategy has the potential to positively affect agency volunteers. The structure, directed nature, and clear objectives may lead to a more positive volunteer experience. Despite the clear calls at both the local and national level for more volunteers in policing, there appears to be relatively little research on how to maximize benefits for law enforcement agencies, and conversely, how to maximize benefits for volunteers. More research is needed to understand this complicated bi-directional relationship.

Our multifaceted analysis suggests that near-repeat burglary prevention programs can be a useful for:

- improving police-community relations,
- educating the public regarding crime prevention,
- increasing uniformed presence in a cost-effective manner,
- activating informal guardianship and target hardening among residents, and
- increasing satisfaction among police volunteers.

This was the first experimental evaluation of a police intervention designed to disrupt the near-repeat pattern of residential burglary in the United States. Although the lack of significant reduction in residential burglary was disappointing, this research demonstrated that law enforcement volunteers can be used to undertake programs that have positive impacts on the community and to mobilize residents to take action. Additionally, such a program produces positive impacts on community perceptions of the participating law enforcement agencies. Critically, we found no evidence that the treatment increased perceptions of burglary levels or resident fear of crime.

2. Part 2: Quantifying the Crime Prevention Potential of Near Repeat Burglary

2.1   Background

Translational criminology, evidence-based policing, and crime science are three transformative ideas in policing. Translational criminology emphasizes the conversion of research evidence into policies and programs that can be rigorously tested for how well they reduce or prevent crime (Laub, 2011). It goes beyond scientific discovery and simple dissemination to demanding subsequent testing and evaluation about how and when something works. Evidence-based policing involves using evidence to create guidelines and evaluate programs in the 'real world' and then drawing the results of those evaluations to improve the guidelines and subsequently to improve practice (Sherman, 1998). Evidence-based policing is more than using research findings to inform programs; it emphasizes a cycle of continual improvement. New research findings inform policies and programs, programs implemented by agencies are evaluated to determine whether they are successful, the results of those evaluations inform improvements to guidelines and programs. Crime science originated among adherents of situational crime prevention. It focuses on applying scientific methods to prevent and reduce crime (Laycock, 2005). We drew inspiration from these ideas and used them to inform our examination of using near repeat burglary patterns to prevent future residential burglaries.

A large and growing body of evidence indicates that once a burglary has occurred, nearby homes are at higher risk for also being the victim of a burglary. The spatial risk is often spatially constrained to a small geographic area, often one to two blocks in urban settings. Further, the risk is highest immediately after the burglary and rapidly decays over time. Taken together these facts suggest that a relatively small and predictable space-time window of risk exists; a potentially easy target for crime prevention efforts. Previous field studies, conducted outside of the United States, have translated this knowledge into successful crime reduction programs in large housing complexes and neighborhoods. But more recent evidence suggests that the strength of the near repeat pattern varies (Chainey, Curtis-Ham, Evans, & Burns, 2018) and that increased police presence is not a panacea for interrupting the near repeat pattern (Elffers, Peeters, van der Kemp, and Beijers, 2018).

Existing literature points out that focusing on near repeat crime offers several potential advantages to police (S. D. Johnson, Bernasco, et al., 2007; S. D. Johnson & Bowers, 2004a; Townsley, Homel, & Chaseling, 2000). First, it allows targeting of scarce police resources. Most law enforcement agencies operate under intense budgetary pressure and are chronically under-staffed. Making the police officers they have more efficient is one way to maintain public safety in a challenging environment. Second, the incidence of near repeat burglary can be used as a performance indicator to highlight police effectiveness (Ratcliffe & Rengert, 2008). Third, areas that are high in near repeat burglaries are typically high in other crime as well. Sending police to address near repeats has the follow-on benefit of sending them into high crime areas. Fourth, many crime prevention programs targeting near repeats emphasize the importance of neighborhood residents in an effective response. Efforts to increase the involvement of neighbors around burglary is likely to diffuse to other crime types and to provide the basis for additional police-community partnerships.

The Micro-Level Near Repeat Burglary Experiment, discussed in part 1, was based on this evidence. The goal of that experiment was to translate the research evidence into an actionable policing strategy that could reduce burglary. The strategy formulated was to deliver a crime prevention program to the space-time window of highest risk. Since police patrol takes place on the streets of a city and near repeats involve relatively short space-time windows, it made sense to create a crime prevention

program targeted at a micro level in both time and space. During the Micro-Level Near Repeat Burglary Experiment, we encountered a much lower micro-level rate of near repeat burglary in Baltimore County and Redlands than expected.

Why was the observed rate of near repeats much lower than expected? One reason had to do with which burglaries we "counted" as outcomes. In order to fairly evaluate the crime reduction achieved by the crime prevention program implemented in the Micro-Level Near Repeat Burglary Experiment, we counted only those burglaries that could possibly be prevented (i.e., any burglary that occurred within the near repeat space-time window after a potential originator had been reported to the police). We termed those preventable burglaries. Near repeats that occur before the police become aware of a problem are not preventable by reactive strategies. Reducing these burglaries would require a proactive prevention strategy. Existing tools identify whether statistically significant space-time interaction is present but do not provide any information about the size of the *preventable* near repeat problem. A scientific approach to evaluating a crime reduction program should include a measure of the crime prevention potential.

Focusing on preventable burglaries when formulating crime prevention programs will help set realistic expectations for the potential crime reduction that might occur because of the intervention. Focusing on preventable burglaries provides police management with a more accurate measure of the likely benefit from deploying a crime prevention program targeted at near repeats. Knowing the likely benefit is also critical to setting appropriate benchmarks to achieve accurate evaluations of program efficacy. This information is essential for accurately estimating a priori effect size and designing a sufficiently powerful research protocol for detecting change. This will help keep effective programs from being discontinued because they are underperforming when in reality they are being judged against an unrealistic goal. To illustrate, consider the following scenario. Two cities have 1,000 burglaries a year. They both are aware of and want to use the research evidence which indicates that focusing on near repeats can significantly reduce burglary. Both implement an intervention to reduce that number. In City A, burglaries go down by 50 incidents or 5% (50/1000). The Chief discontinues the program because of low return on investment. In City B, further analysis was done prior to implementation to identify that there were 100 near repeats in the previous period. In City B, burglaries in program areas go down by 50, the same number as in City A. But, in City B, the amount of crime reduction is measured against the 100 near repeats. City B reports a 50% reduction in near repeats (50/100) and the program is expanded because of its success.

Technology plays a key role in supporting translational and evidence-based criminology. In the case of near repeats, it is very difficult and time-consuming to manually identify events that are near repeats. However, it is relatively straightforward programmatically because a software program iterates through a file, keeps track of each record it reads, and assigns it a status based on the decision rules specified by the user. We developed a software program, Crime Prevention Potential Calculator (CPPC), to quantify the percentage of burglary events that would have been preventable near repeats in a historic data set. The software provides an easy to use tool that allows crime analysts to estimate the likely size of their preventable near repeat burglary problem in the future.

The unexpectedly low rates of repeat burglary within the micro-level space-time thresholds suggested as significant by the near repeat calculator required further investigation. The research described below investigates practice-based questions that agencies would, or should, ask when considering whether to implement a crime prevention program targeting near repeats. First, what is the crime reduction potential of disrupting NR patterns? We examine this question across ten cities in the United States. Second, how can agencies decide whether the size of the near repeat problem is large enough to warrant an expenditure of time and resources? Third, what further analyses of near repeat patterns can inform the deployment of operational programs? In addition, the document describes the

challenges to identifying preventable repeats and the way we dealt with those challenges in the software. However, our focus is on the utility of near repeat patterns for deploying crime prevention initiatives.

2.2 Methodological Issues for Measuring Space-Time Thresholds

There are several methodological issues that are important when establishing preventable near repeat space-time patterns. These include: distance measurement, time measurement, identification of originators and repeats, and assignment of repeats to originators. Decisions under each of these topics influence what is 'counted' as a near repeat event which in turn, directly determines the number of events and the strength of the pattern. We describe each of these decisions and how they were implemented in the Crime Prevention Potential Calculator (CPPC).

2.2.1 *Distance measurement*

Distance is typically quantified using one of three different methods: Euclidean, Manhattan or Street (also known as network). Euclidean distance is measured 'as the crow flies' and thus, provides the straight-line distance which is always the shortest distance between two locations. Manhattan distance (also called taxicab distance) is measured by combining two straight lines connected at a right angle. Thus, it approximates the grid street pattern found in large cities such as in the Manhattan section of New York City. Street or network distance is measured along a street network. On grid street networks, Manhattan and Street distance are equivalent. On non-grid street networks, Euclidean distance is always the shortest, followed by Manhattan distance. Street distance is almost always the longest distance between two points (see illustration in Figure 6). The advantage to street distance is that it offers the most accurate measure of the realistic path between two points (Groff, 2013, 2014; Groff & Lockwood, 2014). Manhattan distance is widely recognized as providing a better measure than Euclidean distance when measurement of the street distance is not possible (Chainey & Ratcliffe, 2005; Rossmo & Rombouts, 2008).

Figure 6. Methods of Measuring Distance
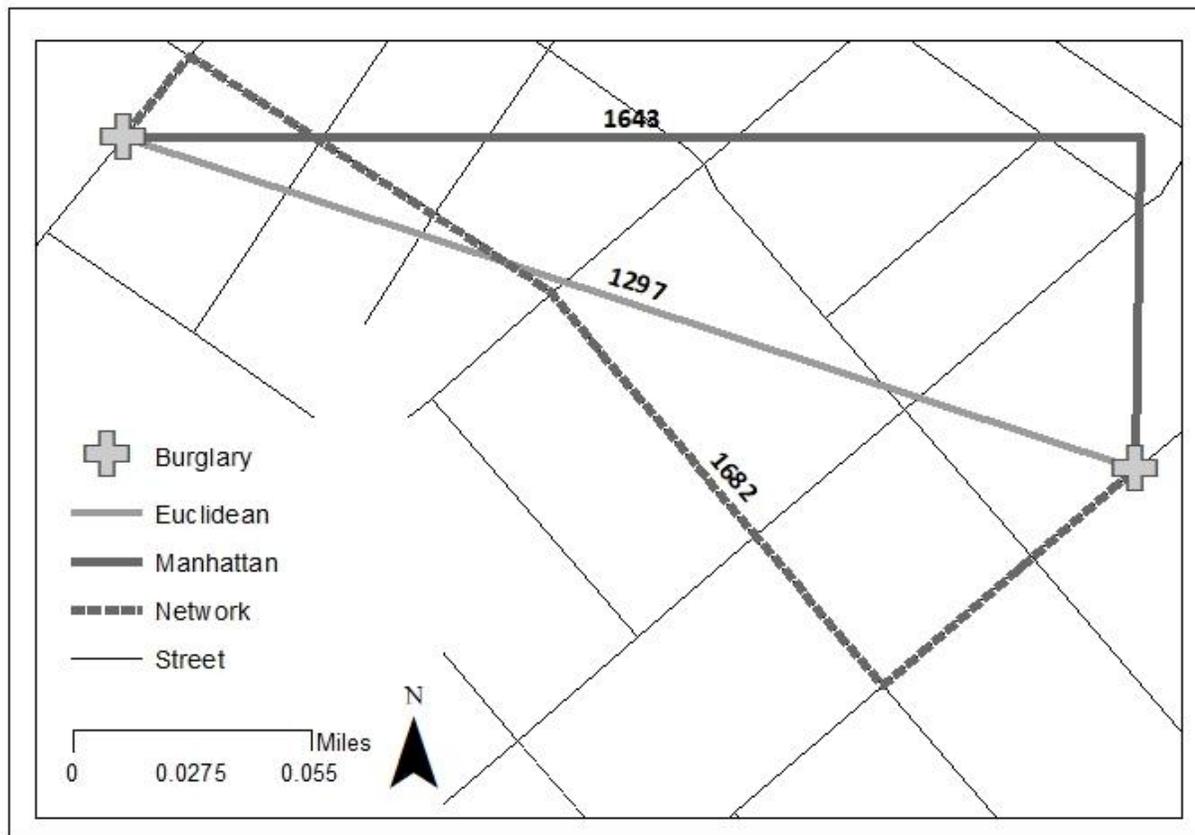
Choosing a methodology for characterizing the distance between two events is important for near repeats because it affects the likelihood that events will be identified as part of a 'near' pair. Figure 6 offers an illustration. In this example, let us say that the two events would be identified as near repeats on the distance dimension using a Euclidean buffer of 1,300 feet because Euclidean distance between the two points is 1297 feet. They would not be identified as a near repeat pair under Manhattan (1,643) or Street distance (1,682). Thus, at the same distance, the use of Euclidean distance produces the highest number of near repeat pairs, followed by Manhattan distance. Street distance identifies the fewest pairs of near repeats. Additionally, Euclidean and Manhattan distance artificially identify events as 'near' that could not be reached via the street network within the distance band. This has implications for both identifying the strength of the near repeat pattern and for accurately identifying the geographic extent of higher risk.

2.2.2 Time measurement

The measurement of time is also important to the identification of space-time high risk windows in a few different ways. First, many burglary events are time span crimes. In other words, a resident leaves home at a particular time and does not realize a burglary has occurred until discovering it upon returning home. This interval could be minutes, hours, days or weeks. When a time-span crime originates a near repeat pattern, any repeats that occur before the burglary is reported to police are not preventable by law enforcement action because the agency does not yet know a crime has occurred and spawned a pattern. This wrinkle means that when considering preventable burglaries, it is important to examine only those that occur after a preceding burglary has been reported.

Another factor related to time is the temporal bandwidth used to define near repeats. This bandwidth is typically defined in days. Most previous near repeat studies have found significant near repeat risk remaining for a month after the originator burglary. A common strategy when examining a near repeat pattern is to define the spatial bandwidth as 7 days (1 week) and then examine patterns across an array of temporal bands. The number of temporal bands depends on how long the near repeat pattern is expected to last. It also depends on the temporal bandwidth chosen. The wider the temporal bandwidth, the fewer temporal bands and vice versa. Of course, basing the choices on findings from previous studies is a defensible starting point. Analysts typically experiment with a variety of different numbers of temporal bands (Ratcliffe, 2007). In Example A (*Event Pair I*; Table 18, Figure 7), burglaries 4 and 9 are within the spatial bandwidth and do not occur on the same day but are outside the temporal bandwidth so they do not qualify as a near repeat pair.

Temporal bandwidths are also important when discussing crime prevention strategies to interrupt near repeat patterns. If near repeat patterns display very short temporal bandwidths of several days, swift action will be necessary to interrupt them. On the other hand, patterns that take longer to emerge allow more time for the delivery of crime prevention programs while there are likely to still be preventable burglaries yet to happen.

A final, more practical aspect of time must be considered. In reality, there are limits to how quickly an agency can respond to, write a report for, geocode, and make an event available for spatial analysis. In highly automated systems this may be easily achieved within hours. In reality, this process is unlikely to occur so quickly. Under less robust systems, it may require manual steps and directed effort to generate the necessary data. The ability to respond to near repeat events must be considered in light of practical limits on how long it takes for the event to become available for analysis.

2.2.3 Identifying originators and assigning follow-on events

The space-time window is also used to identify originators and follow-on events. The temporal ordering of events is the primary mechanism for determining originators. It is important to note if a significant near-repeat pattern exists, a first event is always assumed to generate a high-risk space-time window in which follow-on events are more likely to occur. By definition originators must occur before follow-ons, so identifying originators is done by noting whether a subsequent burglary occurs within a specified temporal and spatial bandwidth. However, at the time a burglary is reported, there is no way to tell if it will become an originator of another event until that follow-on burglary occurs. Existing research gives us some insight into the factors that encourage or facilitate follow-on events. Housing unit characteristics (Budd, 1999; Groff & LaVigne, 2001), situational contexts (Caplan, Kennedy, & Piza, 2013; Moreto, Piza, & Caplan, 2014) and neighborhoods (Nobles, Ward, & Tillyer, 2016) have all been found to be factors that influence the likelihood of near repeat burglary patterns.

Follow-on events are those that occur after an originator event within a certain space-time window. The Crime Prevention Potential Calculator (CPPC) reads a retrospective file of burglaries in the order they were reported to police. The program evaluates each burglary sequentially. Burglaries that occur after the selected burglary but within the space-time threshold are eligible to be counted as follow-on events. However, the rules used to determine how follow-on events can vary determines whether an event is counted as a follow-on. Of course, reporting also affects the number of crimes that are identified as follow-on events. Areas with low reporting may have a problem with near repeats that does not show up in a police department's official data because the follow-on events are not reported. Unfortunately, we know of no reasonable way, at a micro-spatial level, to address this limitation in data reported to the police.

Because the purpose of the CPPC is to identify how many preventable near repeat events are occurring, several additional constraints can be placed on what types of events qualify as a preventable near repeat (Table 18, Figure 7). One constraint involves how potential originator events that occur on the same day are counted. If two events occur on the same day, the earlier one becomes the originator and the other is not counted. In Example B (*Event Pair II*), both burglary 2 and burglary 3 were reported on January 18th so no near repeat burglary is counted (Table 18, Figure 7). This control is included so that analysts can easily generate reports that identify to what extent near repeats occur on the same day as the originator. If the goal of an analysis is to identify to what extent preventable near repeats occur in a jurisdiction, then it makes sense to exclude same day events because there is no way to prevent them. If instead, the goal is to identify the extent of the near repeat problem more generally, then identifying them would help. The program allows flexibility in this choice.

Another constraint explicitly defines that events are not allowed to be repeats for multiple originators. In example C, burglary 7 is within the spatio-temporal window for burglary 5 and counts as a near repeat (*Event Pair IV*). When burglary 5 is evaluated in relation to burglary 6 (*Event Pair III)*, it does not count as another near repeat because it was previously allocated to burglary 7.

Table 18: Identifying Preventable Near Repeats

Event Pair ID	Event	Event	Within Distance?	Different Day?	Within Time?	Event Not Previously Allocated?	Near Repeat?
Example A							
I	4	9	Yes	Yes	No	Yes	Not a near repeat
Example B							
II	2	3	Yes	No	Yes	Yes	Not a near repeat
Example C							
III	5	6	Yes	Yes	Yes	Yes	Near Repeat Pair
IV	5	7	Yes	Yes	Yes	Yes	Near Repeat Pair
V	5	8	Yes	Yes	No	Yes	Not a near repeat
VI	6	7	Yes	Yes	Yes	No	Not a near repeat
VII	6	8	Yes	Yes	No	No	Not a near repeat
VIII	7	8	Yes	Yes	No	Yes	Not a near repeat
Example D							
IV	1	10	No	Yes	No	Yes	Not a near repeat

Figure 7. Graphical Examples in Table 18
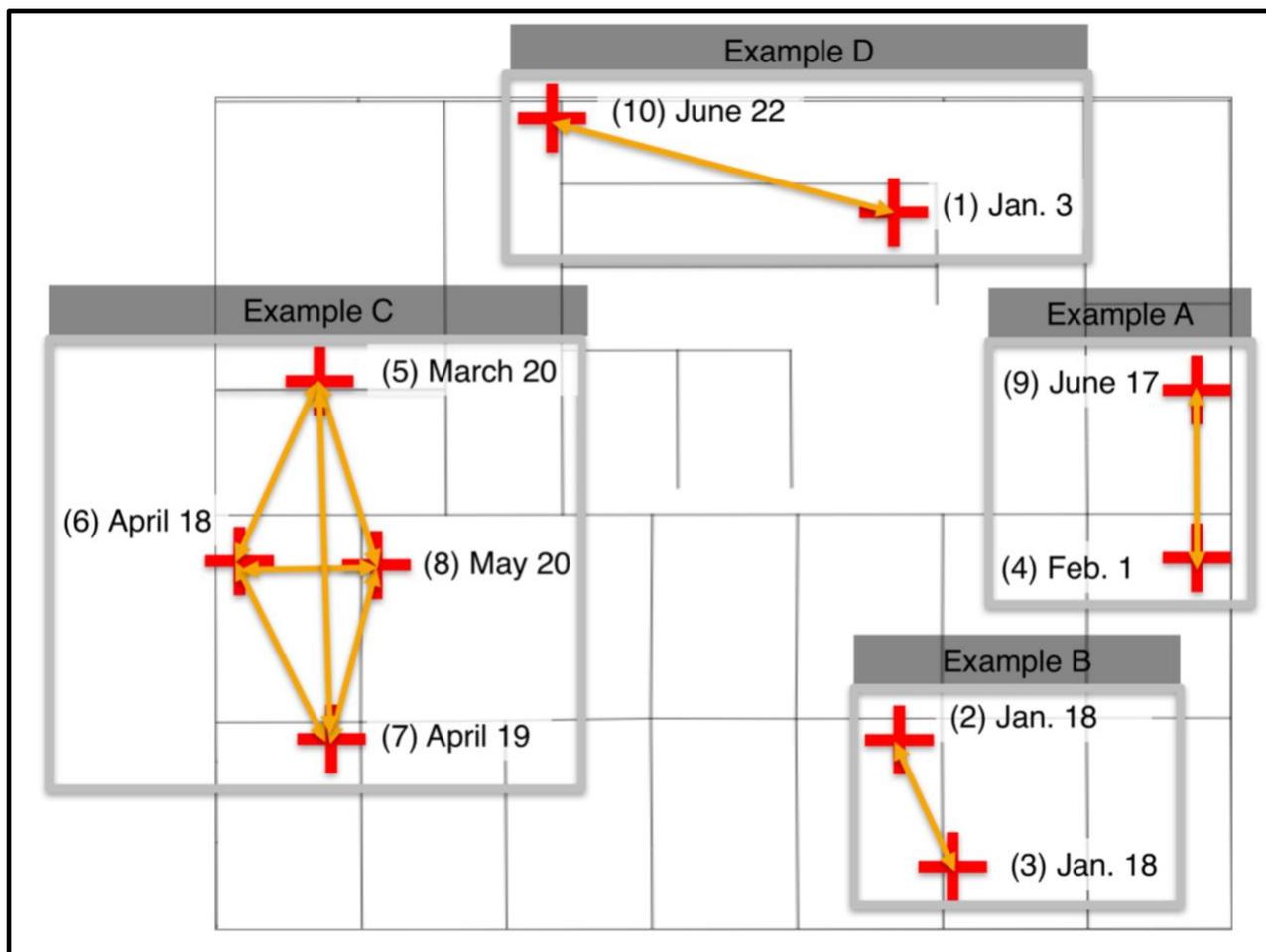
A third constraint, prevents burglaries from being both originators and repeats (Table 18, Figure 7). Once an event is designated as a repeat, it cannot be an originator for a different near repeat pattern. In Example C, burglaries 6 and 7 (*Event Pair VI)* could not spawn their own repeat burglary pattern because they were designated as part of an earlier near repeat pattern. Of course, the actual backstory for each near repeat pattern may be more complex but we do not have enough information to quantify that so plausible assumptions are necessary. These choices allow the analyst to control to what extent events within the file are 'double-counted' in multiple patterns.

These three decisions allow the analyst to control to what extent the CPPC produces an estimate of the potentially preventable burglaries. By implementing all constraints on the relationship between originator and follow-on events, the program produces the most conservative estimate of near repeat crime prevention potential. Selecting the most permissive settings produces results that mirror the evaluation criteria of the Near Repeat Calculator. Table 19 provides an overview of the distance measurement functionality in the Near Repeat Calculator and the Near Repeat Crime Prevention Potential Calculator (CPPC).

Table 19: Comparison of Functionality – NRC Versus CPPC

Parameter	Near repeat calculator (NRC)	Crime prevention potential calculator (CPPC)
Distance		
Euclidean	Yes	Yes
Manhattan	Yes	Yes
Street	No	Yes[1]
Time		
Days	Yes	Yes
Identifying status		
Allow events to be repeats for multiple events	Always	User controlled
Allow events to be both originators and repeats	Always	User controlled
Allow events on the same day to count as a repeat	Always[2]	User controlled
Statistical significance		
In-application significance testing	Yes[3]	No

Notes:

1. Network analysis can be on a user defined network shapefile or on data provided by OpenStreetMap.
2. The NRC counts events occurring on the same day, but the impact of those events is constrained to a single column in the space-time contingency table.
3. Statistical significance testing is conducted by a user-selectable number of Monte Carlo simulations.

2.3   Methodology

We use the CPPC software discussed earlier to examine the size of the preventable near repeat burglary problem across ten cities in the United States.

2.3.1   Data

We use our existing data for Baltimore County, Maryland and Redlands, California but add sites using the burglary data listed on the Police Foundation's Public Safety Open Data Portal.[26] We were able to identify eight additional cities that provided incident-level, geocoded burglary data from the mid-2010s (Table 20). The sites are geographically dispersed with five East Coast sites three West Coast sites and two in the middle of the country. On the East Coast, sites are spread north to south with two in the Northeast (Philadelphia, PA and Baltimore County, MD) and three in the Southeast (Durham, NC; Fayetteville, NC; and Orlando, FL). The West Coast sites are in California (Redlands, CA and Santa Rosa, CA) and Washington (Seattle). Two cities are in the center of the country (Denver, CO and St. Louis, MO). The sites offer a wide range of burglary volume from under 400 to almost 9,000 per year. Population and housing units also ranged widely from very small towns like Redlands at about 70,000 and 26,000 respectively to major cities such as Philadelphia at about 1.5 million people and 670,000 units.

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[26] For more information on the Police Foundation Public Safety Open Data Portal see (https://www.policedatainitiative.org/)

Table 20: Comparison sites

Reporting Agency	Number of burglaries	Data period	Housing units (HUs)[1]	Burglary rate per 1,000 HUs	Population[2]
Baltimore Co., MD[3]	611	9/8/2013 – 9/7/2014	335,622	1.82	831,026
Denver, CO	2,495	2015	285,797	8.73	693,060
Durham, NC	2,580	2016	103,221	25.00	263,016
Fayetteville, NC	1,958	2015	87,005	22.51	204,759
Orlando, FL	2,122	2015	121,254	17.50	277,173
Philadelphia, PA	8,716	2013	670,171	13.01	1,567,872
Redlands, CA	361	2013	26,634	13.55	71,288
Santa Rosa, CA	522	2016	67,396	7.75	175,155
Seattle, WA	7,567	2016	308,516	24.53	704,352
St. Louis, MI	3,670	2015	176,002	20.85	311,404

Notes:

1. April 1, 2010, U.S. Census Bureau, 2010 Census of Population, P94-171 Redistricting Data File. Updated every 10 years. American Factfinder. July 1, 2016 housing unit estimates are available for counties but not cities. For consistency, all housing unit figures are April 1, 2010.

2. July 1, 2016, U.S. Census Bureau, Population Estimates Program (PEP), Updated annually. Population and Housing Unit Estimates.

3. Only includes burglary events for the study area used in the Micro-level Near Repeat Burglary Experiment.

2.3.2 Analytic approach

The Crime Prevention Potential Calculator (CPPC) was used to quantify the probable impact of implementing a near repeat burglary prevention program. Findings from the literature indicate that generally, the strongest near repeat patterns have been identified for two blocks and one month. To provide consistency with the literature and with the space-time window used in the micro-level near repeat burglary prevention experiment, we report outcomes for two blocks (244 meters/800 feet, approximately 2 city-blocks on a typical grid street pattern) and a variety of temporal windows up to one month.

We used the parameters listed in Table 21 to explore near repeat patterns in each of the sites listed above.

Table 21: CPCC Parameters

Parameter	Setting
Allow events on the same day as the originator to count as near repeats	No
Allow events to be both originators and repeats	No
Allow events to count as repeats for multiple patterns	No
Distance calculation type	Manhattan and Network

The program identifies the number of events that fall within each space-time threshold. We computed the percentage of the total events for each threshold combination which provided the potential crime prevention value of focusing on near repeat burglary.

In order to deploy operational programs, more analysis is needed to identify where a problem exists. As a natural first step, simple descriptive analyses, including computing the concentration of near repeats, were used to evaluate which operational units accounted for most of the problem. Spatial analysis was used to drill down further and answer the question of where law enforcement action might yield the greatest crime prevention value.

We examined the spatial patterns of the near repeat events using ArcMap desktop v 10.5. There are a variety of methods available to examine the spatial patterns and map clusters of near repeat burglary events (Eck, Chainey, Cameron, Leitner, & Wilson, 2005). We used a kernel density surface because it is one of the most accessible, visually appealing and frequently used among crime analysts.[27] Creating a kernel density surface allows operational personnel to visualize the areas with the higher densities of near repeat events (the darker shaded areas on the map). The kernel density of preventable near repeat events revealed three distinct areas where near repeats are highest. Programs targeting these areas are most likely to yield higher crime reductions because there are more crimes there to prevent.

2.3.3 Strengths and weaknesses of the approach

There are several strengths to the approach taken here. First, we developed a computer program to support the identification of preventable near repeat burglaries in a data set. It is very time consuming to manually identify near repeat events in official data because both spatial and temporal conditions must be satisfied in order to qualify as a near repeat. In addition to making it possible to analyze crime data with the goal of identifying near repeat events, computer programs also have additional benefits (Groff, 2013). They save time by allowing the analysis to be completed in seconds or minutes rather than days or weeks. They increase accuracy because they take humans out of the equation. They encourage replication by increasing transparency and making decisions more explicit. They can be easily shared to promote additional studies using different data sets. Second, we explicitly examined the influence of the distance measurement used on the number of near repeats identified; an area of study that needs more systematic attention. Third, by examining a variety of different data sets rather than a single case study, we increased the external validity of our findings.

Most of the weaknesses to identifying the crime prevention potential involved issues with using official crime data that are well known and issues related to time span crimes such as burglaries. It is rarely possible to identify exactly when a time span crime occurred. The victim can only say with certainty when they saw their property last and when they discovered it missing. The best-case scenario is when the amount of time in-between those two known moments is minutes or hours rather than days or weeks. From the perspective of identifying near repeats, time span crimes can lead to errors in temporal ordering because the actual date and time cannot be known. For example, a burglar may victimize home A on 1/1 and then go to the next block over and break into home B on 1/7. The resident of home B discovers the burglary later that day and reports it. The resident of home A is on vacation and does not discover the burglary until they return on 1/8. The near repeat pattern started on 1/1 with the

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[27] One drawback to kernel density is that it does not provide an indication of statistical significance. There are a number of other spatial statistical analyses that do provide such a measure (Eck et al., 2005). The need to differentiate statistically significant hot spots is greatest when a large number of such areas exist. When working over relatively small areas with relatively few hot spots, statistical significance adds less value; a more descriptive approach can be taken to inform implementation and evaluation.

first break-in but the fact that a pattern was occurring was not discovered until 1/8 when the vacationing resident returned and reported it. Of course, in official records it now looks like the 'actual' originator occurred after the burglary reported on 1/7. This potential problem with temporal ordering is well-known and impossible to solve using official data or victimization data. In our study, since we were interested in preventable near repeats, we used the date the burglary was reported to the police.

A weakness of the study design is that we used a convenience sample consisting of agencies that made their spatially referenced burglary data available on an open data portal. At the same time, using open source data allows immediate replication of our study. Additionally, because of resource constraints we were only able to use jurisdictions that provided point-level, geocoded crime data. Conducting our own geocoding efforts with other data that were available online was not possible. Future research should examine more sites and use a stratified random sample of jurisdictions with different amounts of burglary and different types of housing styles.

2.4   Results

Table 22 summarizes the output of the CPPC tool using street data from OpenStreetMap. We quantified the size of the preventable near repeat burglary problem across three spatial thresholds (approximations for two, three and four city blocks) and one temporal threshold (28 days). Orlando had the highest percentage of burglaries that were preventable near repeats (21.1%) using a two-block/28-day space time window. Half the sites (St. Louis, Philadelphia, Seattle, Fayetteville and Durham) had between 10 and 14% near repeats and remaining sites had less than 10%.

Using a three block/28-day window, Orlando once again had the highest percentage of preventable near repeats at 28.8%. Two sites, Philadelphia and St. Louis, had almost a quarter of their burglaries falling within that space-time window. Two other sites had close to 20% (Seattle and Durham) and two sites had approximately 17% (Denver and Fayetteville). Once again, Santa Rosa, Redlands and Baltimore County had the lowest proportions.

At four blocks and 28 days, Philadelphia had the highest percentage (38.3%) of preventable near repeat burglaries. St. Louis and Orlando both had approximately 37%. Seattle, Durham, Denver and Fayetteville all had between 26 and 31%. Across all spatial bandwidths, there was consistency in the ranking of cities. Near repeat crime prevention potential is highest in Orlando, St. Louis, Philadelphia and Seattle and lowest in Santa Rosa, Redlands and Baltimore County. Interestingly the three sites with the lowest number of burglaries also had the lowest rates of near repeat but the fifth smallest population site, Orlando, had the highest rate of near repeat burglaries at both two and three blocks. Except for Orlando, the sites with the most burglaries also had the highest proportion of preventable near repeats. Ironically, the two cities ranked 9th and 10th at all distances, Baltimore County, Maryland and Redlands, California, were the two sites used in the Micro-Level Near Repeat Burglary Experiment. The low rates of near repeat likely played a large role in the finding of no significant differences between treatment and control sites.

Table 22: Comparison of Near Repeat Crime Prevention Potential using Manhattan distance

Reporting Agency	Burglaries	Two blocks 28 days % (number)	Two Block Rank	Three blocks 28 days % (number)	Three Block Rank	Four blocks 28 days % (number)	Four Block Rank
Philadelphia	8,716	13.38 (1166)	3	24.70 (2153)	3	38.31 (3339)	1
Seattle	7,567	12.59 (953)	4	19.98 (1512)	4	31.02 (2347)	4
St. Louis	3,670	13.68 (502)	2	24.80 (910)	2	37.71 (1384)	2
Durham	2,580	10.08 (260)	6	18.49 (477)	5	28.84 (744)	5
Denver	2,495	9.71 (286)	7	17.62 (519)	6	27.10 (798)	6
Orlando	2,122	21.11 (448)	1	28.79 (611)	1	37.13 (788)	3
Fayetteville	1,958	10.37 (203)	5	16.65 (326)	7	25.89 (507)	7
Baltimore Co.	611	4.26 (26)	10	7.36 (45)	10	10.15 (62)	10
Santa Rosa	522	8.05 (42)	8	12.07 (63)	8	17.62 (92)	8
Redlands	361	6.65 (24)	9	11.08 (40)	9	16.34 (59)	9

The Micro-Level Near Repeat Burglary Experiment used street distance to calculate the incidence of near repeat burglary. Table 23 provides a comparison of the strength of the near repeat pattern using Manhattan distance versus street distance. As mentioned earlier, street distance best describes how humans travel and thus provides the most accurate estimate of the size of the problem. Additionally, street distance buffers are more compact. Thus, it is not surprising that the number of near repeats quantified through street/network distance is consistently lower than the number discovered through Manhattan distance.[28] The relationship between the number of repeats using network distance and the number using Manhattan distance is generally linear and strongly suggests one could be used to estimate the other (Groff & McEwen, 2005). It also demonstrates that the type of distance measurement affects the estimation of the size of the problem. Using a space-time window of 244 meters/800 feet and 28 days, the difference in the proportion of crimes identified as near repeats varies widely across the ten sites. This illustrates that the impact of the distance measurement method on the estimates of near repeat burglaries, specifically Manhattan distance rather than street distance, will vary by city. We discuss this further next.

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[28] The number of incidents discovered using Euclidean distance is consistently the highest. Data available from author.

Table 23: Comparison of Manhattan Versus Street Network Distance for Two Blocks (244 meters/800 feet) From 7 to 35 Days

	0 – 7 days		0 – 14 days		0 – 21 days		0 – 28 days		0 – 35 days	
	Manhattan	**Network**	**Manhattan**	**Network**	**Manhattan**	**Network**	**Manhattan**	**Network**	**Manhattan**	**Network**
Baltimore Co.	1.47 (9)	1.15 (7)	1.96 (12)	1.47 (9)	3.27 (20)	2.78 (17)	4.26 (26)	3.60 (22)	5.24 (32)	4.42 (27)
Denver	2.75 (81)	1.97 (58)	5.23 (154)	3.77 (111)	7.37 (217)	5.50 (162)	9.71 (286)	7.27 (214)	11.71 (345)	8.59 (253)
Durham	2.83 (73)	1.98 (51)	5.39 (139)	4.22 (109)	7.95 (205)	6.05 (156)	10.08 (260)	7.75 (200)	12.44 (321)	9.73 (251)
Fayetteville	3.58 (70)	3.17 (62)	5.67 (111)	4.90 (96)	8.12 (159)	7.05 (138)	10.37 (203)	8.99 (176)	12.97 (254)	10.78 (211)
Orlando	6.64 (141)	4.29 (91)	12.21 (259)	7.63 (162)	16.73 (355)	10.79 (229)	21.11 (448)	13.90 (295)	25.49 (541)	17.62 (374)
Philadelphia	3.77 (329)	2.77 (241)	6.95 (626)	5.31 (463)	10.53 (918)	8.17 (712)	13.38 (1166)	10.46 (912)	16.45 (1434)	12.82 (1117)
Redlands	0.83 (3)	0.28 (1)	3.88 (14)	3.05 (11)	5.26 (19)	3.88 (14)	6.65 (24)	4.43 (16)	9.70 (35)	6.09 (22)
Santa Rosa	2.68 (14)	3.07 (16)	5.36 (28)	6.13 (32)	6.90 (36)	7.28 (38)	8.05 (42)	9.00 (47)	9.20 (48)	10.34 (54)
Seattle	4.48 (339)	2.55 (193)	6.78 (513)	3.24 (245)	9.59 (726)	4.78 (362)	12.59 (953)	6.40 (484)	14.02 (1061)	7.18 (543)
St. Louis	3.87 (142)	2.81 (103)	6.95 (255)	4.55 (167)	10.22 (375)	6.70 (246)	13.68 (502)	8.80 (323)	16.84 (618)	10.60 (389)

Note: This table shows the strength of the near repeat pattern at two blocks over five different time periods. The fields show the percentage of near repeat burglaries with the total number in parentheses. The percentage represents the proportion all burglaries in the jurisdiction that occurred within the space-time window. All totals produced using Open Street Map (OSM) rather than a user-supplied shapefile. Results for other distances available from first author.

But how much does the distance measurement method matter across different distances and durations? Examining how the percentage difference between street/network distance and Manhattan distance varies across space/time thresholds provides some illuminating information (Table 24 and 14. Appendix J).[29] Descriptive statistics in Table 24 provide an overview and graphs of the differences provided in 15.Appendix K provide more detail.

One way to examine how much the method of distance measurement matters is by looking at the inflation/deflation factor associated with using Manhattan distance as compared to street distance. The statistics in Table 24, provide a summary across 25 different space-time windows[30]. For nine of the ten jurisdictions, Manhattan distance inflated the number of near repeats by 22 to 102 percent as compared to street distance. Three cities had one or more space-time windows where Manhattan distance undercounted the number of near repeat events. In most sites, the percent difference between the two measures is larger at shorter distances than longer distances because the numbers of events are smaller.

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[29] The formula used to calculate the differences was: ((Manhattan - network) / network) * 100.
[30] Space thresholds included: 0 – 122, 0 – 244, 0 – 366, and 0 – 611 meters. Temporal thresholds included: 0 – 7, 0 – 14, 0 – 21, 0 – 28, and 0 – 35 days.

Table 24: Inflation/Deflation Factor Associated with Manhattan Versus Street Network distance

Reporting Agency	Average % Δ between distance measurement techniques[1]	Min % Δ between distance measurement techniques[2]	Max % Δ between distance measurement techniques[3]	SD % Δ between distance measurement techniques[4]	Space/time window of min Δ between distance measurement techniques[5]	Space/time window of maximum Δ between distance measurement techniques[6]
Baltimore Co.	23.05	6.90	42.11	7.27	610/7	366/14
Denver	25.21	8.56	50.00	14.70	610/21	122/21
Durham	25.18	10.71	43.14	7.29	122/21	244/7
Fayetteville	21.54	4.04	34.29	8.56	366/7	122/28
Orlando	43.70	5.28	104.00	33.09	610/7	122/7
Philadelphia	26.64	-2.38	109.59	31.44	610/7	122/7
Redlands	46.10	-40.00	200.00	55.15	488/7	244/7
Santa Rosa	-1.15	-12.50	11.11	7.58	244/7 and 14	610/7
Seattle	102.29	6.13	404.62	128.39	610/7	122/21
St. Louis	52.03	5.56	208.70	61.69	610/21	122/7

Note: All statistics were calculated across all 25 space-time threshold combinations. The minimum is the smallest percentage change and the maximum is the largest percentage change.

1. The average percentage difference between street/network distance and Manhattan distance, within the same temporal window (e.g., if a 122 meter/7-day count using street/network calculation yielded 8 events and a 122 meter/7-day count using Manhattan distance yielded 10 events, it would be described as a 25% increase). Positive values indicate larger counts of events using Manhattan distance.
2. The minimum percentage difference between street/network distance and Manhattan distance, within the same temporal window. Positive values indicate larger counts of events using Manhattan distance.
3. The maximum percentage difference between street/network distance and Manhattan distance, within the same temporal window. Positive values indicate larger counts of events using Manhattan distance.
4. The standard deviation percentage difference between street/network distance and Manhattan distance, within the same temporal window.
5. The space time window with the smallest difference between street/network distance and Manhattan distance. (e.g., 610/7 indicates that of all spatio-temporal bandwidths considered, 610 meters and 7 days had the smallest difference between street/network distance and Manhattan distance).
6. The space time window with the largest difference between street/network distance and Manhattan distance.

       Graphing the numbers of near repeat events enables visualization of the relationship between street/network distance across space-time thresholds both within a single city and across cities (15. Appendix K). The differences between the two measures are visibly large and consistent across distance bandwidths in Orlando and Seattle. Both cities have major features of the landscape such as rivers and lakes that funnel travel around them or to specific traversal points such as bridges and/or tunnels. Several sites have similar patterns in the size of the gap between the two distance measures as the spatio-temporal threshold increases from 122 meters/400 feet m to 610 meters/2001 feet such as Baltimore County, Durham, and Fayetteville. Philadelphia and St. Louis both have large gaps prior to 610

meters when it gets much closer. Finally, the slope of change over temporal thresholds tends to be lower at shorter thresholds and increase as the distance increases. At shorter distances, a longer temporal threshold does not add as many burglaries as does a longer threshold at larger distances.

These findings suggest that the characteristics of the site where the program will be deployed should be taken into account when deciding which distance measurement to use. In cities such as St. Louis, using a 244 meter (800 feet) / 28-day threshold would indicate a potential to reduce crime by 13.7 percent (502 burglaries) if using Manhattan distance but only 8.8% (323 burglaries) if using street distance; a difference of 179 burglaries. However, in Fayetteville, the same space-time bandwidth would only have a differential of 1.4% (27 burglaries). This is true regardless of the scale of the intervention since the actual differences between distance measures will also vary by where the program was deployed within the city. The safest course of action would be to test all three methods before deciding on the most appropriate one for the situation.

Identifying the size of the 'preventable' problem with near repeat crime is the first step in analyzing near repeat crime. The next step is to use that information to evaluate whether the problem is serious enough to warrant an expenditure of time and resources. The answer to this question is not a simple yes or no and must be considered in the light of local community and policing priorities.

Some factors that are relevant to answering the question of whether the number of near repeats is high enough to warrant a crime prevention program include the absolute number of preventable near repeats, the proportion of all burglaries that are near repeats, and the amount of concentration in the geographic locations of near repeats.[31] We discuss these in the next several sections.

2.5   Further Analysis Using Philadelphia As Example

There are several methods available to highlight the places where the problem is most serious. We use Philadelphia to provide an example of the workflow that an analyst might use. First, looking at the number of preventable repeats city-wide reveals that for the spatial bandwidth of two blocks and temporal bandwidth of 28 days, there were 819 burglaries that had near repeat events (Table 25). Of those near repeat events, 69.4% had one near repeat burglary associated with them. Of the remaining 251 originators, the majority had two near repeats. The length of the near repeat chain ranged from two to seven events.

Table 25. Length of Near Repeat Chains

Near repeats	Originators	
	Number	**Percentage**
1	568	69.35%
2	182	22.22%
3	57	6.96%
4	8	0.98%
5	2	0.24%
6	1	0.12%

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[31] Another aspect for consideration not addressed here is the potential for crime prevention activity targeted at burglaries to reduce other types of crime. Although we found no effect on other types of property crime that take place on the street, hot spots policing findings suggest that increased police visibility in small places should reduce crime.

	7	1	0.12%
Total		819	100.00%

One logical method for examining near repeats is by police operational units. Philadelphia is split into 21 operational units called Police Districts (Table 26). Like most crime types, residential burglary is unevenly distributed across districts. At the same time, no police district has more than 10% of the city's burglaries. One way to begin is to identify which districts have the biggest problem with burglary and near repeat burglary. Looking first at burglary, the top four districts (15, 2, 12 and 22) accounted for 33% of all burglaries in Philadelphia. Sorting the table by percentage of Philadelphia's near repeat burglaries that occurred in the district, yields the same four districts. Together those four districts account for 27% of all near repeat burglaries in Philadelphia.

Table 26: Burglary Across Districts in Philadelphia, PA, Sorted by the Percentage of Overall Burglaries Per District

District	Total burglaries	NR Burglaries (2 blocks / 28 days)	Percentage of all Philadelphia burglaries occurring in district	Percentage of Philadelphia near repeat burglaries occurring in district	Percent of district burglaries that are NR
15	837	126	9.60%	10.81%	15.05%
2	705	82	8.09%	7.03%	11.63%
12	699	115	8.02%	9.86%	16.45%
22	620	90	7.11%	7.72%	14.52%
14	557	67	6.39%	5.75%	12.03%
19	549	67	6.30%	5.75%	12.20%
24	487	72	5.59%	6.17%	14.78%
18	450	50	5.16%	4.29%	11.11%
39	446	57	5.12%	4.89%	12.78%
35	438	53	5.03%	4.55%	12.10%
26	403	60	4.62%	5.15%	14.89%
7	378	45	4.34%	3.86%	11.90%
25	378	43	4.34%	3.69%	11.38%
17	346	57	3.97%	4.89%	16.47%
3	314	45	3.60%	3.86%	14.33%
16	243	31	2.79%	2.66%	12.76%
8	238	18	2.73%	1.54%	7.56%
9	211	30	2.42%	2.57%	14.22%
5	162	21	1.86%	1.80%	12.96%
1	129	15	1.48%	1.29%	11.63%
6	126	22	1.45%	1.89%	17.46%

Another way to look at the role of near repeats is to examine to what extent the burglary problem in each district can be associated with near repeat patterns. Table 27 shows the same data sorted by the percentage of district burglaries that are near repeats. In the top four districts (6, 17, 12, and 15), near repeats account for 15% or greater of their burglaries.

In Philadelphia, using the percentage of all of Philadelphia's burglaries that occurred in a district (15, 2, 12 and 22) or the percentage of Philadelphia's near repeat burglaries that occurred in a district (15, 12, 22 and 2) both produced the same set of Districts (even though the ranking changed slightly) and captured more of the near repeat events than using the percent of the burglaries in the district that were near repeats. One reason for the difference is that a district, in this case it was District 6, can have a low number of burglaries (n = 22) but a high rate of near repeat among those burglaries (17.5%). The fact that high numbers of burglaries are not always associated with high numbers of near repeat burglaries makes it prudent to examine more than one method for ranking.

Table 27: District Level Analysis, Philadelphia, PA, Sorted by the Percentage of that District's Burglaries that are Near Repeats

District	Total burglaries	NR Burglaries (2 blocks / 28 days)	Percentage of all Philadelphia burglaries occurring in district	Percentage of Philadelphia near repeat burglaries occurring in district	Percent of district burglaries that are NR
6	126	22	1.45%	1.89%	17.46%
17	346	57	3.97%	4.89%	16.47%
12	699	115	8.02%	9.86%	16.45%
15	837	126	9.60%	10.81%	15.05%
26	403	60	4.62%	5.15%	14.89%
24	487	72	5.59%	6.17%	14.78%
22	620	90	7.11%	7.72%	14.52%
3	314	45	3.60%	3.86%	14.33%
9	211	30	2.42%	2.57%	14.22%
5	162	21	1.86%	1.80%	12.96%
39	446	57	5.12%	4.89%	12.78%
16	243	31	2.79%	2.66%	12.76%
19	549	67	6.30%	5.75%	12.20%
35	438	53	5.03%	4.55%	12.10%
14	557	67	6.39%	5.75%	12.03%
7	378	45	4.34%	3.86%	11.90%
2	705	82	8.09%	7.03%	11.63%
1	129	15	1.48%	1.29%	11.63%
25	378	43	4.34%	3.69%	11.38%
18	450	50	5.16%	4.29%	11.11%
8	238	18	2.73%	1.54%	7.56%

In summary, near repeat burglary is a significant problem across Philadelphia. All but one district has an 11% or higher rate of preventable near repeat burglaries. Districts 15 and 12 appear in each analysis and represent the districts with the strongest pattern of near repeats. Together they account for 17.6% of all burglaries and 20.7% of all near repeat burglary in Philadelphia. Of course, police management may also decide to focus their efforts to prevent near repeat burglary in particular areas within districts (i.e., those where it is most prevalent) or where areas of concentration cross police district boundaries. The next section addresses how the output from the CPPC tool can be used to visualize the spatial distribution of near repeat high risk places using the 15th District as an example.

2.5.1 *Examining the spatial distribution of preventable near repeat burglary*

To examine the spatial distribution of events within the 15th district (15d), the analyst must first separate the 126 burglaries that took place in 15d from the rest of the city. However, since 15d borders four other districts, it is also important to include the incidents that fall in those districts. Using a geographic information system, it is straightforward to include other near repeat burglaries that occurred within 800-feet/244 meters of 15d's boundary by using a buffer operation (n=13).[32] Figure 8 shows the distribution of those events across the 15th district and in the buffer boundary. The district

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[32] Only the subset of burglaries that were preventable near repeats were used in this step.

has three distinct areas of highest concentration and another several areas of increased density that would be candidates for more in-depth near repeat burglary prevention analysis.

Because patterns in official data are really a sample of actual crime that has occurred, we investigated whether considering both originators and repeats would provide additional information about spatial patterns. Another reason to think that adding originators might be valuable is that, unlike repeat victimization where the same housing unit is victimized, the location of the originator event might supply additional information to understand the process behind the near repeat phenomena. For example, the type of housing, the method of entry, and so on. Such information could potentially inform practitioner decisions regarding the most appropriate type of response and its location. Figure 9 shows the distribution of the originator and repeat events in 15d as well as the kernel density surface. The same general pattern of hot spot areas exists in both maps but including the originator burglaries results in larger hot spots that are hotter (i.e., more clustered).[33] Seven distinct areas emerge as candidates for focused actions (outlined using boxes).

Additional analysis would be necessary to identify the type of near repeat prevention program with the best chance of success. Such an analysis would require collecting additional data to examine the characteristics of the burglary event and the social and environmental landscape of where that burglary occurred. Previous studies have provided guidance regarding the characteristics of places that are associated with residential burglary. They also indicate the characteristics of burglaries that deserve special attention. This information could be used in a problem-solving framework to develop appropriate burglary prevention activities (Clarke & Eck, 2005).

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[33] Both maps were created using the kernel density tool in the spatial analysis toolbox of ArcMap (100-foot grid cells and a 1,600 foot bandwidth).

Figure 8. Density of Near Repeat Burglaries in One District

Figure 9. Density of Both Originator and Near Repeat Burglaries in One District
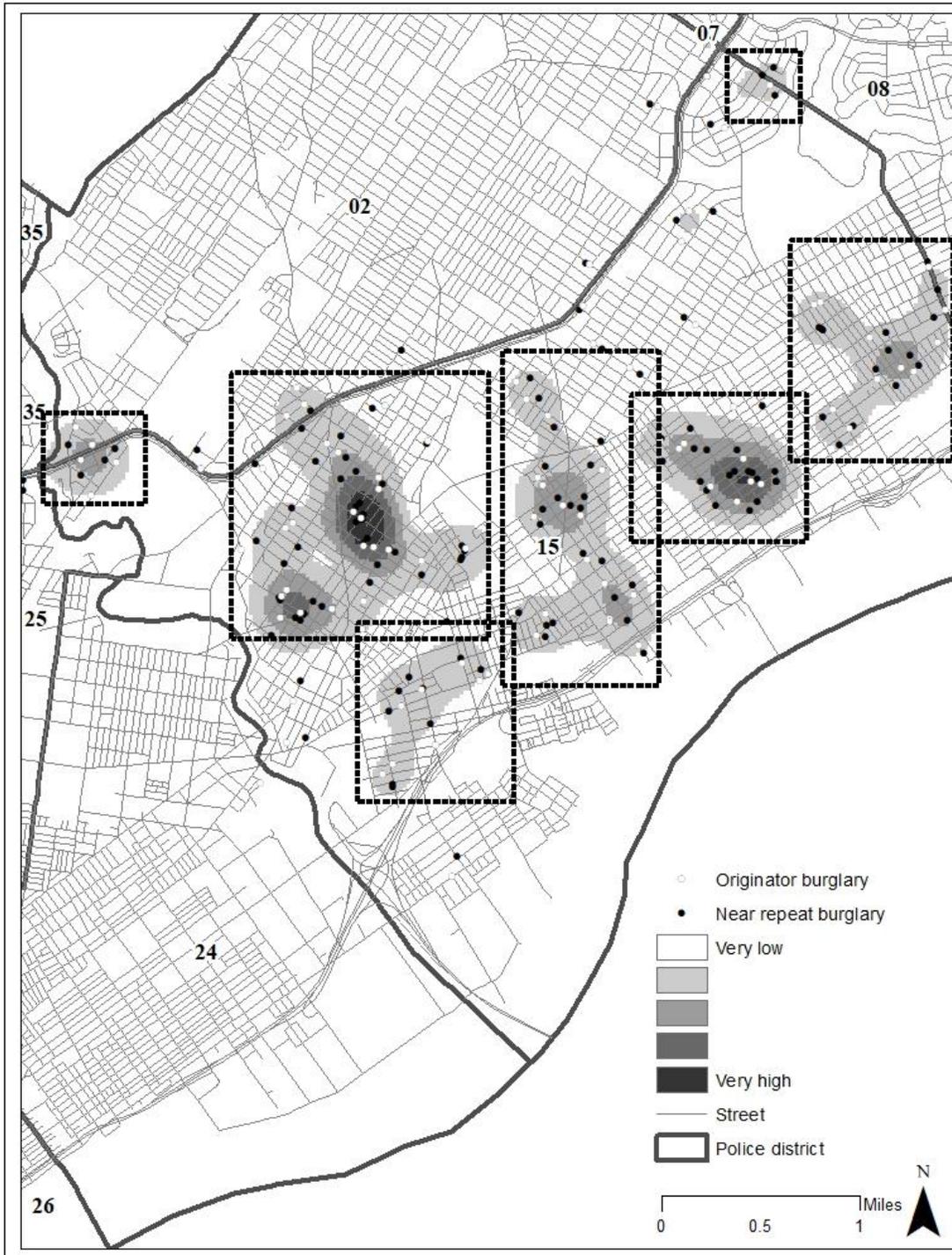
2.6   Discussion

Policing has been moving toward a more evidence-based posture over the last 20 years. At the same time, many researchers have been trying to assist that movement by evaluating police initiatives, investigating research topics that have an applied focus, and translating their findings so that the applications to practice are more explicit. Repeat and near repeat victimization are excellent examples of research findings that have been translated into several different flavors of crime prevention programs. The repeat victimization programs have been evaluated and substantial evidence indicates that such programs can reduce residential burglary. The evidence supporting the use of near repeat victimization is smaller and mixed.

The Micro-Level Near Repeat Burglary Experiment (Groff & Taniguchi, 2016) was undertaken because a body of evidence suggested that a single burglary on a street puts nearby dwellings at higher risk of victimization over the next few weeks. The results, as detailed in Part 1, suggested that the intervention did not result in a significant reduction in residential burglary or other kinds of property crimes. During the experiment we observed relatively low rates of near repeat victimization in the two study sites. Was this unique to our study sites or more widespread? To what extent does a near repeat problem at the jurisdiction level translate into actionable micro-level patterns? Investigating these questions led us to explore the micro-level crime prevention potential of statistically significant near repeat patterns. We hypothesized that significant near repeat patterns may not necessarily indicate a large enough number of preventable near repeat burglaries to warrant an intervention at the scale of individual, micro-level high-risk space-time windows. Results suggested that the Micro-Level Near Repeat Burglary Experiment may have been a victim of poor luck. By chance it appears that both Redlands and Baltimore County had significant near repeat patterns but the patterns did not ultimately generate many "preventable" burglaries. As both researchers and police move toward a more evidence-focused stance, one area in the near repeat literature that has received little attention is the quantification of *crime prevention potential*.

The initial exploration of crime prevention potential across ten cities provides a plausible explanation for why the burglary intervention fielded in Baltimore County and Redlands was unsuccessful. Baltimore County and Redlands had the lowest numbers of preventable near repeats among the jurisdictions that we evaluated. In other words, it was difficult for the intervention to achieve a crime reduction because there were so few near repeats to prevent. Despite finding significant near repeat patterns in both jurisdictions, there were relatively few actionable near repeat burglaries that the agencies could have prevented. As a demonstration, $\mathrm{Table\ 28}$ displays the results from the NRC for both Redlands and Philadelphia. Not surprisingly, the near repeat problem is strong across many space-time bands in Philadelphia. However, the value for the 0-7 days and 1- 400-foot band in Redlands (2.29) was actually larger than the same space-time window in Philadelphia (1.72; Table 28). This suggests that the strength of the values reported by the NRC does not provide enough information to determine if there are sufficient actionable burglaries to warrant an intervention at the micro-level of the space-time high risk window.

Table 28: Near Repeat Calculator Results for Philadelphia and Redlands

	Days				
	0 to 7	8 to 14	15 to 21	22 to 28	29 to 35
Redlands[1]					
Same location	**3.52**	0.88	1.08	**2.90**	**3.72**
1 to 400 feet	**2.29**	0.58	0.94	0.94	0.53
401 to 800 feet	1.09	1.07	0.89	**1.46**	1.29
801 to 1200 feet	1.52	1.23	1.03	0.73	1.10
Philadelphia[2]					
Same location	**5.88**	**2.18**	**1.41**	1.24	**1.45**
1 to 400 feet	**1.72**	**1.19**	**1.18**	**1.11**	**1.13**
401 to 800 feet	**1.09**	**1.04**	**1.05**	1.03	1.03
801 to 1200 feet	**1.12**	**1.07**	1.03	**1.05**	1.02

Notes: Values in shaded cells were significant at p < .05.
1. Calculated with 2013 and 2014 residential burglary data.
2. Calculated with 2013 residential burglary data.

Our investigation uncovered several reasons for the differences between the output of the NRC and the CPPC output used in this study. One major difference are the characteristics that define a near repeat. The methodology we used to identify preventable near repeats necessarily disqualifies those burglaries that have already occurred by the time the police find out about a burglary. Because of this, the CPPC will produce lower counts than the NRC. Additionally, we did not count the originator burglary and burglaries could be originators or repeats but not both. Finally, we used street distance rather than Manhattan distance to define the spatial parameter of risk. In most cities, street distance offers a more conservative count of near repeats than Manhattan distance.

Another difference between the NRC and the CPPC is their main purpose. The NRC was developed to identify whether near repeat clustering is present in a distribution of events and the space-time windows in which it is significant. The NRC is based on the Knox statistic which is a global statistic. Global statistics provide a summary across a population; but do not necessarily apply to specific instances. Thus, the significant space-time threshold identified by NRC exists for the entire study area and the identification of particular places within that study area with significant NR patterns is not possible. Recently released space-time tools in ArcGIS do allow for the identification of significant space-time clusters and should be used in future research.

Overall, these results suggest that the NRC alone is often not sufficient to determine whether a near repeat problem is large enough to warrant an intervention; especially in jurisdictions with lower absolute numbers of burglary. The CPPC should be used as a necessary second step in the analysis. For agencies using a problem-oriented policing (POP) framework, it easily fits into the scanning or analysis stage. Calculating crime prevention potential offers a more useful benchmark for decision-making. Given what we have learned here, additional evaluations of micro level prevention programs should be conducted in cities with high near repeat crime prevention potential.

2.6.1 Using crime prevention potential to quantify potential benefits

Considering crime prevention potential prior to developing, implementing and evaluating programs to address near repeats has several advantages. It can be used both for identifying where near

repeats are concentrated. This is important to understanding the characteristics of places with high near repeats. Calculating crime prevention potential more accurately grounds agency and citizen expectations for program impact in empirical reality. Recall, the example in an earlier section of this document. If a police department does some analysis to identify their near repeat crime prevention potential and finds a maximum reduction of 100 of their 1000 burglaries if the program was 100% successful. That information supplies a more realistic benchmark to use when evaluating program effectives. A reduction of 75 near repeats represents a 75% reduction (75/100) not a 7.5% reduction that would result if the total number of jurisdiction burglaries were used in the calculation (75/1000). Some readers may be thinking that this is simply a linguistic sleight of hand to inflate the impact of an intervention. We respectfully disagree. Accurate estimation of the effectiveness of a program requires using a realistic denominator. Decision makers require easy to understand and robust estimates from which to make decisions and evaluate programs (Figure 10).

Figure 10. Likely Outcome of Cost/Benefit Interaction on Crime Prevention Program Perceptions
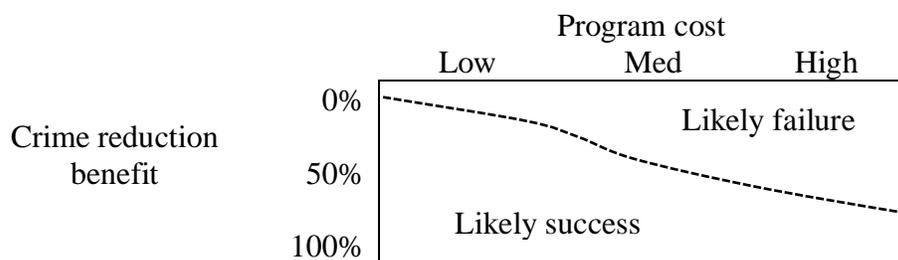
The calculation of crime prevention potential also develops the basis for calculating cost-benefit analysis (Ekblom, Law, Sutton, Crisp, & Wiggins, 1996). A simple strategy would be to use the average monetary loss from a burglary nationwide or better yet, the average burglary loss for residences in the local jurisdiction. Multiplying the average loss by the number of burglaries prevented provides a rough estimate of potential savings in dollars. For example, in 2016, the national average loss in the United States was $2,361 per burglary (FBI, 2017a). The prevention of 75 burglaries would translate to $177,075 in losses prevented (75 * $2,361 = $177,075).[34]

If the potential savings is high enough to continue the evaluation process, the next step would be to develop a crime reduction program targeted at reducing near repeat burglaries. The program would need to be specified in enough detail to allow an estimation of the staff time (both sworn and civilian) as well as the costs of any equipment or other expenses needed to support it. Subtracting the total estimated cost from the total estimated savings of preventing near repeat burglaries in the area targeted by the intervention provides an estimate of potential savings (if outcome is positive) or potential cost (if negative). In this way, police could evaluate whether the size of the preventable near repeat problem is large enough to warrant that particular expenditure of time and resources.

It is critical to supply a range of scenarios related to both the potential cost and the potential benefit sides of the equation. Crime prevention programs involve the application of interventions with different crime prevention intensities (Bowers, Johnson, & Hirschfield, 2004; Ekblom et al., 1996). Intensity is measured as the cost of an intervention per household. If possible, costs should be estimated for a range of different interventions involving different levels of crime prevention intensity (e.g.,

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[34] More rigorous approaches are available. Manning and colleagues offer an accessible resource for implementing cost-benefit analysis as part of the What Works project at the College of Policing. For more information see (http://whatworks.college.police.uk/Research/Pages/Cost_Benefit_Tool.aspx). Resources include a brief guide to economic analysis and an Excel tool for estimating the costs of intervention as well as the monetized benefits.

volunteer-based information delivery versus information plus directed patrol). In addition, the potential benefits should be measured across a range of different projected levels of effectiveness (0%, 25%, 50%, 75%, and 100% reductions in near repeats). These types of information-based estimates provide critical decision-making information in a landscape of shrinking budgets. Finally, evidence-based estimates provide a realistic metric for evaluating program success. By examining the program cost versus the program benefit, decision-makers can easily identify the potential for success. For example, a program that costs little and provides little crime prevention value is likely to be discontinued. At the other end of the spectrum a program that costs a great deal and offers a great deal of crime prevention value may be considered a success but be unsustainable.

We used Philadelphia data to provide an example of how this evaluation would work. The top four police districts in Philadelphia experienced 2,008 residential burglaries of which 320 could be classified as preventable near repeat events. Using the national average loss of $2,361, it is straightforward to estimate the projected savings from burglaries prevented across several program effectiveness levels. If a new program targeting near repeats reduced near repeats by 25% (n = 80), the cost savings would be $188,880. If instead, the program reduced near repeat burglary by 50% or 75% the savings would be $377,760 and $566,640 respectively. Of course, these figures must be reduced by program costs. For example, if staff time is the only cost and it comes to $100,000 then the net savings of implementing a program that reduces near repeats by 25% is $88,880, by 50% is $277,760 and by 75% is $466,640.

Further analysis must be conducted to guide deployment once the burglary prevention potential has been evaluated. This analysis should be systematic and examine both the proportion of near repeat burglaries that occur in geographic areas such as police districts and their proportion of all burglaries. Spatial analysis such as kernel density can be used to identify specific sets of streets on which to target crime prevention activity. We admit that this cost benefit analysis does not consider the other costs or benefits that crime prevention efforts may experience. In the Micro-Level Near Repeat Burglary Experiment we found considerable positive impact on both community-police and citizen volunteer-agency relationships. Quantifying these kinds of intangible benefits is more challenging. We also ignored opportunity costs for agencies engaging in these programs. If agencies are deciding between conducting a near-repeat based program instead of an alternative program, there may be other impacts on crime to consider. Nevertheless, routine use of a cost-based approach to selecting crime prevention interventions is overdue (see footnote 34). Given the difficulty of quantifying these other factors, a more simplistic approach is warranted as a first important step in establishing a mindset of development, implementation, and evaluation.

Finally, future work could be done to tailor projects even further based on results from on-going evaluations. It may be possible, for example, to improve the efficiency of treatment delivery by identifying the events that are most likely to result in near repeat events or even better, the events that are most likely to result in multiple near repeat events. Events (e.g., how the burglary was carried out) or environmental factors (e.g., housing density, housing type, or other land use patterns) may help us better understand which events will eventually turn into near repeat originators. If this is true, further refinement to deployment strategies may be possible.

2.6.2 Implications for future research

For researchers, understanding the crime prevention potential allows for the development of research protocols that are more appropriately powered or designed. Had we known what we know now about the need for calculating crime prevention potential prior to the Micro-Level Near Repeat Burglary Experiment we could have taken a variety of different actions. Knowing the low near repeat rates in Baltimore County and Redlands we could have implemented a longer study period or added a

third jurisdiction both of which would have resulted in more treatment and control locations. Alternatively, we may have tried to implement the experiment in Orlando instead of Redlands because the concentration of near repeats was over three times higher.

Given what we have learned here, future researchers may want to use the crime prevention potential to influence the design of micro level interventions. Instead of targeting intervention and evaluation efforts based on the space-time bandwidths with significant near repeat crime patterns, researchers can instead target areas with the highest concentration of near repeat events. Or they may want to use recently developed space-time tools to proactively identify micro-level intervention areas before an initial burglary takes place.[35]

2.6.3   Conclusion

In sum, the findings of this research illustrate the need for researchers and practitioners to carefully quantify the likely crime prevention value of near repeat interventions targeted at the micro level. Identifying that a global near repeat pattern exists is necessary but not sufficient to quantify the likely crime prevention value. Once quantified, an informed decision can be made about whether focusing on near repeat crime is likely to yield enough benefits to justify the cost. If so, an appropriate intervention should be developed, conducted, and evaluated. Having a clear idea of the size of the problem will help with developing a realistic evaluation because it gives the police department and the community a good idea of the maximum potential crime reduction. In the example carried out above we demonstrate how this process could be applied to near repeat burglary to establish how much an agency should spend given different levels of intervention effectiveness. Within the near repeat crime framework, we argue that agencies should evaluate the success of reactive intervention programs in terms of the crime prevention potential and not the total number of burglaries. After all, police can only respond to crime once it is reported and thus, can only prevent additional crime from occurring.

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[35] Predictive software such as the prospective mapping took developed by Bowers and Johnson (cite and get cite for other predictive software (Bowers et al., 2004; S. D. Johnson, Bowers, Birks, & Pease, 2009; Rosser et al., 2017).

3. Part 3: Practitioner Guide -- Tackling Near Repeat Crime: Using technology to formulate and evaluate crime prevention strategies

3.1 Introduction

This document is designed to assist law enforcement professionals in identifying and responding to near repeat patterns of victimization. Several open source tools are broadly discussed as they are necessary to quantify near repeat patterns and develop interventions; we encourage you to review those program's user manuals for more details. This report will help you:
1) Understand what near repeat patterns are and why they are useful to policing
2) Evaluate global and local patterns of near repeat
3) Formulate appropriate responses to these patterns
4) Develop program metrics to understand the effect of the intervention
5) Evaluate a near repeat crime prevention program

3.2 Overview of Near Repeat Victimization

Research has found that once a crime has occurred, additional crimes are more likely to occur in nearby areas within a short period of time. This pattern has been called "near repeat". Empirical research has clearly identified the existence of both a repeat (same target, another crime) and a near-repeat phenomenon for crimes such as burglary, robbery, weapons violations and other crimes. The exact spacing and timing of increased risk varies by the place. But we know that the increased risk level that occurs after a burglary is temporary (Johnson, Bowers, & Hirschfield, 1997) suggesting that police must act quickly to maximize the potential for reaping crime prevention benefits. This knowledge of the near repeat phenomenon provides police with a way to "shorten the odds of being in the right place at the right time to deflect or detect crime" (S. D. Johnson, Bernasco, et al., 2007; Pease & Laycock, 1999, p. 2). Such interventions require that additional police resources be sent to the specific locations most likely to experience further victimization and that agencies not only address the crime that has been committed but work to prevent future victimization.

3.3 Steps in Tackling Near Repeat Victimization

The following sections describe a set of steps that can be used to identify, address, and evaluate interventions designed to tackle near repeat victimization patterns. There are a number of technical and practical challenges to undertaking this kind of intervention. Several tools have been developed to assist with this work. General guidelines are provided to act as a starting point for understanding the unique patterns within a jurisdiction.

3.3.1 Step 1: Quantify the size of the near repeat problem in your jurisdiction

This section describes the process of identifying and quantifying the scope of the near repeat pattern. Two programs have been developed to assist with quantifying the size of the near repeat pattern. Both programs, the Near Repeat Calculator (NRC) and the Near Repeat Crime Prevention Potential Calculator, were funded by the National Institute of Justice and are freely available online.

Identify a crime type

The intervention should be designed around a specific crime type or crime types with similar characteristics. Existing research has found near repeat patterns among several types of crime in a variety of settings. Residential burglary, in particular, has been studied extensively in both the US and the UK. Knowledge about near repeat patterns for person-crimes is less robust but exists.

Gather historical data

There are no definitive rules on how much historical data should be considered to evaluate near repeat patterns. The volume of events will be the main consideration; a higher volume of events will require a shorter historical period for assessing near repeat patterns. In general, use of at least one year of historical data is recommended to smooth over any seasonal or transient effects. Try to include a month prior and a month after to get a better estimate of the originators that take place prior to the study period and the repeats that occur after the end of the study period.

Quantify the global near repeat pattern

The intensity of near repeat patterns can be established by the Near Repeat Calculator.[36] Developed by Dr. Jerry Ratcliffe, and funded by the National Institute of Justice, the NRC is used to determine if a near repeat pattern exists, and if that pattern is significant. The user is responsible for setting a few parameters: the file location, identifying coordinates and date variables, and spatial and temporal bandwidths. A reasonable starting point for analysis is to set the temporal bandwidth at 7 days and the spatial bandwidth at 400 feet (122 meters).

Quantify the number of preventable near repeats

The Near Repeat Crime Prevention Potential Calculator (NR-CPPC) is a tool to identify the proportion of a crime type that are "preventable". This tool answers the question: how much crime could be averted if all near repeat events were prevented? In conjunction with spatial analysis techniques, the output can be used to identify where within a jurisdiction near repeats are a problem. The tool uses historical data to provide a baseline for determining the crime prevention potential of an initiative aimed at addressing near repeat crimes. The program considers the spatio-temporal distribution of events and indicates how many events fall within the specified high-risk space-time window. This figure represents the maximum treatment potential if the intervention was 100% effective at eliminating all near repeat events.

Step 1 Summary: Begin by identifying a crime type. More research has been done on the near repeat victimization of certain types of crimes, but many crimes have been found to demonstrate this pattern. Gather sufficient historical data (at least one year) to produce reliable estimates. Evaluate near repeat patterns at the global level. If results are positive, calculate the number of "preventable" near repeats that occurred.

3.3.2   Step 2: Identify where near repeat patterns are most prevalent

As described above, a first pass at exploring near repeat patterns occurs at the global level. Further refinements can then be made to better understand the amount of near repeat crime that is actually involved in creating those global patterns. A next consideration is identifying where these near repeat patterns are strongest. Data from the NR-CPP can be exported and brought into a mapping application. Originator and repeat events can be plotted on a map for visual inspection and analysis. Creating a

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[36] Details on the use of this program can be found at: http://www.cla.temple.edu/cj/resources/near-repeat-calculator/.

kernel density (e.g., hotspot) map of these events will allow for a more complete understanding of their spatial distribution. Depending on how these events are distributed, the intervention may be limited to a subset of the entire jurisdiction.

Step 2 Summary: The Near Repeat Calculator produces a global (i.e., jurisdictional) estimate of near repeat patterns. The NR-CPP can be used to better understand the spatial distribution of near repeat patterns. Output from the NR-CPP can be used to develop a more targeted intervention.

3.3.3   Step 3: Design a near repeat crime prevention program

In theory, a wide variety of strategies could be used to disrupt near repeat victimization. In general, research has found place-based crime prevention strategies to be more effective than other kinds of strategies such as those that focus on individuals. Research specifically designed to disrupt near repeat patterns of crime are few and have generally focused on burglary. Ultimately the intervention will be based on the specific crime issue, resources available, and community needs. Nevertheless, speed is key. Near repeat patterns often diffuse rapidly. An effective intervention must be designed in such a way that it is possible to get field personnel in a treatment area quickly.

Develop an evaluation plan

An evaluation plan should be decided in advance. Three areas are worthy of consideration: the effect on crime, the effect on the community, and the effect on the agency. A multifaceted approach to evaluating the impact of a program can provide a more comprehensive understanding of program impact.

Tracking the impact of an intervention on crime tends to be the most straightforward method of evaluating programmatic success. There are a variety of ways to asses change in crime with varying levels of scientific rigor. The generally recognized gold standard approach is to use random assignment to achieve treatment and control groups. Other approaches may be less rigorous but may be more feasible to implement. Quasi-experimental pre- and post-evaluations may provide a reasonable test of program effectiveness in reducing crime.

Understanding the impact of the intervention on the community should also be a key goal. Two questions are worth considering. First, did the intervention have the intended behavioral changes on individuals in the treatment area? Many crime prevention strategies rest on the assumption that the public should take steps to ensure their own safety. For example, a crime prevention strategy to reduce vehicle burglary may instruct residents to secure their vehicles and remove or hide valuables. A key question then becomes whether or not the program actually prompted any changes in actions. Second, were there any unintended consequences of the program? Geographically focused policing initiatives have been criticized because of their disproportionate impact on minority communities. Other kinds of interventions may cause unnecessary fear of being victimized. Understanding how the community might experience the intervention should be a key component of the evaluation.

Finally, the experiment may have an effect on the functioning of the agency and/or its personnel. At a minimum level, it may be worthwhile to track outputs such as the number, type, or amount of time spent in treatment areas. This information provides essential information to understand the true cost-to-implement of a program and allows for better understanding of return on investment. Additional concerns may also warrant evaluation. Programs may impact the treatment providers.

Step 3 Summary: Developing an evaluation strategy should be an integral part of program development. Consider the impact of the program on crime, residents, and the agency to develop a holistic understanding of the program's effectiveness.

3.3.4   Step 4: Implementation

Implementation of a near-repeat focused crime prevention strategy can be difficult. Quick action is needed, and treatment providers need guidance on identification of the targets at risk. Furthermore, evaluation concerns may necessitate assigning areas to treatment or control groups. The Near Repeat Area Identifier Tool (NRAIT) was built to assist with the process of area identification and treatment deployment. The NRAIT can support randomized controlled experiments or quasi-experimental designs. The program can be run manually daily or triggered for automatic analysis at a set time. The NRAIT evaluates all new crimes for that day. It establishes if the event should be an outcome event of a previous event or if it should generate a new high risk near repeat zone. If a new zone is generated it can be randomly assigned to treatment or control conditions. One additional function to consider is whether zones can be retreated at a later date. This would allow zones to re-enter the treatment pool in order to provide follow-up treatments (e.g., the agency may be willing to provide treatment to a zone if there is another crime six months later).

Track outcomes

The NRAIT will count all events occurring in treatment/control areas during a specified time period. For example, you may be interested in understanding how much crime has occurred in these zones in the four weeks after they are created. These data can be exported for use in any statistical analysis software. The NRAIT also produces a daily output file that tracks the status of each individual event run through the program. This output, for example, tells the user if an event was allocated to treatment or control, or if the event could not be set to treatment/control why it was left unallocated. A new burglary can be disqualified for use in the experiment for a variety of reasons and the specific reason is important in understanding the spatio-temporal pattern of residential burglary. These logs are useful for diagnostics and for understanding how events are being allocated (i.e., to treatment, control or being discarded because a new zone would overlap an existing one).

Step 4 Summary: Quick action is needed. The Near Repeat Area Identifier Tool has been developed to streamline the identification of near repeat high risk zones and facilitate deployment of resources to those zones. The NRAIT also tracks outcome measures that may be useful for evaluation purposes.

3.3.5   Step 5: Analysis

Evaluation of a near repeat intervention can be complex and an in-depth discussion of this issue is outside the scope of this summary. In general, the evaluation will be dictated by the design established in Step 3. If the intervention has been run as an experiment, a t-test using the outcome tracker of the NRAIT can be sufficient to understand effectiveness in preventing crime. Quasi-experimental designs may require more complex evaluations like pre-post or time series analyses. Evaluation of community or agency data may be simple descriptives such as averages and percent change.

Step 5 Summary: With proper setup, the analysis component of the project should be straight forward. Experimental designs often lend themselves to simple statistical approaches. Other data, such as resident surveys or administrative data, require additional consideration.

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5. Appendix A: Measuring Distance Illustration

Figure A-1 illustrates potential distance calculation methodologies. The two blue dots are the origin and destination. The line in dark blue is Euclidean distance and represents the most direct, shortest distance connection between the two points. Manhattan distance travels along a horizontal then vertical track to connect the two points. Network distance follows the actual street network and respects connectivity of the network. Network distance is more computationally demanding but best models the impact of real world features on travel. The Near Repeat Calculator uses Manhattan or Euclidean distance measures. The NRAIT to CPC have an additional option for network distance.

Figure A-1. Distance measures
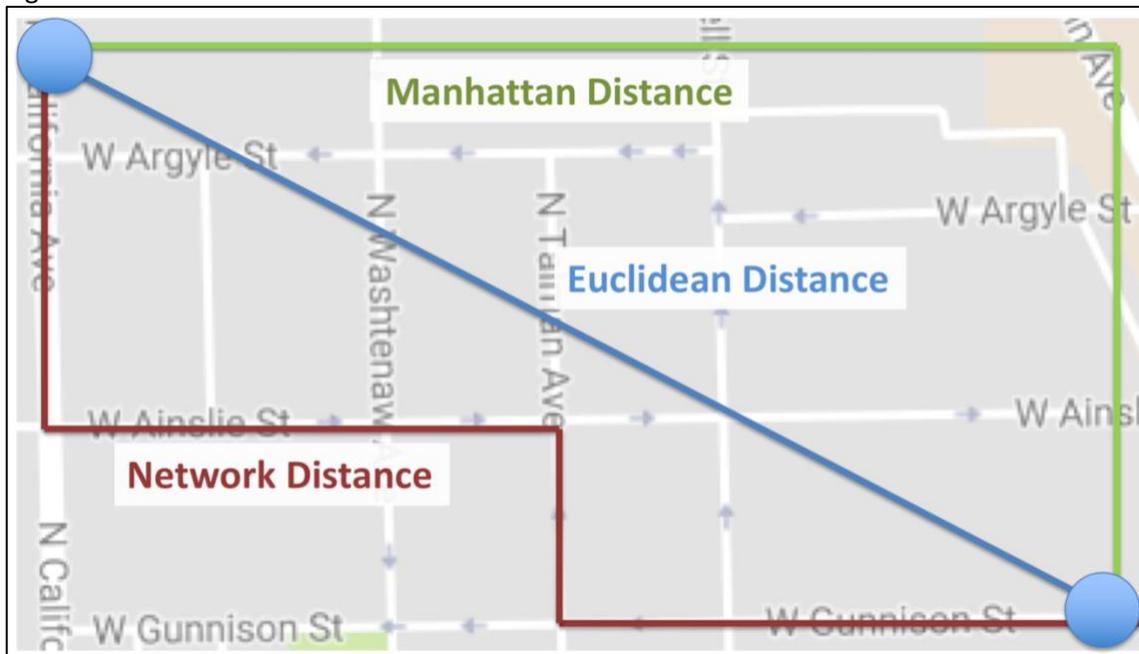
6. Appendix B:
Near Repeat-High Risk Zone (NR-HRZ) Intervention Tool

This program is designed to identify and operationalize the concept of near repeat crime. In short, a near repeat pattern is one where the areas surrounding a crime event are at a higher risk for future crime events for a limited amount of time. This tool was designed to test whether quickly providing residents with information about increased risk of burglary victimization could reduce subsequent burglaries. The tool can also be used to address other types of crime on a routine basis and evaluate the outcome.

6.1   Licensing

The Near Repeat-High Risk Zone Intervention Tool. Copyright (C) 2014. Elizabeth Groff, PhD & Travis Taniguchi, PhD. This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License (version 3) as published by the Free Software Foundation.

6.2   System Requirements

- Windows, Mac, or Linux OS
- 64-bit operating system recommended
- Several GB of storage space
- Internet access to CRAN package repository and http://tile.stamen.com/ on port 80 (R can be configured to use a proxy if necessary)

6.3   Program Requirements

- R
- Text editor
- Geographic Information System (optional)
- Near repeat calculator (optional)

6.4   Data Requirements

- Address Shapefile (points)
- Street network Shapefile with proper connectivity to support network analysis (lines)
- Study area mask Shapefile (polygons)
- Crime/incident Shapefile (points)

6.5   Access

The NR-HRZ tool and documentation can be downloaded at:
https://www.policefoundation.org/projects/translating-near-repeat-theory-into-a-geospatial-policing-strategy/

7. Appendix C:
Output from the Near Repeat High Risk Zone (NR-HRZ) Tracking Tool

The NR-HRZ tracking tool produced a treatment area provider form when treatment areas are assigned. The pdf document identified key information needed for event tracking as well as provided a space to log information on contacts made and treatments delivered.

Figure C-1.   Page 1- Experimental zone identifier and position in randomization sequence

```
Experiment Zone ID: 140044765, RCT Slot: 16
```
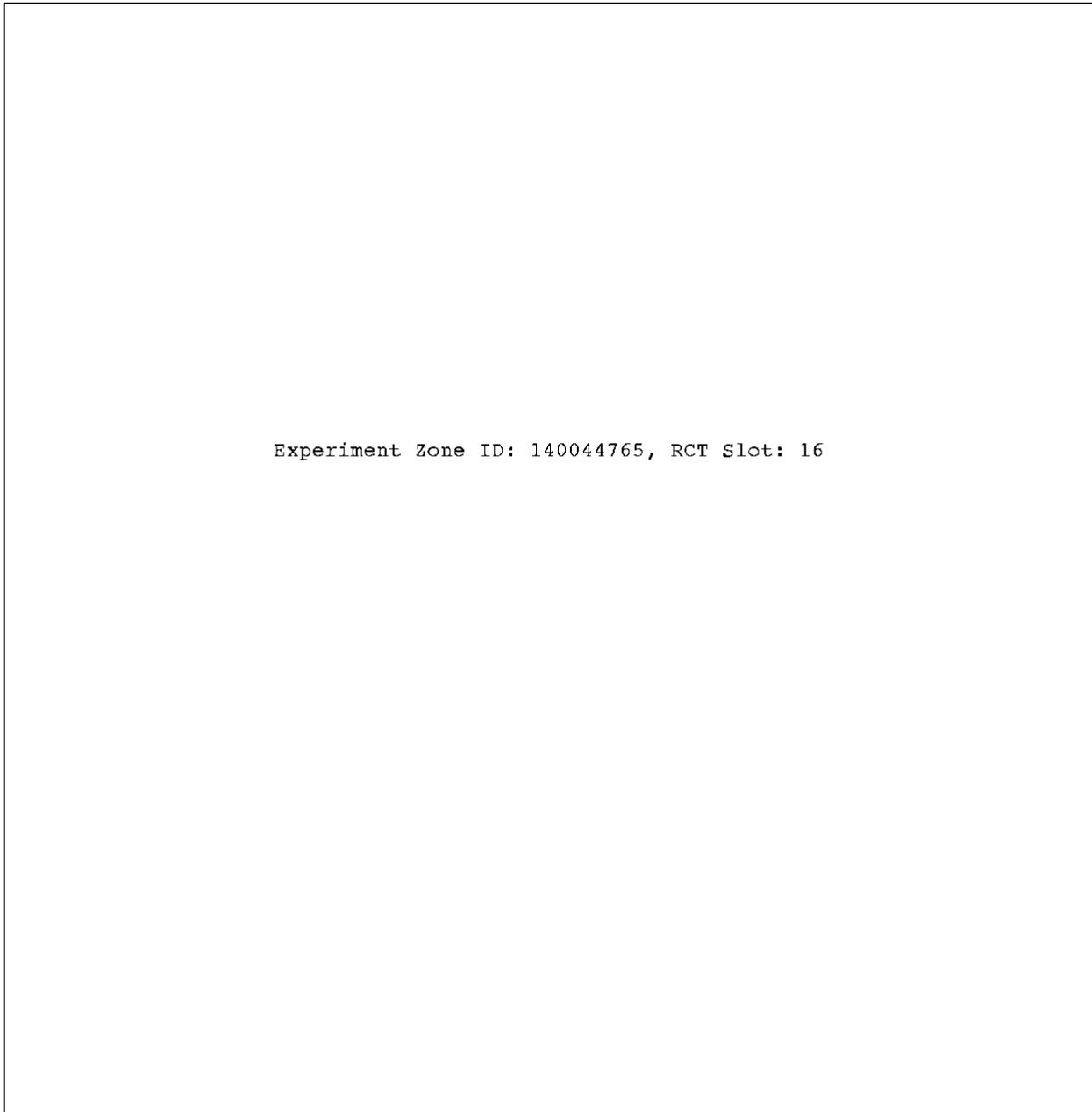
Figure C-2.   Page 2- Map of treatment area

Treatment Addresses & Instigating Event
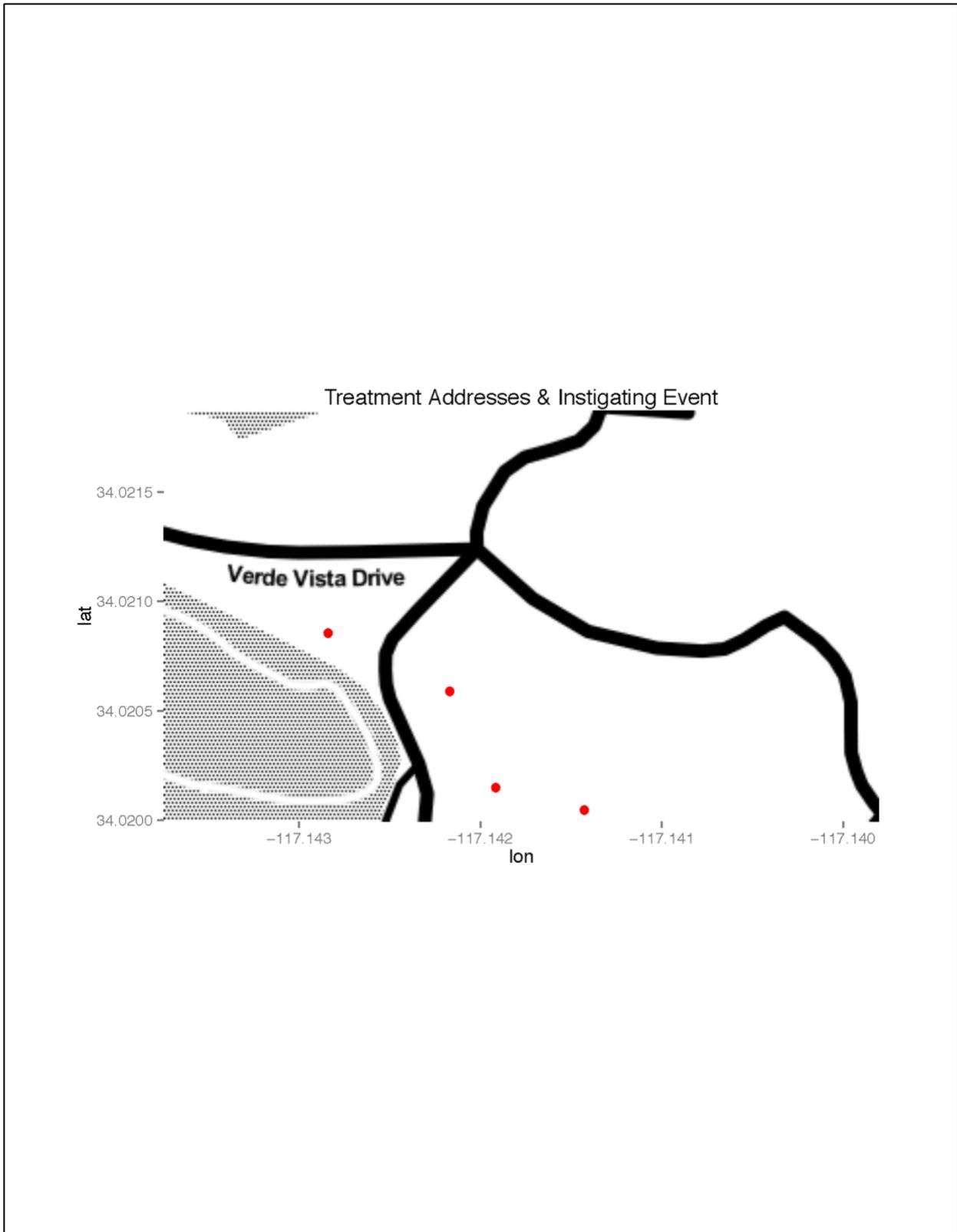
Figure C-3.　　　Page 3. Treatment area address list and activity log

StreetSegmentID	Address	Hangtag	Conversation	Referral
4193	101 VERDE VISTA DR	__	__	__
4193	193 COUNTRY CLUB RD	__	__	__
6630	199 COUNTRY CLUB RD	__	__	__
6630	190 COUNTRY CLUB RD	__	__	__
6630	193 COUNTRY CLUB RD	__	__	__
6630	114 COUNTRY CLUB RD	__	__	__
6630	117 COUNTRY CLUB RD	__	__	__
6630	120 COUNTRY CLUB RD	__	__	__
6630	122 COUNTRY CLUB RD	__	__	__

8. Appendix D: Treatment Script*

Instructions for field personnel

You are part of a part of a program to reduce the risk of near repeat residential burglary (i.e., burglaries that occur near one another in both time and space).

To accomplish this goal, you are being dispatched to visit all properties within approximately one block of the burglarized residence. Refer to the map and list of addresses you received for the specific addresses to be included.

At each residence, you should deliver a message with the following components: Inform – Reassure – Advise.

Ideally this message would be delivered within 24 hours of the burglary event. If you are unable to speak with the resident of the home, leave one of the burglary 'hangtags' on the front door. Although, the general burglary prevention tips on the hangtag are not likely to provide the same immediacy to residents, limited resources do not allow for multiple visits.

When you are able to speak with someone the following script should be used:

Inform

Tell the resident *"I'm not sure if you are aware, but there was a burglary nearby within the last few days"*. It's possible the resident may already be aware that there was a burglary or may be concerned why the police were in their neighborhood the day before. Tell them that you are there as part of a crime prevention program being implemented by the Department.

Reassure

Tell the resident *"The chances of you being burglarized are very low"* because they are. Although they are at a heightened risk, the actual probability of them being burglarized is still low. If you say "you are at a heightened risk of being burgled" it's likely they will interpret this as a burglary is imminent. The fact that a police department representative is on their doorstep speaking to them is already likely to raise alarm and concern, so tempering this with a realistic measure of risk is necessary.

Advise

Tell the resident *"There are a couple of things that you can do to help us out. If you see anything suspicious call 911, for non-emergencies call (909) 798-7681, or use the iPhone/Android Redlands Police app".* This contact information is on the hangtag. Offer practical seasonally-sensitive, tailored crime prevention advice. If you have been properly trained, offer to conduct a security assessment of the house.

It is critical for you to properly educate residents on the risk of burglary! Remember that the goal is to encourage actions that prevent future burglary.

*NOTE: This script was developed by Spencer Chainey and is used with permission. Chainey, S. (2012). Predictive mapping (predictive policing). JDI Briefs. Retrieved from Jill Dando Institute of Security and Crime Science website: http://discovery.ucl.ac.uk/1344080/3/JDIBriefs_PredictiveMappingSChaineyApril2012.pdf

9. Appendix E: Hang Card Text

Figure E-1. Redlands hangtag (English)

Figure E-2.   Redlands Hangtag (Spanish)

10. Appendix F: Resident Survey

Residential burglary prevention survey

This study involves research conducted by Temple University, the Police Foundation, and AGENCY. The purpose of the research is to understand your perceptions about the risk of residential burglary. This research is intended to benefit both your neighborhood and the [AGENCY] to reduce residential burglary. This research project is being funded by the National Institute of Justice under award number 2012-IJ-CX-0039.

What you should know about participating in this research study:
• The reasonably foreseeable risks from participating are minimal.
• Whether you take part is up to you.
• You can choose not to take part in the research study.
• Feel free to ask all the questions you want before and after you decide.

The estimated duration of your study participation is 10 minutes. The study procedures consist of one survey that may be conducted online at [WEBSITE] or via hardcopy which can be requested from Travis Taniguchi, PhD, Police Foundation, by calling 202-833-1460.

The benefits you will obtain from the research are the $5 (should you choose to claim it) and knowing that you have contributed to the understanding of how crime prevention materials are perceived by residents. By completing this survey, you will be assisting Temple University, the Police Foundation, and [AGENCY] in designing better responses to residential burglary. Your feedback is critical.

The alternative to participating is to not complete the survey and disregard any follow-up contact.

Please contact the research team with questions, concerns, or complaints by calling Elizabeth Groff, PhD (215-204-5164) at the Department of Criminal Justice, Temple University or Travis Taniguchi, PhD (202-833-1460) at the Police Foundation. This research has been reviewed and approved by the Temple University Institutional Review Board. Please contact them at: (215) 707-3390 or e-mail them at: irb@temple.edu for any of the following: questions, concerns, or complaints about the research; questions about your rights; to obtain information; or to offer input.

Confidentiality: This is an anonymous survey. In addition, every effort will be made to limit the disclosure of your individual responses only to people who have a need to review this information. However, there is always a slight risk of loss of confidentiality. There are several organizations that may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects. These organizations include the IRB, Temple University, its affiliates and agents, and the Office for Human Research Protections.

If you wish to receive the survey results, please visit our website at: http://goo.gl/hnrkCN
1. Do you agree to participate in the survey?
      ◯ Yes
      ◯ No

Background information

2. What type of home do you live in?
- ○ Detached single family home
- ○ Apartment or condo (single story)
- ○ Apartment or condo (2 or more stories)
- ○ Duplex or twin
- ○ Row home
- ○ Manufactured or modular home
- ○ Other Please enter an 'other' value for this selection.

3. Do you rent or own your home?
- ○ Rent or lease
- ○ Own

4. Is your home on a corner property (a property at the intersection of two or more streets)?
- ○ Yes
- ○ No

5. What type of street is your home located on?
- ○ Residential through street
- ○ Dead end or cul-de-sac
- ○ Major road

Burglary perceptions
6. Do you worry about being the victim of residential burglary?
- ○ Not at all
- ○ A little
- ○ Sometimes
- ○ Frequently
- ○ Always

7. To the best of your knowledge, how many burglaries have occurred near you (within two blocks) in the last six (6) months?
- 0
- 1
- 2-5
- 6-10
- 11 or more

- I don't know

8. Have you ever been the victim of a residential burglary at your current address?

◯ Yes
◯ No

9. [IF YES, Q. 8], When did the burglary occur? (If you have been burglarized more than once, please think back to the most recent occurrence)

- Less than a month ago
- 1-3 month(s) ago
- 4-6 months ago
- 7-9 months ago
- 10-12 months ago
- More than 1 year ago

10. [IF YES, Q. 8] Did you report this burglary to the police? (If you have been burglarized more than once, please think back to the most recent occurrence)

◯ Yes
◯ No
◯ I don't remember

Intervention

11. In the last six (6) months, have you received a notification, via a door hangtag or a visit from an uniformed representative of the [AGENCY], stating that your home was at higher risk for residential burglary?

◯ Yes
◯ No

12. [IF YES Q. 11] Were you home when the notification was delivered?

◯ Yes, and I spoke to the agency representative
◯ Yes, but I did not speak to the agency representative
◯ No, but another member of the household was home at the time
◯ No

13. [IF YES Q. 11], Was the person who delivered it courteous and helpful?

◯ Yes
◯ No
◯ I did not interact with the agency representative
◯ I do not recall

14. [IF YES, Q. 11] Did the agency representative offer to examine your home to assess the risk of burglary? (This may have been called a safety audit or a safety inspection).

○ A safety inspection was offered and conducted

○ A safety inspection was offered but I declined

○ A safety inspection was not offered

○ I was given a referral to schedule a safety inspection

15. [IF YES, Q. 11] Prior to the notification, did you know that a neighbor had been burglarized?

○ Yes

○ No

○ I do not remember

16. [IF YES Q. 15], How did you learn about the burglary

○ Directly from the neighbor that was burglarized

○ From another neighbor

○ From a crime alert service

○ From an online news source

○ From a print news source

○ From a television news source

○ Directly from an officer or other member of the [AGENCY]

○ Other Please enter an 'other' value for this selection.

17. [IF YES, Q. 11], Having received this notice/alert... Check all that apply.

□ I was more likely to report a burglary to the police

□ I was more vigilant about locking doors/windows/setting alarms

□ I installed physical security devices (such as deadbolts or security doors)

□ I installed a burglar alarm

□ I installed better exterior lighting

□ I trimmed trees and hedges away from windows and doors

□ I was more likely to watch out for my neighbors

□ I formed or joined a neighborhood watch program

□ I visited www.crimemapping.com to learn about crime in my neighborhood

□ I visited the [AGENCY NAME] website to learn about steps I could take to prevent crime

□ I signed up for email alerts about crime in my neighborhood

□ Other Please enter an 'other' value for this selection.

18. [IF YES, Q. 11], Did your perceptions of burglary in your neighborhood change as a result of the notification?

  ◯ I thought my neighborhood had more burglary

  ◯ I thought my neighborhood had less burglary

  ◯ I thought my neighborhood had about the same amount of burglary

19. [IF YES, Q. 11], If you received a notification and did not change your behavior or act on any of the burglary prevention suggestions, what kept you from doing so? Check all that apply.

  ☐ I did not want to spend the money on the suggestions

  ☐ I did/do not have the authority to change lighting, landscaping, etc.

  ☐ I did not have enough time to implement any changes

  ☐ I did not believe the suggestions would be effective

  ☐ I already used or employed the suggested crime prevention techniques

  ☐ I did not believe that the risk of burglary was very high

  ☐ Other Please enter an 'other' value for this selection.

Agency Perceptions

20. [IF YES, Q. 11], To what extent do you agree or disagree with the following statement: "The notification made me feel that [AGENCY] was being proactive in preventing burglary?"

  ◯ Strongly Disagree

  ◯ Disagree

  ◯ Neither agree nor disagree

  ◯ Agree

  ◯ Strongly agree

  ◯ No opinion

21. [IF YES, Q. 11] In general, what is your assessment of this burglary prevention effort?

  ◯ Very poor

  ◯ Poor

  ◯ Average

  ◯ Good

  ◯ Very good

  ◯ No opinion

22. [IF YES, Q. 11] Would you recommend that the [AGENCY] continue this program?

  ◯ Yes

  ◯ No

23. How likely are you to report suspicious activity in your neighborhood to the police?

⭕ Very unlikely

⭕ Unlikely

⭕ Neutral

⭕ Likely

⭕ Very likely

⭕ Undecided

24. If you were the victim of a residential burglary, how likely would you be to report it to the police?

⭕ Very unlikely

⭕ Unlikely

⭕ Neutral

⭕ Likely

⭕ Very likely

⭕ Undecided

Demographics

25. How many people are in your household (include yourself in the count)?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6 or more

26. What is your household income?
   - Less than $14,999
   - $15,000 - 29,999
   - $30,000 - $44,999
   - $45,000 - $59,999
   - $60,000 - $74,999
   - $75,000 - $99,999
   - More than $100,000
   - Prefer not to say

27. How long have you lived at your current residence?
   - Less than 1 year
   - 1 - 2 years
   - 3 - 5 years
   - 6 - 10 years
   - More than 10 years

28. If you have any questions or comments for the [AGENCY] or research team, write to us in the box below.

11. Appendix G: Treatment Provider Survey

Burglary mitigation initiative
Survey of field personnel

This study involves research conducted by Temple University, the Police Foundation, the Baltimore County Police Department, and the Redlands Police Department. The purpose of the research is to understand your perceptions about the residential burglary mitigation project in which you participated. This research is intended to assist both the community and the agencies to reduce residential burglary. This research project is being funded by the National Institute of Justice under award number 2012-IJ-CX-0039.

What you should know about participating in this research study:
- The reasonably foreseeable risks from participating are minimal.
- Whether you take part is up to you.
- You can choose not to take part in the research study.
- Feel free to ask all the questions you want before and after you decide.

The estimated duration of your study participation is 10 minutes. The study procedures consist of one survey that may be conducted online at [URL] or via hardcopy which can be requested from Elizabeth Groff, PhD, Temple University, by calling [PHONE].

The benefits you will obtain from the research are the $15 (should you choose to claim it) and knowing that you have contributed to the understanding of how crime prevention materials are perceived by the officers who delivered them. By completing this survey, you will be assisting Temple University, the Police Foundation, and law enforcement agencies in designing better responses to residential burglary. Your feedback is critical.

The alternative to participating is to not complete the survey and disregard any follow-up contact.

Please contact the research team with questions, concerns, or complaints by calling Elizabeth Groff, PhD [PHONE] at the Department of Criminal Justice, Temple University or Travis Taniguchi, PhD [PHONE] at RTI International. This research has been reviewed and approved by the Temple University Institutional Review Board. Please contact them at: [PHONE] or e-mail them at: [E-MAIL] for any of the following: questions, concerns, or complaints about the research; questions about your rights; to obtain information; or to offer input.

Confidentiality: This is an anonymous survey. In addition, every effort will be made to limit the disclosure of your individual responses only to people who have a need to review this information. However, there is always a slight risk of loss of confidentiality. There are several organizations that may inspect and copy your information to make sure that the study team is

following the rules and regulations regarding research and the protection of human subjects. These organizations include the IRB, Temple University, its affiliates and agents, and the Office for Human Research Protections.

If you wish to receive the survey results, please visit our website at: [URL]

1) Do you agree to participate in the survey?*
( ) Yes

( ) No

> ***Page exit logic:** Page Logic**IF:** Question "Do you agree to participate in the survey?" #1 is one of the following answers ("No") **THEN:** Disqualify and display: "Sorry, you cannot participate in this survey if you do not agree to the informed consent document. "*

2) Did you participate in a burglary prevention program that involved the delivery of these crime prevention hang tags?*

( ) Yes
( ) No

3) How many times did you go out to target areas to deliver burglary prevention information?*

( ) 0
( ) 1-2
( ) 3-5
( ) 6-10
( ) 11 or more

4) Did you participate in the burglary prevention initiative training provided by the Department?

( ) Yes
( ) Unsure
( ) No

5) Are you trained to complete burglary prevention security audits for residents?

( ) Yes
( ) Unsure
( ) No

6) Indicate your level of agreement with the following statement: "The goals of my activity in the targeted crime prevention areas were clear"

( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

7) What did you think were the goals of this burglary prevention initiative (select all that apply).

[ ] Preventing more burglary from occurring

[ ] Preventing other kinds of crime

[ ] Engaging the community in crime prevention

[ ] Putting more uniformed personnel in the community to act as the "eyes and ears" of the department

[ ] Educating residents on how to make it more difficult to burglarize their homes

[ ] Being a visible presence representing the Department

[ ] Locating witnesses or other sources of evidence for detectives/investigators

[ ] Other - Describe: _____

Logic: Hidden unless: Question "What did you think were the goals of this burglary prevention initiative (select all that apply)." #7 is one of the following answers ("Preventing more burglary from occurring","Preventing other kinds of crime","Engaging the community in crime prevention","Putting more uniformed personnel in the community to act as the "eyes and ears" of the department","Educating residents on how to make it more difficult to burglarize their homes","Being a visible presence representing the Department","Locating witnesses or other sources of evidence for detectives/investigators","Other - Describe")

Piping: Piped From Question 7. (What did you think were the goals of this burglary prevention initiative (select all that apply).)

In your opinion, how successful was the program in achieving the goal of: [question("piped title")]

( ) Successful

( ) Somewhat successful

( ) Somewhat unsuccessful

( ) Unsuccessful

Indicate your agreement with the following statements:

8) "I felt safe while delivering the community notifications"

( ) Strongly agree

( ) Agree

( ) Undecided

( ) Disagree

( ) Strongly disagree

9) "Volunteers/Auxiliary officers should always be deployed in pairs"

( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

10) "The community responded positively to my presence in their neighborhood"

( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

11) "I had a positive impact on the community's relationship with the Department"

( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

12) "I had a meaningful impact in preventing burglary"

( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

13) "Overall, I had a positive impact on the community"

( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

Engagement with the Department

Indicate your agreement with the following statements:

14) "Participation in this program improved my experience volunteering with the Department"
( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

15) "Participation in this program would make me more likely to volunteer in the future"
( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

16) "I am an important part of the Department's crime prevention strategy"
( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

17) "The Department should continue this burglary prevention program"
( ) Strongly agree
( ) Agree
( ) Undecided
( ) Disagree
( ) Strongly disagree

18) Were there any especially positive experiences that you would like to tells us about?

_____

_____

19) Were there any especially negative experiences that you would like to tell us about?

_____

_____

20) Are there any improvements to the program that you would suggest?

_____

_____

Demographics

21) Age
( ) 18-24
( ) 25-34
( ) 35-44
( ) 45-54
( ) 55-64
( ) 65+

22) Gender
( ) Male
( ) Female

23) How long have you been a volunteer with the department?
( ) Less than 12 months
( ) 1 Year
( ) 2 Years
( ) 3 Years
( ) 4 Years
( ) 5 Years
( ) 6 Years
( ) 7 Years
( ) 8 Years
( ) 9 Years
( ) 10 Years or more

24) I am a...
( ) RPD CVP
( ) RPD CVPR
( ) BCPD Auxiliary Officer
( ) BCPD Police Officer
( ) Other - Please Describe: _____

25) Are there any other comments about this crime prevention effort that you would like to share?

_____

_____

26) Do you wish to claim the survey incentive?*
( ) Yes
( ) No

<div style="background-color:#b5a5cf; border:1px solid black; padding:10px;">

Page exit logic: Page Logic**IF:** Question "Do you wish to claim the survey incentive?" #26 is one of the following answers ("No") **THEN:** Jump to page 8 - Thank You! Flag response as complete

</div>

As compensation for participation in this survey, we are offering a $15 Amazon gift card. If you do not want this Amazon gift card you can leave the this page blank.
27) Provide the email address where your Amazon Gift Certificate will be sent. (Your email address will not be used for any other purpose besides receiving this gift certificate.)
Email: _____

If you would prefer to receive your Amazon Gift Certificate via mail, please enter your address below. We will not use this address for any other purpose. Once your gift certificate has been mailed we will delete this address. You do not need to enter a mailing address if you wish to receive the gift certificate via email.

28) Mailing address
First Name: _____
Last Name: _____
Street Address: _____
Apt/Suite/Office: _____
City: _____
State: _____
Zip: _____

Thank You!
Thank you for taking our survey. Your response is very important to us.
                                             ###

12. Appendix H: Treatment Provider Tracking Form

High risk area id number

Date & time treatment was requested   Date: _____   Time:

Date & time entered treatment area   Date: _____   Time:

Time exited treatment area   Time: _____

# of personnel delivering treatment

Indicate the number of:
        Hangtags delivered, no conversation
        Conversations w/ resident, no hang tag
        Conversation w/ resident, + hang tag
        Conversations with individuals in public
        Security surveys requested

Locations requesting residential security survey (if any)
 1.   4.
 2.   5.
 3.   6.

Were any addresses not treated? *Record address and reason for not treating.*
Total Number of houses not treated: _____
 1.   4.
 2.   5.
 3.   6.

Were any addresses added to treatment? *Record address and reason for not treating.*
Total Number of houses not treated: _____
 1.   4.
 2.   5.
 3.   6.

Was any criminal intelligence gathered?	Yes	No

If yes, please explain the nature of the intelligence (*do not include any confidential information*):

If information was passed to local burglary section, list the officer name:

Enter this form at [WEBSITE]
Save the hard copy

13. Appendix I: Near Repeat Crime Potential Calculator

A significant number of previous studies have identified that once a crime occurs, there is a significantly higher probability that another crime will occur within a short temporal and spatial window. This tool allows the calculation of the number of near repeat events that occurred in historical data which provides an estimate of the likely number of events that might be prevented if an agency undertook an intervention aimed at reducing near repeat crime. In short, the tool quantifies the crime prevention potential across a range of times and distances.

13.1 Licensing

The Near Repeat Crime Prevention Calculator. Copyright (C) 2018. Elizabeth Groff, PhD & Travis Taniguchi, PhD. This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License (version 3) as published by the Free Software Foundation.

13.2 System Requirements

- Windows, Mac, or Linux OS
- 64-bit operating system recommended
- Several GB of storage space
- Internet access to OpenStreetMap to access network files (optional).

13.3 Program Requirements

- Geographic Information System (optional)

13.4 Data Requirements

- Address Shapefile (points)
- Street network Shapefile with proper connectivity to support network analysis (lines; optional)

13.5 Access

The Near Repeat Crime Prevention Calculator and documentation can be downloaded at: https://www.policefoundation.org/projects/translating-near-repeat-theory-into-a-geospatial-policing-strategy/

14. Appendix J: Effect of the treatment on other property crime

Table J.1   **Other Property Crimes (ex. Burglary) in Treatment/Control Areas—Baltimore County**

			1 Week		1-2 Weeks		1–4 Weeks		1–8 Weeks		1–12 Weeks	
		N	Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)
NR-HRZ	Control	120	0.042 (.201)	-0.517	0.092 (0.317)	-0.542	0.258 (0.542)	-0.874	0.442 (0.818)	-0.608	0.608 (1.014)	-0.585
	Treatment	122	0.057 (0.267)	(0.605)	0.115 (0.345)	(0.589)	0.328 (0.686)	(0.383)	0.508 (0.884)	(0.544)	0.689 (1.114)	(0.559)
Buffer	Control	120	0.083 (0.357)	0.670	0.150 (0.461)	0.489	0.283 (0.638)	-0.219	0.508 (0.926)	0.001	0.708 (1.232)	-0.028
	Treatment	122	0.057 (0.234)	(0.503)	0.123 (0.398)	(0.625)	0.303 (0.77)	(0.827)	0.508 (1.159)	(0.999)	0.713 (1.411)	(0.978)

Table J.2.   **Other Property Crimes (ex. Burglary) in Treatment/Control Areas—Redlands**
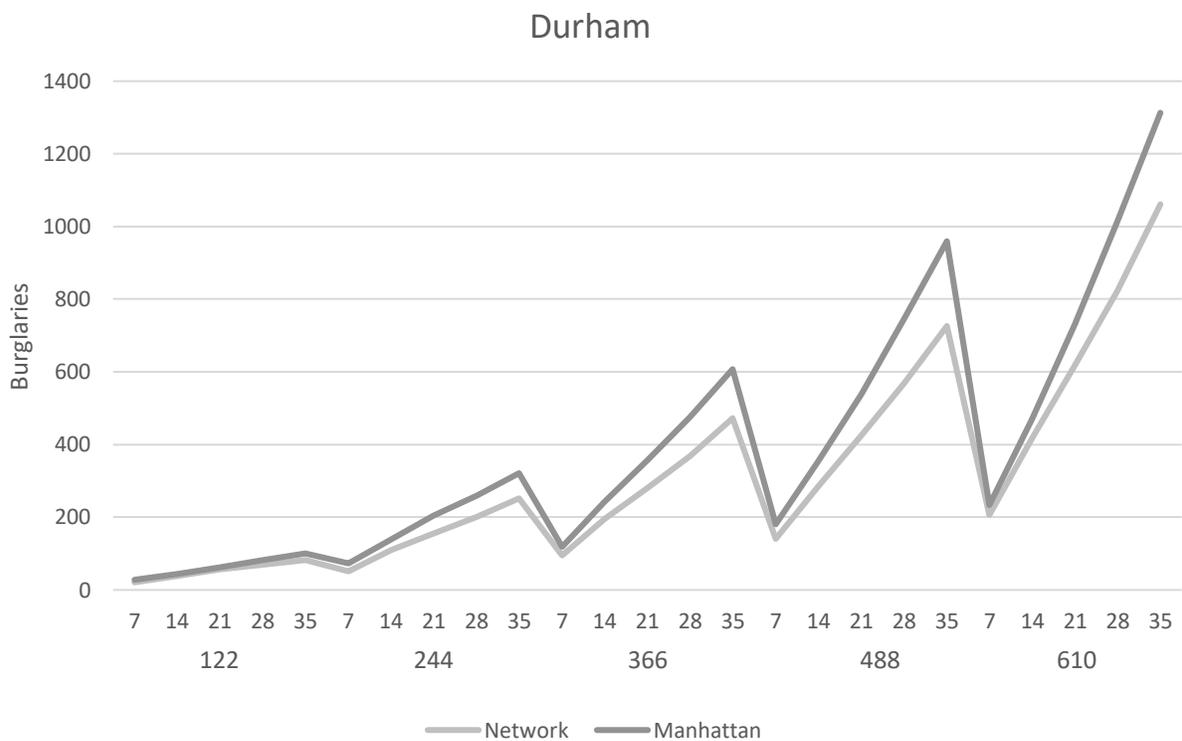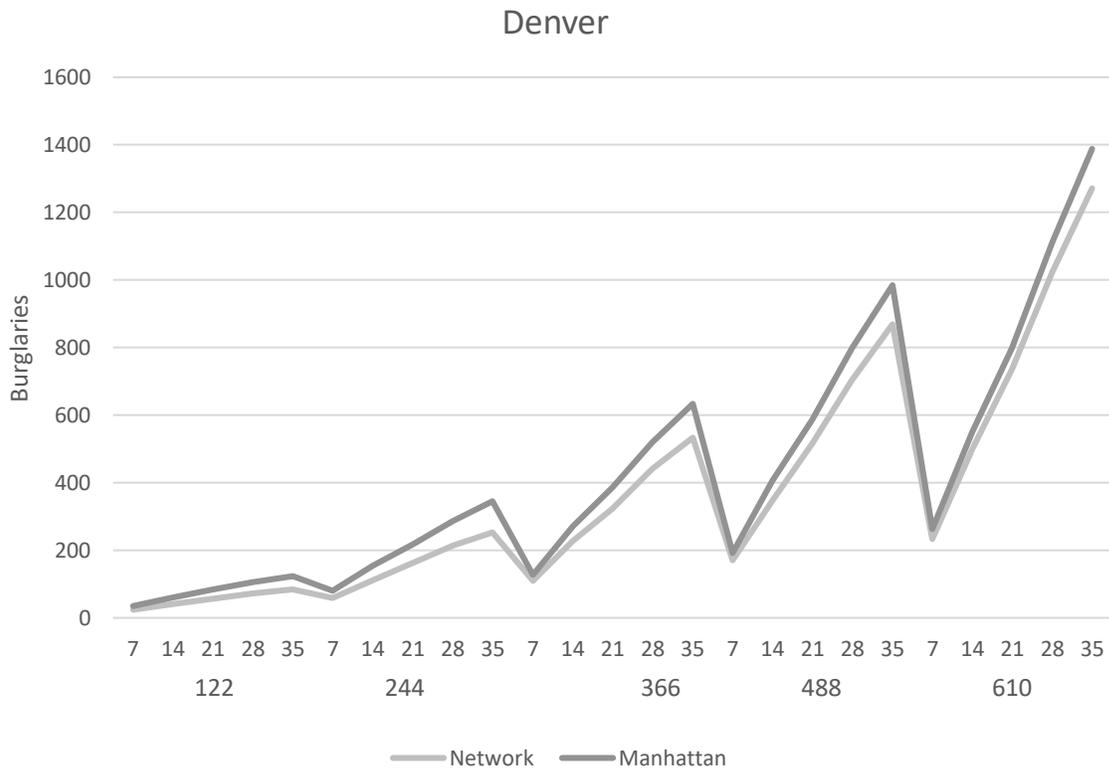
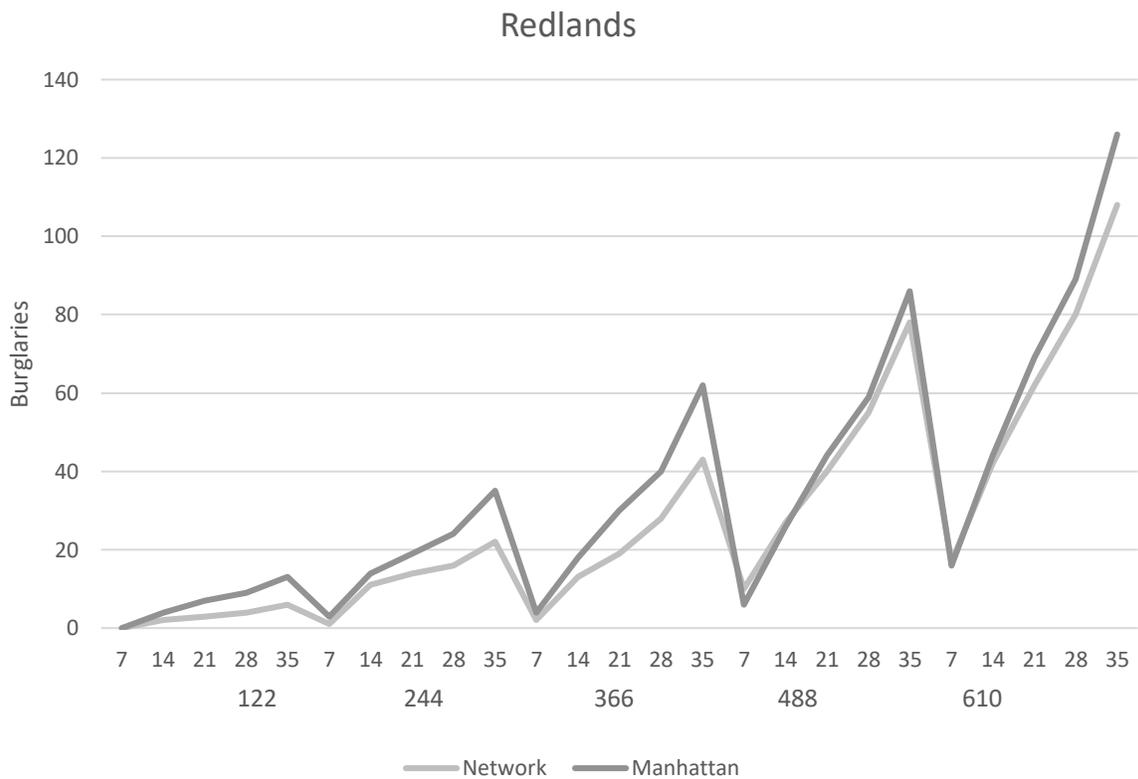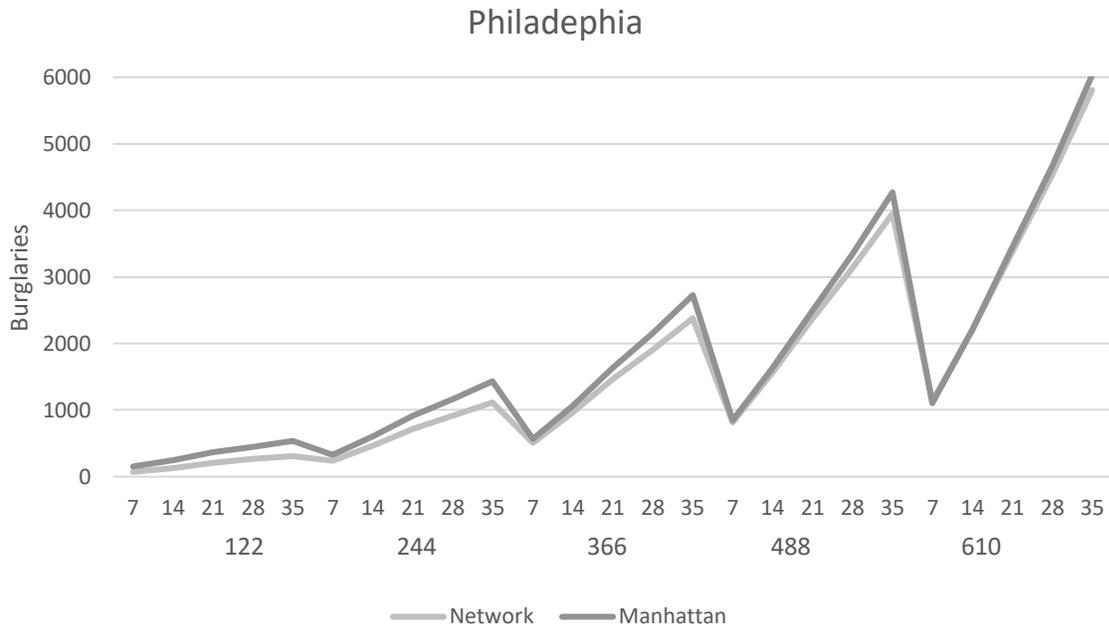|			1 Week		1-2 Weeks		1–4 Weeks		1–8 Weeks		1–12 Weeks	
		N	Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)	Mean (SD)	t (p)
NR-HRZ	Control	65	0.0 (0.0)	-1.392	0.015 (0.124)	-1.315	0.092 (0.384)	-0.526	0.154 (0.507)	-0.509	0.231 (.580)	-0.786
	Treatment	69	0.0294 (0.170)	(0.166)	0.058 (0.237)	(0.191)	0.1323 (0.486)	(0.600)	0.206 (0.659)	(0.612)	.353 (1.117)	(0.433)
Buffer	Control	65	0.092 (0.292)	1.5269	0.138 (0.428)	0.276	0.215 (0.545)	-0.345	0.385 (0.784)	-0.597	.569 (1.045)	-0.415
	Treatment	69	0.0294 (0.170)	(0.129)	0.118 (0.441)	(0.783)	0.250 (0.608)	(0.730)	0.471 (0.872)	(0.552)	0.647 (1.117)	(0.679)

15.   Appendix K: Variation in numbers of burglaries per space-time interval by distance measurement method
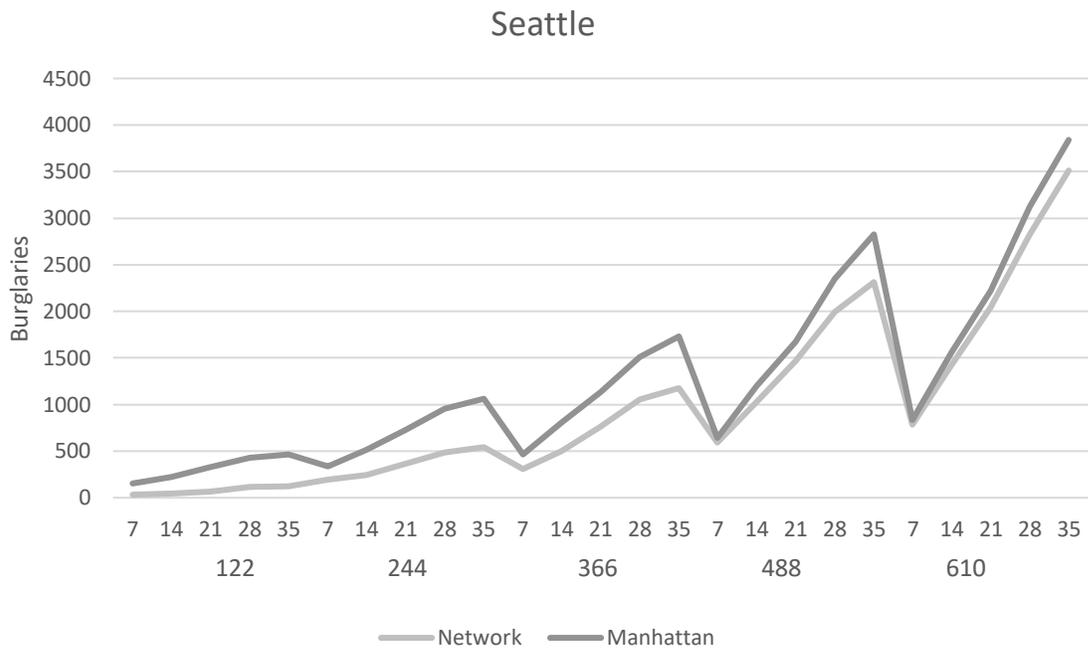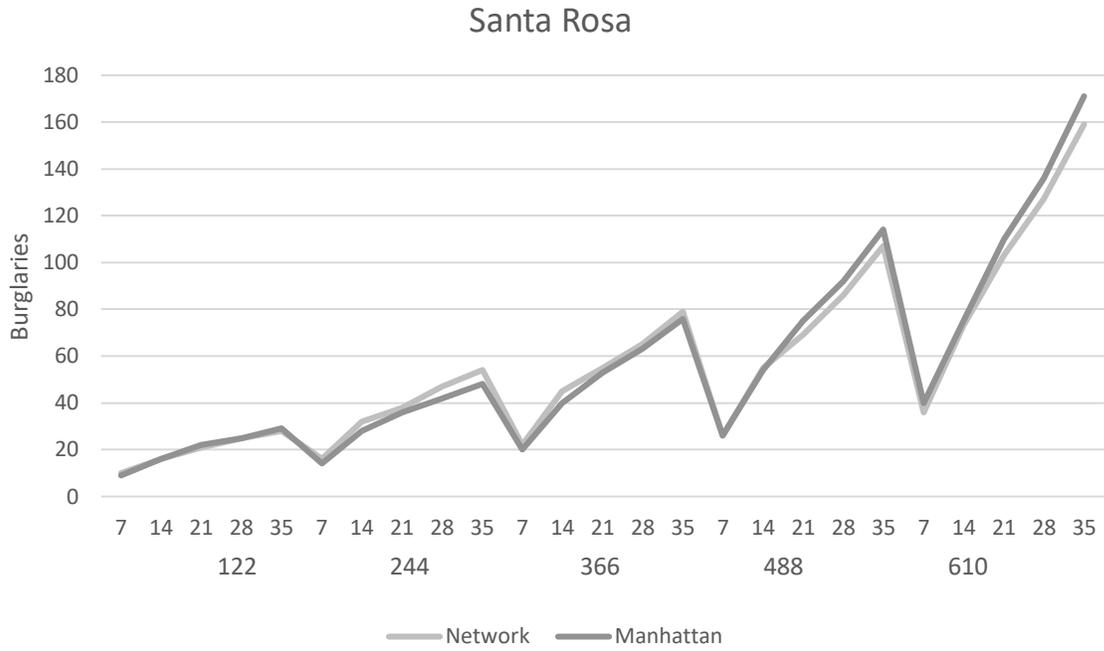
This series of graphs shows the number of burglaries on the y-axis and the day-time window on the x-axis (7, 14, 21, and 35-day temporal bands for each distance band of 122, 244, 366, 488, and 610 meters). The size of the difference between the two measurement methods is represented by the gap between the two lines.
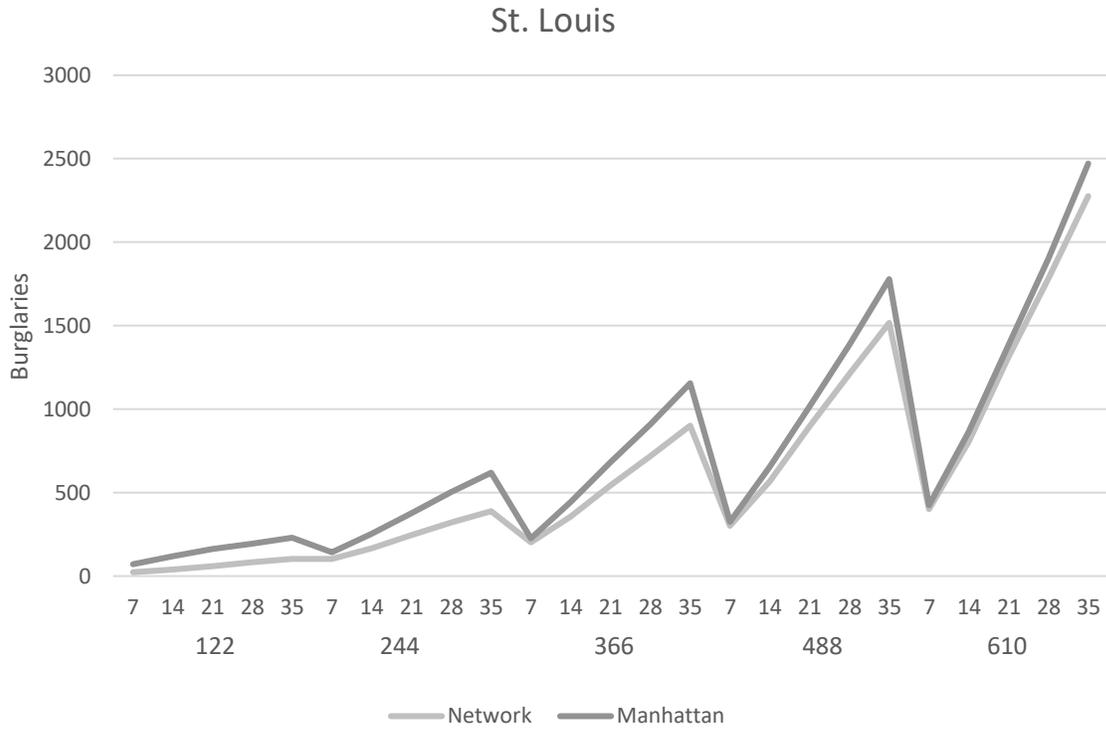
In the case of Baltimore County, the size of the difference between the two measurement methods increases as the size of the distance band used increases. For each new bandwidth, the number of burglaries increases as the temporal bandwidth increases. The increases are larger as the spatial bandwidth size increases.

Baltimore County

Denver

Durham

Fayetteville

Orlando

Philadephia

Redlands

Santa Rosa

Seattle

St. Louis
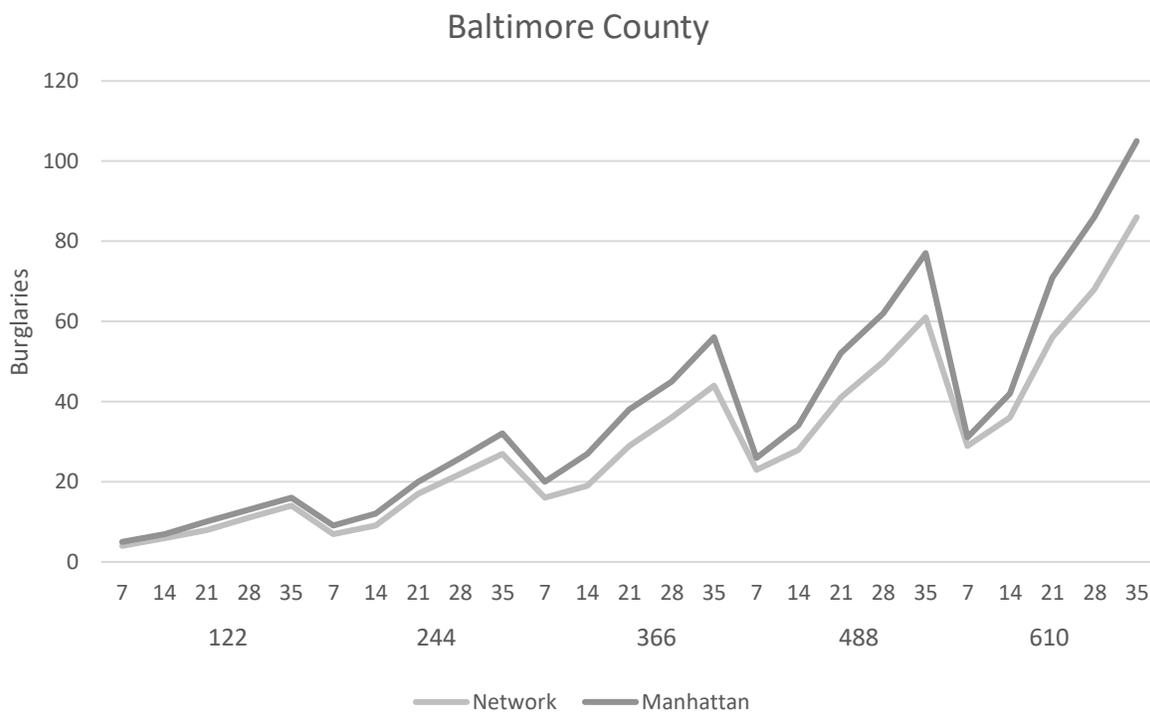
Related Publications:

1. Micro-Level Policing for Preventing Near Repeat Residential Burglary
   Monograph (Technical Report)

2. Interrupting 'Near Repeat' Burglary Patterns: Rapid Identification and Interaction with At-Risk Residents After a Burglary
   Research Brief (Summary Report)

3. Near Repeat Crime Prevention Potential Calculator
   User Manual, v. 1.0

4. Near Repeat Area Identifier Tool
   User Manual, v. 2.3

5. 5 Things You Need To Know About Near-Repeat Patterns and Crime Prevention
   Police Foundation *5 Things* series

6. Preventing Near Repeat Residential Burglary
   Police Foundation *Research Summaries* series

7. Tackling Near Repeat Crime, A Practitioner's Guide
   Police Foundation *Strategy Briefs* series