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ORIGINAL PAPER

Proactive Police Response in Property Crime Micro-time Hot Spots: Results from a Partially-Blocked Blind Random Controlled Trial

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Abstract

Objectives To evaluate the impact of proactive police response on residential burglary and theft from vehicle in micro-time hot spots as well as whether spatial displacement occurs.

Methods Over 2 years, 114 treatment and 103 control micro-time hot spots were assigned to groups using "trickle-flow" randomization. Responses were implemented as part of the police department's established practices, and micro-time hot spots were blocked based on their temporal proximity—sprees or ongoing. The study was blinded and tested proactive patrol versus a no-dosage control condition.

Results The department responded to each micro-time hot spot with, on average, five 20-min responses per day for 19 days. Eighty percent of the response time involved conducting directed patrol without encountering suspicious activity. Results show that treatment micro-time hot spots had significantly fewer crimes after 15 days (79%) and 30 days (74%). Treatment effects were greatest in the first 15 days (1.15) followed by days 16–30 (.83).

Conclusions The study examines a real-world strategy institutionalized into the day-today operations of a police department. The largest impact on crime was seen during response. In addition, crime reductions that occurred while micro-time hot spots received response held for 2 months after the responses end with no evidence of spatial displacement. Our findings reveal larger effect sizes than most hot spots policing studies which may be due to how the unit of analysis was defined, the systematic nature of the response implementation, and the use of a no-dosage, blind control condition.

Keywords RCT · Blind experiment · No-dosage control · Proactive policing · Micro-time hot spots · Property crime

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Introduction

A comprehensive review of the research testing proactive policing strategies published by the National Academic of Sciences has recently concluded that place-based strategies are effective in reducing crime (Weisburd and Majmundaar 2018). The evidence suggests that these strategies produce short-term crime-reduction effects without spatial displacement and generate diffusion of benefits into immediately adjacent areas (Weisburd and Majmundaar 2018). Importantly, most of the studies on which these conclusions are based test strategies implemented in long-term, stable concentrations of crime (Braga et al. 2019).

In practice, police have identified and responded to short-term spatial concentrations of crime as part of their crime reduction efforts for many decades (Austin et al. 1973; Gallager et al. 2017; O'Shea and Nicholls 2003; Santos 2017). Yet, there are few studies that examine police response in short-term crime clusters (Braga et al. 2019), which are referred to here as micro-time hot spots. The National Academy of Sciences committee recognizes this gap and emphasizes the need to examine real-world application of proactive policing strategies that are place-based (Weisburd and Majmundaar 2018). The Society of Prevention Research (SPR), which lays out standards for prevention research more generally, also endorses studies conducted in real-world conditions because they can help set the stage for later implementation and sustainability of effective interventions on a broader scale (Gottfredson et al. 2015).

To help fill the gap of research on short-term crime clusters and on real-world implementation of proactive policing approaches, we previously conducted a 5-year quasi-experimental evaluation of proactive police response to micro-time hot spots (Santos and Santos 2015a, b, c). The results have recently been assessed as "effective" based on the National Institute of Justice's crimesolutions.gov methodology (National Institute of Justice 2018). The study tested one police department's place-based strategy to address residential burglary and residential theft from vehicle micro-time hot spots using directed patrol. Using propensity scores to match treatment and comparison micro-time hot spots, the findings of two separate analyses showed that police response lead to statistically significant reductions of nearly 20% for both crime types (Santos and Santos 2015b, c).

These encouraging findings provided support for conducting a random controlled trial to test the same place-based strategy which is presented in this article. Our research design is somewhat unique, so before presenting our study, we discuss how it coincides with recent efforts to expand and refine hot spots policing research. In a recent article published in *Criminology*, Ariel et al. (2020) argue that the treatment effects found in previous hot spots policing studies are highly dependent on response dosage. They admit it is difficult to make definitive conclusions because exact measures of treatment group dosage in studies have been rare. However, in a cursory review of several hot spots studies with transparent measures of dosage, they found the higher the dosage in the control group, the lower the effect size. They conclude this may be a contributing factor in explaining why effect sizes of previous hot spots policing experiments "to date" are generally small (Ariel et al. 2020, p. 104).

More specifically, Ariel et al. (2020) argue that while experiments should start with treatment and control groups that have similar levels of response dosage, it is the gap between the levels during implementation that is an important consideration when assessing effect size. They argue that when the gap between the treatment and control dosage is relatively small, researchers may be underestimating the impact of the treatment by essentially watering it down. Their concern is that effect sizes that result from experiments

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where the gap is smaller depends just as much on the level of patrol in the control group as it does in the treatment group. They concede that this is a difficult issue to unravel in previous studies, but suggest to avoid this problem altogether, future hot spots policing experiments must include research designs with a "no dosage control condition" (Ariel et al. 2020, p. 105).

Our study was conducted before Ariel et al. (2020) make these arguments. We thought it important to place this research within the context of their recent ideas since they advocate improving hot spots policing research, and our study contributes to this cause. In this study, the unit of analysis is the micro-time hot spot which "flares up" throughout a jurisdiction and does not necessarily occur in long-term or chronic crime concentrations. While each individual reported crime receives a traditional police response (i.e., patrol answered the call and wrote a report), there is no proactive response implemented for individual crimes. In addition, the proactive responses are activated only when crimes cluster into a definable micro-time hot spot. Thus, no proactive response occurs in a micro-time hot spot when it is assigned to the control group which results in a no-dosage control condition. Even further, the study is blinded which makes the integrity of the no-dosage control condition even stronger.

Consequently, this article presents the results of a partially-blocked, blinded random controlled trial (RCT) that tests the effects of a proactive policing strategy for residential burglary and residential theft from vehicle micro-time hot spots. This study improves upon the methodology and data collection of the quasi-experiment while examining the same research question. It is our hope that the findings using rigorous methods, a clearly defined unit of analysis, specific response requirements, and a no-dosage control condition offer meaningful evidence and understanding of proactive policing approaches applied to short-term property crime concentrations.

The Micro-time Hot Spot

Micro-time hot spots are not crime counts or statistical predictions, but are instead, defined as the emergence of several closely-related crime incidents within a few minutes travel distance from one another that occur within 1–2 weeks (i.e., micro-time). Clearly differentiating micro-time hot spots from long-term hot spots is important for both research and police practice in order to truly understand which strategies work in different conditions and to direct police resources correctly (Gorr and Lee 2015; McLaughlin et al. 2007; Santos and Taylor 2014). While both types are defined as concentrations of crimes occurring in relatively small geographic areas, the distinction lies in their temporal durations. Long-term hot spots are typically identified using between 12 and 24 months of crime incident data (Braga et al. 2019) and are stable year to year (Weisburd et al. 2012). Micro-time hot spots are identified with recent data (e.g., the most immediate 1–14 days), are short-lived, and occur in high and low crime areas throughout a jurisdiction—in other words, are crime "flare ups" (Santos 2013).

In essence, micro-time hot spots are clusters of near repeats. Researchers have found that non-victimized places near places that have been victimized are much more likely to be victimized, and these "near repeats" tend to occur rather rapidly (Bowers and Johnson 2005; Johnson et al. 2007, 2009). Much of near repeat research has focused on residential burglary and theft from vehicle crime. Studies show that houses located on the same side of the street of an initial burglary were 1.5 times more likely to be burglarized than houses

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on the opposite side of the street (Bowers and Johnson 2005), most near repeat burglaries occur within 7 days of the original burglary (Sagovsky and Johnson 2007), and roughly 40% all theft from vehicle near repeats occur within 14 days and 50% within 28 days (Johnson et al. 2007).

The research also consistently finds that individuals living where near repeats occur are likely suspects because offenders use the least amount of effort by choosing targets most convenient to them (Bernasco 2010; Bernasco and Nieuwbeerta 2005). That is, offenders tend to commit crime relatively close to where they live, and the farther offenders travel from where they live, the less likely they will offend (Bernasco 2010). Studies show around 98% of repeat burglaries that occur within a week are caused by returning offenders (Bernasco 2008; Johnson et al. 2009). Through interviews with serial burglary offenders, Johnson (2013) finds that they commit crimes in close proximity in time and space even if the crimes are separated by long time periods.

Notably, micro-time hot spots occur within stable, long-term hot spots as well as in other areas not accustomed to high levels of crime (Gorr and Lee 2015; McLaughlin et al. 2007; Santos 2013). Johnson et al. (2008) examined residential burglary and theft from vehicle data in 2-week intervals over 6 months and found most 2-week periods had little risk of victimization, but there were 2-week periods in certain areas with very high risk for crimes. These researchers and others conclude that identifying long-term hot spots can create the misconception that crime is continuous or consistently non-existent in an area, which can overlook crime flare ups that occur in isolation (Gorr and Lee 2015; Johnson et al. 2008). Taken together, these findings strongly suggest that short-term crime flare ups can and should be a focus of proactive place-based policing approaches.

Hot Spots Policing Strategies

The goal of police response to micro-time hot spots is to immediately curtail subsequent crimes once the micro-time hot spot is identified. As a short-term phenomenon, they warrant an immediate, short-term response. The Campbell Systematic Review concludes that implementing a short-term police response—particularly increased directed patrol—in long-term hot spots is effective in reducing crime; however, the effects of the responses tend to dissipate quickly after the intervention has ended (Braga et al. 2019). Thus, it is important to examine if the same hot spots policing responses are effective for reducing crime in short-term hot spots. Consequently, the responses tested in this study are similar to those tested for long-term hot spots and include directed patrol and field contacts, arrests, and crime prevention contacts with citizens.

The way in which the proactive responses were implemented in this study is important for both methodological considerations as well as practical implications. Response to micro-time hot spots has been institutionalized into the day-to-day crime reduction activities of the police department in this study. That is, for many years, the department has systematically responded to micro-time hot spots as part of an overall proactive crime reduction approach called stratified policing.[1] A departmental policy dictates that crime analysts

[1] Stratified policing is an organizational model for carrying out proactive problem-based, placed-based, offender-based, and community-based activities as part of the day-to-day business of the police organization. The primary goal is to systematize implementation and sustain proactive crime reduction practices by providing a framework for processes similar to the institutionalized process of answering calls for service. For more information see, Santos and Santos (2020).

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identify micro-time hot spots every day. When a crime analysis product is disseminated, specific responses by multiple divisions in the agency immediately occur for a set time period. A system of accountability to ensure the responses are implemented includes real-time response documentation as well as weekly and monthly meetings in which managers and commanders are held accountable for both response implementation and success. This established process allowed for the study to be blinded as well as a test of sustained practices.[2]

Research Setting

This experiment was conducted with the Port St. Lucie, FL Police Department.[3] Because the city is a suburban bedroom community with no major malls and very few large business plazas, residential burglaries and thefts from vehicles occurring in residential neighborhoods are two key crime problems addressed by the police department.[4] The department fully institutionalized its stratified policing structure and response to all micro-time hot spots was mandatory—similar to how answering calls for service is mandatory for police officers. Notable characteristics of the study include:

1. No one knew the study was being conducted except the chief, two assistant chiefs, two crime analysts, and the two researchers.
2. The police department considers burglary and theft from vehicle in residential areas together because proactive police strategies addressing them are very similar. All micro-time hot spots that included either or both of these crimes were considered to reflect the department's day-to-day practices.
3. Micro-time hot spots were randomly allocated to treatment and control conditions as they were identified on a daily basis.
4. Responses occurred as part of normal police department business with no additional resources. Each micro-time hot spot received a similar response.
5. Control micro-time hot spots received no proactive police response and were not known to department personnel (i.e., no dosage control condition).

Experimental Design

The research design is a partially-blocked, blind random controlled trial conducted over 2 years. The next sections provide details on the identification and randomization of micro-time hot spots, how the treatment was implemented, as well as the data collection and variables used in the analysis.

[2] More detail on this process is provided in the treatment fidelity section.

[3] The study was conducted pro bono by the researchers as well as the police department in that no one or entity received external funding for time or resources spent to carry out the research.

[4] The department serves the city of Port St. Lucie, Florida which is located along the southeast coast. The city's population in 2015 was around 175,000 with over 120 square miles. As of July 2015, there were 224 authorized sworn and 65 civilian positions and the property crime rate in 2014 and 2015 was 1449 and 1364 per 100,000, respectively.

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Identification of Micro-time Hot Spots

For the duration of the experiment, the same two crime analysts used minimum criteria based on the geographical size of the jurisdiction, the nature of single family home zoning, the amount of crime in the community, and the area that was realistic for officers to patrol in cars for around 15–20 min. The minimum criteria included:

- At least two residential burglary and/or residential theft from vehicle incidents occurring within 14 days in a .20-mile radius; or
- At least 3 of these crimes within 14 days in a .40-mile radius.

Importantly, meeting these criteria did not automatically result in a micro-time hot spot. The crime analysts finalized each micro-time hot spot using qualitative crime pattern identification methodology which considers the victim/suspect relationship, method of the crime, time of day, property taken, and unique characteristics of the crimes (Gallager et al. 2017; Santos 2017). In addition, the crime analysts critically assessed environmental and geographic factors, such as physical (e.g., large interstates, zoning) and social barriers (e.g., neighborhood boundaries), when determining if crimes were related. These critical decisions were based both on the characteristics of the crimes themselves as well as on the potential for focused police response. This entire analytical process is different than other methods identifying short-term clusters of crime that only use temporal and spatial proximity of the crimes.[5]

Once a micro-time hot spot was identified, the crime analyst produced a one-page bulletin including information such as date, time, location, modus operandi (MO), property taken, whether evidence was collected at the scene (e.g., fingerprints and DNA), and if known burglary or theft offenders live in the area. A map was included that illustrated the crime locations, field intelligence contacts, known offenders' residences, and the geographic radius of the crimes. The following three variables were gleaned from the initial bulletin for the equivalence analysis of the treatment and control groups:

- Initial Crime: Number of crimes in the micro-time hot spot which measures its relative intensity.
- Initial time span: Number of days between the first and last crime which provides the temporal scope of the micro-time hot spot.
- Initial radius: Radius created by a circle placed around the outermost crimes and provides the relative size of the micro-time hot spot.

Sample Size and Blocking

An important factor in an experiment is having an adequate sample size to produce the necessary power and to have confidence in the results (Weisburd and Gill 2014). At the outset of the project, we used the G*Power 3.0.10 software to conduct an a priori analysis to determine the necessary sample size. The effect sizes (Cohen's *d*) that resulted in the

[5] Some examples of these other methods include the near repeat calculator (Ratcliffe 2009), the Near Repeat Crime Prevention Potential Calculator (NR-CPPC) (Groff and Taniguchi 2019), and the early warning system (EWS) for temporary hot spots (Gorr and Lee 2015).

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quasi-experiment's analyses ranged from medium to large—.57 for the theft from vehicle analysis and .77 for the residential burglary analysis (Santos and Santos 2015b, c). Using these estimates as a guide and to increase the power of the current study, we chose the more restrictive requirement and computed the required sample size for a medium effect size (.50). Thus, for a *t* test of two independent groups with a medium effect size, the software recommended a sample of 88 per group or a total of 176 cases.

The standard practice of the department was to identify micro-time hot spots with residential burglary, residential theft from vehicle or a combination of both. Thus, all micro-time hot spots that included either or both of these crimes were considered for randomization. This helped to achieve the goal of testing the department's routine practices as well as shortened the time it would take to obtain the minimum sample required.

In practice, there are two distinct types of micro-time hot spots. A "spree" micro-time hot spot is a group of proximate crimes that occur in a very short time period (e.g., within a 24-h period) (Santos 2017). An "ongoing" micro-time hot spot is a group of proximate crimes that occur over several days with a resting period between them (Santos 2017). Because ongoing micro-time hot spots often begin as sprees, the department identified and responded to them in hopes of preventing future related crimes, so both types were considered for the experiment. To ensure that the control and treatment groups had similar numbers of spree and ongoing micro-time hot spots, this distinction was used for blocking in the randomization process.

Randomization

Micro-time hot spots are short-term "flare ups," so they must be randomized as they occur. We used "trickle-flow" randomization (Ariel et al. 2012) in that each micro-time hot spot was evaluated for inclusion as it was identified in real time.[6] To facilitate blocked randomization of spree and ongoing micro-time hot spots, two lists of randomized numbers were created that were used to determine group assignment.

The randomization process started with the initial bulletin. Normally, the analysts would disseminate each bulletin as soon as it was completed to all police personnel. For the study, the analysts first sent the bulletin to the researchers, who assigned it to treatment or control group on the same day. The crime analysts then disseminated the treatment bulletins as usual for response and held back the control bulletins.[7] Importantly, the crime analysts treated all micro-time hot spots the same in the subsequent assessment process.

Treatment: Proactive Policing Response

The dynamic nature of micro-time hot spots makes it difficult to predict when and where they will occur. Therefore, the goal of police response is not to prevent a micro-time hot spot from developing, but to shorten its duration by stopping subsequent related crimes once it is identified. To test the department's established practices, no changes were made to how the micro-time hot spots were identified, how the department responded to each one, or how accountability was facilitated. Department personnel responded to micro-time

[6] Similar to Sherman and Rogan's (1995) experiment on drug houses.

[7] No one else but the analysts and researchers saw the control bulletins.

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hot spots as they had always done, not knowing that some were not being distributed for response.[8]

In standard police practice, individual crimes that are reported to or discovered by the police receive a response which includes a patrol officer responding to the home, taking a crime report, and doing a preliminary investigation. Depending on the evidence and nature of the crime, when appropriate, a detective conducts a follow up investigation. This was done for each crime in micro-time hot spots no matter if they were designated as a treatment or control.

The departments' proactive strategy required that all patrol officers drive into the micro-time hot spot area for between 10 and 20 min for as many times as possible during their uncommitted time (i.e., when not answering calls for service). The department geographically deployed its resources, so responses were carried out by officers assigned to the districts and zones in which the micro-time hot spots occurred. Patrols occurred throughout the 24-h period with emphasis on the time spans of the crimes listed on the bulletin. Officers were directed to drive around the micro-time hot spot and be seen versus being stationary in one location. When possible, they were to stop and talk to suspicious persons walking and/or in vehicles; make traffic stops; write field intelligence cards when relevant; talk with residents about the micro-time hot spot and crime prevention; and leave a crime opportunity card when they observe vulnerable targets.

The department mandated a minimum of 14 days of directed patrol after a bulletin was disseminated. This had been the standard used by the department for many years and was based on the department's resources as well as near repeat research—40% of near repeats occur within 14 days (Johnson et al. 2007). No specialized or dedicated personnel were used for responses, and directed patrol was conducted by all patrol officers during their normal work hours without overtime pay.

While every crime received an initial investigation by a patrol officer, some crimes were not assigned to detectives for follow up investigation based on a solvability scale. As part of normal operations, when a micro-time hot spot was released for response, if the crime analyst identified any known burglary/theft/drug offenders living in the micro-time hot spot area, detectives were mandated to contact them in person and attempt to solicit any investigative leads. Like patrol, no dedicated personnel or overtime pay was used to accomplish this work.

To initiate each response, the crime analyst posted a bulletin to SmartForce®, which is an intranet system designed to facilitate communication and accountability for crime reduction responses. The software was used by officers, detectives, and supervisors to enter information in real time through either their desktop computers or laptops in their cars. The department mandated entries to be made as soon as possible after each response occurred. For the study, these data were downloaded from the intranet system and manually coded into the following categories:

- Patrol, No Suspicious Activity: During proactive directed patrol in the micro-time hot spot, no suspicious activity was seen and no contacts were made.
- FI (Field Intelligence) Stops: During patrol, contact was made with an individual and a field intelligence card was completed.

[8] Interestingly, over the two years of the study, there were only three times in which someone identified a micro-time hot spot on their own. In these cases, the crime analyst released the bulletin for response and the micro-time hot spot was not included in the experiment.

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- Suspicious Person/Vehicle Stops: During patrol, a suspicious person or vehicle was contacted.
- Traffic Stops: During patrol, a vehicle was stopped for a traffic violation.
- Crime Opportunity Cards: During patrol, a vulnerable vehicle or home was identified and a crime opportunity card was left behind.
- Citizen Contacts: During patrol or by detectives, contact with citizens or known offenders occurred.
- Arrests: During patrol or by detectives, arrest was made related to the micro-time hot spot.

In terms of treatment fidelity and accountability, the intranet system was used to facilitate real-time communication among the divisions about the analysis, responses, and status of the micro-time hot spot. Supervisors, managers, and command staff used the system to assign the bulletins to patrol supervisors and detectives, to ensure responses were carried out appropriately, and to close down responses based on department criteria. Lastly, the software has a mechanism for aggregate reporting that was used by managers to report what was done for each micro-time hot spot in weekly and monthly crime reduction accountability meetings.

Measures of Effectiveness

After a micro-time hot spot was identified, the crime analysts tracked subsequent related crimes in both treatment and control micro-time hot spots by using the same methodology they used for identification. For treatment micro-time hot spots, when another crime was identified, an updated bulletin was posted to the intranet system and responses were mandated for an additional 14 days. The crime analysts continually tracked each micro-time hot spot until there were no additional crimes within 14 days of the last crime and within a .40-mile radius. Once these criteria were met, patrol response was shut down and considered resolved by the department. For research purposes, the crime analysts tracked related crimes that occurred within the .40-mile maximum as well as a .20-mile buffer for 90 days. This information was collected to assess the residual effect of the treatment. In addition, the .20-mile buffer was used both to ensure that none of the micro-time hot spots overlapped spatially within a 90-day period as well as to analyze spatial displacement.

Four time periods are used to measure the effect of the treatment on additional crime in the micro-time hot spots. Normally, a bulletin took around a day to publish and responses started the same day for a minimum of 14 days. So, to determine the immediate impact of the response, the first time period considers crimes occurring within 15 days of bulletin publication. In addition, the average response time period was 19 days with a standard deviation of around 8 days, so the second time period measures crimes occurring within 30 days of bulletin publication. To measure residual impact (Sherman 1990), the third and fourth time periods consider crimes occurring within 60 and 90 days of bulletin publication.

Characteristics of Micro-time Hot Spots and Equivalency Tests

Our a priori power analysis required 176 cases. In the 24 months of the experiment, there were a total of 217 micro-time hot spots identified and randomly assigned. In terms of the partial blocking, 71 were spree micro-time hot spots and 146 were ongoing micro-time hot spots. Trickle-flow randomization and responses occurred from June 2013 to July 2015 with 106 micro-time hot spots occurring in the first 12 months and 111 in the second

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Table 1 Tests of equivalence in treatment and control groups

All	Treatment N = 114		Control N = 103		*T* value	Sig.
	Mean	SD	Mean	SD	(*df* = 215)	
Initial crime count	2.73	0.79	2.75	0.92	0.168	0.866
Time span	4.74	4.20	4.94	4.21	0.359	0.720
Radius	0.20	0.12	0.20	0.12	0.286	0.775
Spree	Treatment N = 39		Control N = 32		*T* value	Sig.
	Mean	SD	Mean	SD	(*df* = 69)	
Initial crime count	2.67	0.70	2.66	0.94	−0.054	0.957
Time span	0.77	0.43	0.78	0.42	0.119	0.906
Radius	0.16	0.12	0.16	0.12	0.153	0.879
Ongoing	Treatment N = 75		Control N = 71		*T* value	Sig.
	Mean	SD	Mean	SD	(*df* = 144)	
Initial crime count	2.76	0.84	2.79	0.91	0.199	0.843
Time span	6.80	3.77	6.82	3.78	0.027	0.978
Radius	0.22	0.11	0.22	0.11	0.107	0.915

12 months. There were 105 theft from vehicle micro-time hot spots, 25 burglary micro-time hot spots, and 67 micro-time hot spots that included both crimes.

Descriptive statistics for all 217 micro-time hot spots indicate they ranged from 2 to 6 crimes that occurred between 0 and 14 days which met the department's minimum criteria for identification. The average number of crimes is similar for spree (2.66) and ongoing (2.77) micro-time hot spots. However, the time span is much shorter for sprees (.77 days versus 6.81 days) since sprees happen on the same day or overnight. The average radius is also slightly smaller for sprees (.16 versus .22) since, by definition, they happen in a much closer geographic proximity.

To ensure randomization was successful, independent *t* tests of crime count, time span, and radius were conducted for the two groups and within blocks. Table 1 shows that while there were slightly more treatment micro-time hot spots, there are similar proportions of spree and ongoing micro-time hot spots in each group. That is, for example, sprees made up 34% of the treatment group (i.e., 39 of 114) and 31% of the control group (i.e., 32 of 103). The *t* test results show that none of the equivalency measures is significantly different between the groups or within blocks. The medians and standard deviations are similar as well. Thus, the randomization was successful and yielded two comparable groups of micro-time hot spots with similar proportions of spree and ongoing micro-time hot spots.

Description of Response and Dosage

There is a wide range of research on the effects of directed patrol in long-term hot spots (Braga et al. 2019). Most of the research treats response as a presence/absence condition and assumes an intention to treat (Haberman 2016; Hoover et al. 2016; Groff et al. 2015; Telep et al. 2014a). Police scholars emphasize that, for research to be meaningful

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Table 2 Descriptive of response characteristics

N = 114	Mean	SD	Median	Min.	Max.
Total response count	96.45	46.17	90.50	6.00	235.00
Total hours of response	31.27	13.18	31.38	2.10	59.25
Days of response	19.14	8.75	15.50	12.00	57.00
Minutes per response	19.96	2.70	20.29	12.11	30.84
Response per day	5.12	1.86	5.09	0.50	9.67
Hours per day	1.69	0.62	1.70	0.18	3.29

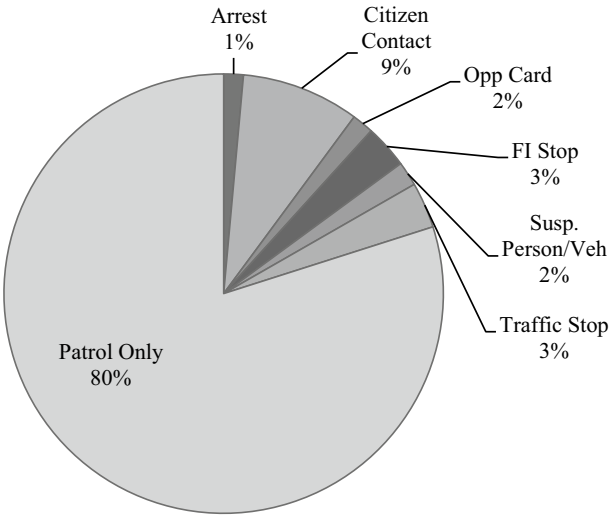

Fig. 1 Percentage breakdown of time spent on different response activities

in practice, researchers must examine crime prevention interventions that are realistic and practical. In addition, for replication purposes, they must also try to fully describe how an intervention, particularly patrol response, is carried out (Ariel et al. 2020; Gottfredson et al. 2015; Johnson et al. 2015; Wain and Ariel 2014).

The control group had no proactive police response. Table 2 provides measures of central tendency for the response variables. On average for the 114 treatment micro-time hot spots, the police department employed a total of 96.45 individual responses for 31.27 h. While the medians of these variables are close to the means, the ranges and standard deviations are fairly large. This is because these are the raw counts and are influenced by the length of response, which varied by the number of subsequent crimes in each micro-time hot spot.

The remaining variables in Table 2 are normalized using ratios based on number of responses and/or number of days in the response. The standard deviations are much smaller and indicate consistency of the responses across the 114 treatment micro-time hot spots. The department deployed on average for each micro-time hot spot 5.12 responses per day that were each 19.96 min long (i.e., 1 h and 40 min total) over 19.14 days.

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Table 3 Descriptives of response activities

N = 114	Count per micro-time hot spot		Minutes per response	
	Mean	SD	Mean	SD
Patrol no results	71.81	35.48	21.49	2.76
FI stops	3.32	4.43	20.52	6.08
Susp. per./veh. stops	2.82	5.02	16.30	5.40
Traffic stops	2.93	4.28	23.24	5.92
Citizen contacts	11.94	13.30	16.10	4.12
Crime opp. cards	2.92	5.03	12.70	3.67
Arrests	0.72	1.40	41.55	6.74

Figure 1 illustrates the breakdown of response activities by total time spent for all 114 treatment micro-time hot spots. The overwhelming majority of the response time (80%) was spent on directed patrol with no suspicious activity. Contacts with citizens or offenders constituted 9% of the response time, and each of the remaining categories made up 1–3% of the total time.

Table 3 breaks down the response activities by the average number of responses per micro-time hot spot and the average length of each activity. Thus, of an average of 96 responses implemented, about 72 were patrol responses with no suspicious activity; 12 were citizen contacts; 3 were field intelligence stops; 3 were suspicious person or vehicle stops; 3 were traffic stops, and around 1 was an arrest. The average length of a directed patrol response with no suspicious activity was around 21 min. FI stops took about the same amount of time at 20 min. Suspicious person and vehicle stops took about 16 min each, but traffic stops and arrests took somewhat longer at 23 and 41 min, respectively. The least amount of time was spent on crime opportunity cards (13 min), which is expected since no contact was made with an individual.

Where most hot spots policing studies measure dosage in counts and time, these statistics provide insight to the nature of the activities that were carried out systematically for 2 years. Importantly, the majority of response time is spent conducting 20 min directed patrols in the micro-time hot spot area.[9]

Tests of Effectiveness: Related Crime After 15, 30, 60, and 90 days

Tests of proactive policing responses in long-term hot spots assume that the initial amount of crime in the hot spot is the baseline against which effectiveness of the response is measured. In contrast, the micro-time hot spot is a short-term flare up, so the amount of crime at initial identification cannot be a baseline measure for how much subsequent crime might occur. Consequently, a pre/post analysis or differences-in-difference analysis is not

[9] Note that the time spent by detectives investigating each micro-time hot spot and linking them through evidence, arrests, or property is not included here, because that is difficult to measure and is more reactive to the nature of the information and evidence available for each micro-time hot spot.

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appropriate, so our analysis focuses only on the differences between the groups after the bulletin was published.

We use a combination of straightforward statistics to assess the impact of the response. Independent *t* tests are used to compare the means of the two groups for each of the time periods to determine whether the differences are significant and not due to chance. We also examine the standardized effect (Cohen's *d*) in order to understand the relative magnitude of any differences that are found (Sullivan and Feinn 2012). Since our measures indicate the exact number of crimes that occurred, attention to the absolute effect provides a real world interpretation of our findings (Sullivan and Feinn 2012).

Table 4 shows the results for the cumulative crime counts 15 days, 30 days, 60 days, and 90 days after the bulletin was published. The *t* tests of the means show that the treatment group has significantly lower crime for each measure below the .001 level. Because these time periods are cumulative, the crime counts increase as the time periods become longer. The absolute effects also increase with the exception of crime at 90 days. That is, the treatment group has 1.50 fewer crimes in 15 days, which increases to 2.43 in 30 days, increases again to 2.56 in 60 days, but lowers to 2.49 in 90 days. The absolute effect percent is simply the percent difference between the two groups' means and provides a relative difference statistic since the crime counts are lower in shorter time periods. Thus, the largest absolute percent difference is seen in the first 15 days with the treatment group having 79% fewer crimes than the control group.

The standardized effect (Cohen's *d*) is computed by dividing absolute effect by the pooled standard deviation (of both groups together) and provides a standardized measure of effect. Table 4 shows that the effect sizes for all four cumulative time periods are over .94, which are large according to Cohen (1988) since they are over .80. The largest effect of 1.30 is for the 30 day time period, with the 15 day period next with 1.15, followed by 60 days with 1.10, and 90 days with .94.

To dissect the impact within time periods, Table 5 shows the same statistics for each distinct (non-cumulative) time period. The results for the first 15 days are the same as in Table 4 and are significant. The *t* tests also show a significant difference between the groups in days 16–30 with an absolute effect of .93 fewer crimes. Notably, 79% less crime occurred in the treatment group in the first 15 days, and 67% less crime within days 16–30. The standardized effect results show that the first 15 days and days 16–30 have large effects at 1.15 and .83, respectively. Finally, 17% less crime occurred in the treatment group within days 31–60, but 11% more crime occurred in days 61–90. However, neither of these differences is significant, and the effect sizes are very small, .15 and − .08, respectively.

Taking both Tables 4 and 5 together, the results indicate that while the largest effect occurs at 30 days (1.30), it is the first 15 days after the bulletin is published that accounts for more of the impact (79% less crime and 1.15 Cohen's *d*) than the second 15 days (67% less crime and .83 Cohen's *d*). Also, the large effect sizes seen in all four cumulative time periods in Table 4 are due to the first two 15-day periods since there are no significant difference between the groups after 30 days, as shown in Table 5.

An analysis of spatial displacement was conducted by considering the number of related crimes that occurred in a .20-mile catchment area around the .40-mile maximum radius for up to 90 days after the bulletin was published. An analysis was done on each of the eight time periods presented in Tables 4 and 5. The absolute crime counts in each were very low, so a statistical comparison by groups was not appropriate. For transparency purposes, there were 5 related crimes that occurred in 4 of the 103 control micro-time hot spots (3.9%) and 7 related crimes in 5 of 114 treatment micro-time hot spots (4.3%). These values are both extremely low and similar in nature, so we conclude that there was no spatial displacement

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Table 4 Means, standard deviations, *t* tests, absolute and standardized effects, cumulative time periods

	Treatment N = 114		Control N = 103		*T* value	*df*	SE diff.	2-tailed sig.	Absolute effect (%)	Pooled SD	Std. effect Cohen's d
	Mean	SD	Mean	SD							
Crime 15 days	0.39	0.54	1.89	1.43	9.978	128	0.150	0.000	1.50(79%)	1.30	1.15
Crime 30 days	0.86	0.93	3.29	1.81	12.264	149	0.198	0.000	2.43(74%)	1.86	1.30
Crime 60 days	1.82	1.56	4.39	2.29	9.532	178	0.269	0.000	2.56(58%)	2.32	1.10
Crime 90 days	2.59	1.95	5.08	2.70	7.724	184	0.317	0.000^	2.49(49%)	2.64	0.94

^Equal variances assumed

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Table 5 Means, standard deviations, *t* tests, absolute and standardized effects, non-cumulative time periods

	Treatment N = 114		Control N = 103		*T* value	*df*	SE diff.	2-tailed sig.	Absolute effect (%)	Pooled SD	Std. effect Cohen's d
	Mean	SD	Mean	SD							
Crime 15 days	0.39	0.54	1.89	1.43	9.978	128	0.150	0.000	1.50(79%)	1.30	1.15
Crime 16–30 days	0.46	0.72	1.40	1.28	6.534	157	0.143	0.000	0.93(67%)	1.12	0.83
Crime 31–60 days	0.91	1.14	1.10	1.38	1.078	215	0.171	0.282^	0.18(17%)	1.26	0.15
Crime 61–90 days	0.76	1.01	0.69	0.87	−0.574	215	0.129	0.567^	−0.07(−11%)	0.95	−0.08

^Equal variances assumed

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as a result of the police response which is consistent with findings from most hot spots policing studies (Telep et al. 2014b).

Summary of Results

The treatment tested here is a micro-time hot spots crime reduction strategy in which officers were required to conduct directed patrol as many times as possible during their uncommitted time for a minimum of 14 days. Officers were directed to spend 10–20 min at a time actively patrolling. Over the 2 year experimental period, the department responded to 114 micro-time hot spots with an average of around five 20-min responses (1 h, 40 min) per day for 19 days. Overall, 80% of the officers' time was spent patrolling the micro-time hot spots without encountering suspicious activity or making contacts.

Independent *t* tests show there was significantly less crime in the treatment group than in the control group in each of the cumulative time periods—within 15, 30, 60, and 90 days. The Cohen's *d* statistics show that the effect sizes for each of these time periods is large—1.15, 1.30, 1.10, .94, respectively. At 15 days, the treatment micro-time hot spots had 79% fewer crimes than the control micro-time hot spots; at 30 days, 74% fewer crimes; and at 60 days, 58% fewer crimes. The cumulative impact of the response after 90 days was 49% with no spatial displacement.

A closer look at the non-cumulative time periods refines the results and focuses our interpretation. The *t* tests show that the groups were not significantly different between 30 and 90 days after the micro-time hot spot was published. This indicates that the significant differences found at the 60- and 90-day cumulative time periods are solely due to the first two time periods. Looking at those time periods more closely, the groups are significantly different, and there is 79% less crime in the treatment group in the first 15 days and 67% less crime in the second 15 days. The effect size for both time periods is large at 1.15 and .83, respectively. So, while there is a very large effect in the first 30 days (1.30), within that time period it is the first 15 days that has a larger effect.

Consequently, the largest effects are seen in the time periods in which micro-time hot spots received response during all or most of the time period. Translating these findings to real reductions in crime, with five 20 min responses per day, proactive police response reduced crime by 79% within the first 2 weeks and 74% within the first 30 days. Importantly, when the responses were discontinued, they had a lasting effect. Crime did not spike back up but is similar in both treatment and control micro-time hot spots after 30 days. That is, crime reductions seen while most micro-time hot spots receive response hold for 2 months after the responses end.

Discussion and Conclusions

Our findings can be situated within two conclusions in terms of their practical implications for place-based policing approaches. Thirty years ago Sherman (1990) concluded that geographically-focused increases in police presence might be more effective if they were implemented in limited duration and rotated across different targets. He found that effects began to decay after a short period, and in some cases, there was continued deterrence after the response ended which lasted longer than the response itself. Similarly, we have found that micro-time hot spots can be successfully addressed, primarily with patrol dosage, with

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direct and residual impact. The fact that these are short-term crime flare ups that occur throughout a jurisdiction lends support to Sherman's recommendation that geographically-focused preventative patrol should be implemented in the short-term and rotated across targets.

In the last 30 years, long-term hot spots policing studies that show directed patrol decreases crime have also shown that the effects are short-term (Braga et al. 2019). The National Academy of Sciences committee concludes from research on all proactive policing approaches that the best approach is implementing place-based, problem-solving, person-focused, and community based strategies in combination (Weisburd and Majmundaar 2018). Thus, we suggest based on our findings that an effective way to sustain a place-based strategy in long-term hot spots would be to focus deployment of directed patrols in micro-time hot spots occurring within long-term hot spots while at the same time implementing long-term non-police responses facilitated through problem-solving and community-based strategies.

We believe our findings also have important implications for hot spots policing research. Our findings reveal larger effect sizes than most hot spots policing studies (Braga et al. 2019). In the most recent Campbell Review, looking at the largest effect sizes of the 73 hot spots policing studies (Braga et al. 2019; Fig. 3), only 4 (5.5%) had effect sizes higher than .80 and 16 (22.0%) higher than .50. We believe that how our unit of analysis was defined, the systematic nature of the response implementation, and our use of a no-dosage control condition may help explain these differences.

We believe one reason our effects are larger is the precise measurement and critical way crimes were linked together as micro-time hot spots. In practice and in research, long-term hot spots are identified through aggregate spatial analysis that considers crime type and geographic location of data from a particular period (Braga et al. 2019; Eck et al. 2005). Similarly, near repeat identification is facilitated using software applications that exclusively use geographic and temporal variables to identify short-term near repeats (Ratcliffe 2009; Groff and Taniguchi 2019). In this study, the crime analysts critically examined crimes to determine if they were related in a meaningful way and not merely a function of time and space proximity. This process refined the analysis product so that the proactive police response could be more focused and appropriate to the crimes. Because subsequent crimes were identified with these same methods and were not statistical manifestations, the measurement of effectiveness more accurately reflected the impact of the focused responses.

Another factor is the institutionalization of the crime reduction strategy within the department's operational practices. Nearly all RCTs testing hot spots policing strategies implement the treatment for the sake of the research (i.e., something new or slightly different than what the department is doing) (Braga et al. 2019). There are very few occasions where the mechanisms that carried out the treatment were done before the research started and were sustained beyond the study. In this study, the response requirements and accountability processes were laid out in a departmental policy, were successfully institutionalized before the study began, and continue to this day. These factors likely resulted in higher treatment fidelity than other hot spots policing studies.

Finally, we circle back to Ariel et al.'s (2020) discussion of new directions for hot spots policing experiments. Our findings add evidence to their assertion that it may be that hot spots policing strategies are actually more effective than what has been shown in the research thus far. As we noted at the outset, they hypothesize that larger effect sizes will result when an experiment includes a no-dosage control condition. This is because doing so widens the gap between the treatment and control dosages, and the test of effectiveness

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becomes a comparison between response and "no" response instead of "some" response versus "more" response.

They ask the question, "Would a zero-patrol control group produce a substantially larger effect size than most hot-spots experiments to date? (Ariel et al. 2020, p. 105)" In the same article, they discuss their results from implementing preventative proactive patrol at London Underground platforms that never had such police presence before. In a variety of impact measures, their largest effect sizes ranged from .80 to 1.12 which like the effect sizes in this study are larger than most hot spots policing studies. While this comparison is merely suggestive, it seems to indicate that there something distinctive about Ariel et al. (2020) as well as our study.

As with all RCTs conducted in real world criminal justice settings, external validity is difficult to accomplish. Consequently, our findings add to the evidence but do not make a definitive conclusion of the effectiveness of proactive police response in micro-time hot spots. However, the unique qualities of our study that included precise measurement, response fidelity, blinding the experiment, and 2 years of treatment provide a high level of internal validity which strengthens its contribution to the body of research on hot spots policing approaches. Lastly, this study is an example of a rigorous research design that tests established police practices. Its results suggest that crime reduction can occur with a realistic, sustainable approach, and police should strongly consider using proactive resources to systematically respond to micro-time hot spots.

References

Ariel B, Vila J, Sherman L (2012) Random assignment without tears: how to stop worrying and love the Cambridge randomizer. J Exp Criminol 8:193–208

Ariel B, Sherman LW, Newton M (2020) Testing hot-spots police patrols against no-treatment controls: temporal and spatial deterrence effects in the London underground experiment. Criminology 58:101–128

Austin R, Cooper G, Gagnon D, Hodges J, Martensen K, O'Neal M (1973) Police crime analysis unit handbook. U S Department of Justice National Institute of Law Enforcement and Criminal Justice, Washington, DC

Bernasco W (2008) Them again? Same-offender involvement in repeat and near repeat burglaries. Eur J Criminol 5:411–431

Bernasco W (2010) A sentimental journey to crime: effects of residential history on crime location choice. Criminology 48:389–416

Bernasco W, Nieuwbeerta P (2005) How do residential burglars select target areas? A new approach to the analysis of criminal location choice. Br J Criminol 44:296–315

Bowers KJ, Johnson SD (2005) Domestic burglary repeats and space–time clusters: the dimensions of risk. Eur J Criminol 2:67–92

Braga AA, Turchan B, Papachristos AV, Hureau DM (2019) Hot spots policing of small geographic areas effects on crime. Campbell Syst Rev. https://doi.org/10.1002/cl2.1046

Cohen J (1988) Statistical power analysis for the behavioral sciences. Lawrence Erlbaum Associates, Hillsdale

Eck J, Chainey S, Cameron J, Leitner M, Wilson R (2005) Mapping crime: understanding hot spots. National Institute of Justice, Washington, DC

Gallager K, Wartell J, Gwinn S, Jones G, Stewart G (2017) Exploring crime analysis. International Association of Crime Analysts, Overland Park

Gorr WL, Lee YJ (2015) Early warning system for temporary crime hot spots. J Quant Criminol 31:25–47

Gottfredson DC, Cook TD, Gardner FE, Gorman-Smith D, Howe GW, Sandler IN, Zafft KM (2015) Standards of evidence for efficacy, effectiveness, and scale-up research in prevention science: next generation. Prev Sci 16:893–926

Groff E, Taniguchi T (2019) Quantifying crime prevention potential of near-repeat burglary. Police Q. https://doi.org/10.1177/1098611198280521-30

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Groff ER, Ratcliffe JH, Haberman CP, Sorg ET, Joyce NM, Taylor RB (2015) Does what police do at hot spots matter? The Philadelphia policing tactics experiment. Criminology 53:23–53
Haberman CP (2016) A view inside the ''Black Box'' of hot spots policing from a sample of police commanders. Police Q 19:488–517
Hoover L, Wells W, Zhang Y, Ren L, Zhao J (2016) Houston enhanced action patrol: examining the effects of differential deployment lengths with a switched replication design. Justice Q 33:538–563
Johnson D (2013) The space/time behaviour of dwelling burglars: finding near repeat patterns in serial offender data. Appl Geogr 4:139–146
Johnson SD, Summers L, Pease K (2007) Vehicle crime: communicating spatial and temporal patterns. Jill Dando Institute of Crime Science, London
Johnson SD, Lab S, Bowers KJ (2008) Stable and fluid hot spots of crime: differentiation and identification. Built Environ 34:32–46
Johnson SD, Summers L, Pease K (2009) Offenders as forager: a direct test of the boost account of victimization. J Quant Criminol 25:181–200
Johnson SD, Tilley N, Bowers KJ (2015) Introducing EMMIE: an evidence rating scale to encourage mixed-method crime prevention synthesis reviews. J Exp Criminol 11:459–473
McLaughlin LM, Johnson SD, Bowers KJ, Birks DJ, Pease K (2007) Police perceptions of the long- and shortterm spatial distribution of residential burglary. Int J Police Sci Manag 9:99–111
National Institute of Justice (2018) Program profile: tactical police responses to micro-time hot spots for thefts from vehicles and residential burglaries (Port St. Lucie, Florida). Profile posted on November 13, 2018 to https://www.crimesolutions.gov/ProgramDetails.aspx?ID=626
O'Shea TC, Nicholls K (2003) Police crime analysis: a survey of U.S. police departments with 100 or more sworn personnel. Police Pract Res 4:233–250
Ratcliffe JH (2009) Near repeat calculator (version 1.3). Temple University, Philadelphia
Sagovsky A, Johnson SD (2007) When does repeat burglary victimisation occur? Aust N Z J Criminol 40:1–26
Santos RG (2013) A quasi-experimental test and examination of police effectiveness in residential burglary and theft from vehicle micro-time hot spots. Dissertation. Nova Southeastern University
Santos RB (2017) Crime analysis with crime mapping. Sage Publications, Thousand Oaks
Santos RB, Santos RG (2015a) Examination of police dosage in residential burglary and theft from vehicle micro-time hots spots. Crime Sci 4:1–12
Santos RG, Santos RB (2015b) An ex post facto evaluation of tactical police response in residential theft from vehicle micro-time hot spots. J Quant Criminol 31:679–698
Santos RG, Santos RB (2015c) Practice-based research: ex post facto evaluation of evidence-based police practices implemented in residential burglary micro-time hot spots. Eval Rev 39:451–479
Santos RG, Santos RB (2020) Stratified policing: an organizational model for proactive crime reduction. Rowman & Littlefield, Landham
Santos RB, Taylor B (2014) The integration of crime analysis into police patrol work: results from a national survey of law enforcement. Policing 37:501–520
Sherman LW (1990) Police crackdowns: initial and residual deterrence. Crime Justice 12:1–48
Sherman LW, Rogan D (1995) Deterrent effects of police raids on crack houses: a randomized controlled experiment. Justice Q 12:755–782
Sullivan GM, Feinn R (2012) Using effect size—or why the P value is not enough. J Grad Med Educ 4:279–282
Telep CW, Mitchell RJ, Weisburd DL (2014a) How much time should the police spend at crime hot spots? Answers from a police agency directed randomized field trial in Sacramento. Calif Justice Q 31:905–933
Telep CW, Weisburd D, Gill CE, Vitter Z, Teichman D (2014b) Displacement of crime and diffusion of crime control benefits in large-scale geographic areas: a systematic review. J Exp Criminol 10:515–548
Wain N, Ariel B (2014) Tracking of police patrol. Policing 8:274–283
Weisburd D, Gill C (2014) Block randomized trials at places: rethinking the limitations of small N experiments. J Quant Criminol 30:97–112
Weisburd D, Majmundaar MK (eds) (2018) Proactive policing: effects on crime and communities. The National Academies Press, Washington DC
Weisburd D, Groff ER, Yang S-M (2012) The criminology of place: street segments and our understanding of the crime problem. Oxford University Press, New York

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