

# Practice-Based Research: Ex Post Facto Evaluation of Evidence-Based Police Practices Implemented in Residential Burglary Micro-Time Hot Spots

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## Abstract

Background: Police agencies around the country are implementing various strategies to reduce crime in their communities that need to be evaluated. These strategies are often based on systematic crime analysis and

design is employed using 5 years of data from one police agency that has institutionalized the identification and response to micro-time hot spots into its day-to-day practices. Propensity score matching is used to match 54 pairs of micro-time hot spots using logistic regression to compute the propensity scores and greedy 1 to 1 matching with a caliper width of 0.5 of the standard deviation of the logit to match the cases. Results: Independent t-tests show that tactical police response to micro-time hot spots can lead to significant reductions in residential burglary incidents without the spatial displacement of crime. Conclusion: Tactical police responses that seek to achieve short-term reductions in crime appear to be well suited for micro-time hot spots since they are, by nature, short term. Importantly, the conclusions are based on the evaluation of an agency's systematic implementation of the evidence-based practices as its normal practices and not for the sake of research.

### Keywords

practice-based research, police, propensity scores, residential burglary, micro-time hot spots, evidence-based, crime reduction

## Introduction

Evidence-based policing is “the use of the best available research on the outcomes of police work to implement guidelines and evaluate agencies, units, and officers” (Sherman, 1998, p. 3). Over the past 30 years, there has been a great amount of research using rigorous methods (i.e., experiments and quasi-experiments) that provide the foundation for evidence-based policing practices (Telep & Weisburd, 2012). However, determining that police strategies are effective through experiments designed by researchers and implemented with external funding does not necessarily mean that they will also be effective once implemented into the normal, everyday practices of a police agency. Thus, as evidence-based police practices are implemented into police departments, it is also important to determine through research whether and how these practices work in a real-world context. This latter type of research, called “practice-based research” (Boba, 2010), is complementary to evidence-based policing and is just as important to determine which crime reduction strategies are realistic and sustainable.

Over the past decade, the field of psychiatry has recognized this need as well. Marginson et al. (2000) assert that although randomized control trials are important for testing treatments, results of meta-analyses of that

research reveal that there is a lack of evidence instead of evidence for or against a particular treatment. They argue that to complement these experimental studies, evidence based on good quality data collected from routine psychiatry practice may provide direction for implementation of treatments as well. In other words, research conducted in the environment in which the therapy occurs as well as in an academic clinical setting is imperative (Hellerstein, 2008; Marginson et al., 2000).

This study falls into the realm of practice-based research on policing in that it evaluates one police agency's standardized implementation of evidence-based crime reduction practices over 5 years. This provides a unique opportunity for practice-based research in that the agency did not implement the strategies with external funding or specifically for the research but did so with its current resources as part of its "way of doing business." Using the same methodology that examined theft from vehicle crime published in the



victimization of the six month period had stable time series . . . and other areas with equally high cumulative risks experience a much less consistent pattern of risk over time” (p. 39). That is, in some areas, most 2-week periods had little risk of victimization, but there were 2-week periods here and there with very high risk. Thus, simply examining crime for long-term hot spots can (1) create the “illusion” (Johnson, Lab, & Bowers, 2008) that a stable hot spot exists when it does not and (2) ignore crime flare-ups that occur in isolation.

## Evidence-Based Police Response to Micro-Time Hot Spots

Important in translating the evidence into practice is that if different types of hot spots do, in fact, exist, they will require different types of responses. That is, resolving a long-term hot spot would benefit most from identifying long-term solutions such as changing its criminogenic characteristics and the built environment. However, tactical police response seems more appropriate to micro-time hot spots that flare-up, since there is not enough time for long-term solutions to be implemented (Johnson et al., 2008).

In this study, the responses implemented by this police agency are those that have been shown to be effective through long-term hot spots policing research and generally include (1) increased patrol and field contacts, (2) proactive arrests, and (3) crime prevention contacts (Braga et al., 2014). In addition, they are strategies commonly used in police agencies around the United States as well as in the United Kingdom and Australia (Weisburd, Telep, & Braga, 2010). Weisburd and Lum (2005) found in a sample of 125 large U.S. police agencies (with 100 or more officers) that 66% reported using the hot spots policing approach. A survey conducted by Police Executive Research Forum (2008) found that in a sample of 192 U.S. police agencies, 74% used hot spots enforcement to address violent crime.

The Campbell Collaboration systematic review of hot spots policing studies has shown that this approach is effective in reducing crime (Braga et al., 2014). Thus, it is considered an “evidence-based approach” (Lum & Koper, 2011). Closer examination of these results as well as findings from less rigorous hot spots studies shows that the decreases in crime and calls for police service are primarily short term (Braga & Weisburd, 2010). The long-term hot spot studies that show a decrease in crime also show that the effects tend to dissipate quickly after the intervention and are not sustained (Braga et al., 2014). Thus, it appears as though these particular tactical

responses to hot spots have a short-term effect, which supports the notion that these responses might be better suited as response for “crime flare-ups” since they are also short term.

## The Current Study

This evaluation examines micro-time hot spots of residential burglary,

## Unit of Analysis and Data

Operationalization of the micro-time hot spot by the police department was based on standard crime analysis practice for identifying crime patterns (Santos 2012), the geography of the jurisdiction, the frequency of theft from vehicle crime in the city as well as what is realistic for police response with the resources available. The agency's criteria were (1) two or more residential burglaries, (2) occurring from 1 to 14 days of another, (3) within a 0.5-mile radius or 0.79 square miles.

The maximum radius was chosen by the police department based on the city's size (i.e., over 110 square miles), the nature of zoning (i.e.,

natural or man-made barriers that would make it less likely that the same offender(s) committed them.

Once a micro-time hot spot was identified, the crime analyst produced a one-page bulletin including information such as date, time, locations of the crimes, modus operandi (MO) and suspect information, known residential burglary offenders that live in micro-time hot spot, related field interview information, and whether evidence was collected at the scene (e.g., fingerprints and DNA). A map was included on the bulletin that illustrated the locations of the crimes, the field contacts, and residences of known offenders as well as the radius in which the crimes occurred. Figure 1 is an example of what was distributed to police personnel.

Importantly, the first bulletin only depicted the initial micro-time hot spot that would initiate the police response. The crime analysts tracked each micro-time hot spots until there were no additional crimes within 21 days of the last crime that occurred within a 0.50-mile radius in order to determine whether the micro-time hot spot was resolved and the responses could be stopped. If there were more crimes, an updated bulletin was produced and disseminated, which might depict a new radius. Unlike traditional long-term hot spots that are static once identified, micro-time hot spots are dynamic. Figure 2 illustrates how additional crimes are considered and whether they are added to the micro-time hot spot once it is identified.

The left map shows a micro-time hot spot at initial identification with two crimes within a 0.10-mile radius and within 4 days of one another (i.e., February 1st to February 5th). The middle map shows an update in which Crimes #3 and #4 are included because they are within a 0.25-mile radius of the mean center of the two original crimes with #3 occurring 2 days after #2 and #4 occurring 3 days after #4 (i.e., within 21 days). The right map shows how crime #6 is included because it falls inside the 0.25 radius of the other crimes and within 7 days of Crime #4, but that Crime #5 is not included even though it occurred before Crime #6 because it does not fall within 0.50 miles (the maximum based on the criteria) of the center of the other crimes. Finally, although #7 falls within the 0.25-mile radius of the micro-time hot spot, it occurred 25 days after #6 so is not part of the micro-time hot spot. Thus, the micro-time hot spot ends with five crimes occurring within a 0.25-mile radius in 16 days.

It is possible that a new micro-time hot spot could be formed around Crime #5 in terms of space and #7 in terms of time, but they would each have to meet the criteria of a new micro-time hot spot (i.e., 2 crimes within 0.50 miles and 14 days). In other words, once a crime is part of a micro-time



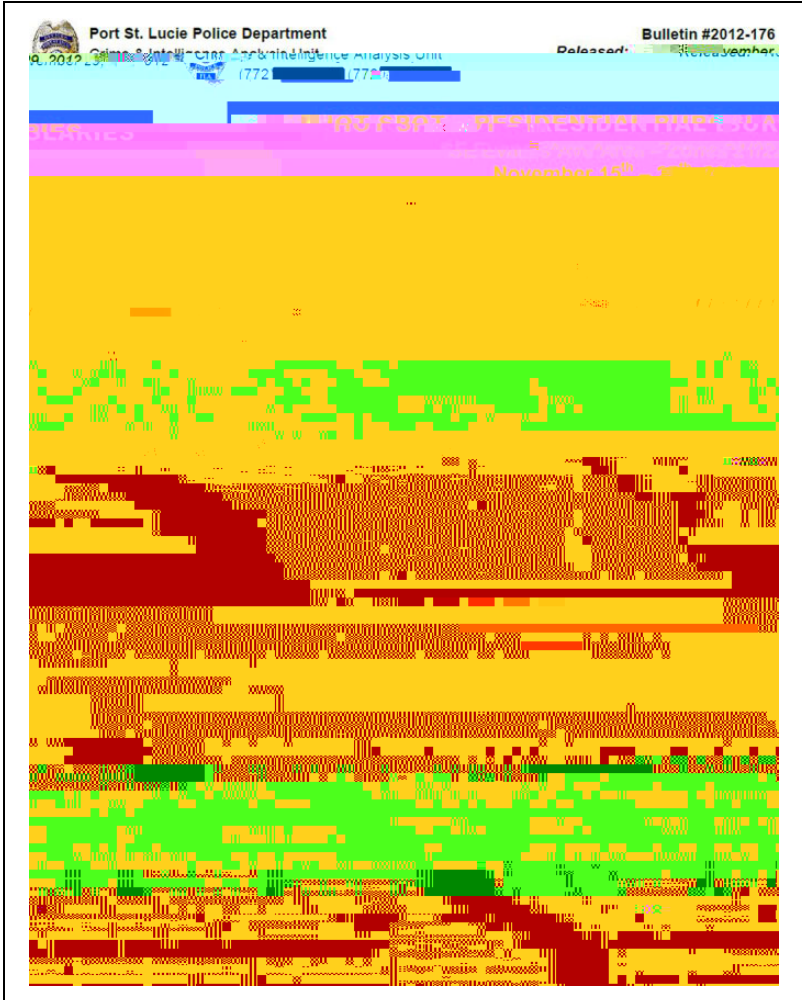


Figure 1. Micro-time hot spot bulletin.

hot spot, it cannot be part of a new one, and even though micro-time hot spots may be close to one another, they cannot overlap.

The same two analysts published all micro-time hot spot bulletins for the agency for the entire 5-year evaluation period following the guidelines that constitute a micro-time hot spot. Each bulletin was posted by the crime analyst into an intranet system. For those micro-time hot spots that were



in person when possible. Lastly, when names and home addresses of known residential burglary offenders living in the micro-time hot spot were provided on the bulletins, detectives and officers made contact to determine whether the individuals were possible suspects for the crimes in the micro-time hot spot or to deter them from committing any or additional crime.

The agency's policy was that responses to each micro-time hot spot were implemented for 14 days after the last crime in the micro-time hot spot. However, the length of police response did not directly correspond with the analysts' time frame for monitoring (i.e., 21 days). This decision was based on the agency's resources and what was realistic to sustain. Importantly, this process included a continual review by the crime analysts and response by police that ended when there was a continual absence of any crimes for 21 days. The duration of the response was determined by the last date of the last response for a particular micro-time hot spot even if the responses had

treatment cases. An important step in reducing bias in the matching process is including theoretically relevant covariates whenever possible (Rosenbaum & Rubin, 1985). It is impossible to account for all potential covariates that might differentiate micro-time hot spots, particularly, those related to the agency's policies for allocating response. Not being able to control for those unobservable factors with random assignment is the weakness of an ex post facto quasi-experimental design; however, we have included all the observed characteristics of the micro-time hot spots as captured on the bulletins as well as two characteristics that were created after the fact based on information on the bulletin—season and number of targets. In addition, in the Appendix, we present the results of a rigorous sensitivity analysis (i.e., RBOUNDS) that examines the potential effect of unobservable covariates as well when using propensity score matching. This following is a description of each covariate that was used and its theoretical justification for its inclusion.

- Year: Year in which the initial micro-time hot spot was identified. It is included as a predictor because the levels of overall crime varied by year in the 5 years of the evaluation. This variable is a proxy for the larger criminogenic environment of the city.
- Season: Based on the month in which the initial micro-time hot spot was identified, the months were coded: January, February, and March = 1; April, May, and June = 2; July, August, and September = 3; October, November, and December = 4. The season may impact the opportunities for crime. For example, in the summer months, juveniles might be more likely to commit residential burglaries since homes are empty and juveniles are not in school during the daytime.
- District: Location within the city where the micro-time hot spot occurred. The police department separates the city into four districts. The nature of housing and commercial businesses in each of the districts is somewhat different. For example, one district is primarily residential and is somewhat denser than other districts with very little commercial property except along large roads. Another district is primarily residential, but many of the homes are located in gated communities that limit access and reduce opportunities for crime.
- Radius: Radius of the crimes (in miles) in the initial micro-time hot spot. On each bulletin, a circle on the map encompassed all the crimes in the micro-time hot spot, which is a proxy for the area in which police responses could be implemented. In fact, the agency's stated policy is that officers are to patrol the area within the radius.

- Density of potential targets: This variable was created using aerial maps to count the parcels designated as single family homes within the radius as well as each multifamily home. This variable accounts for the specific differences in the number of potential residential targets for each micro-time hot spot.
- Initial number of crimes: Number of crimes when the micro-time hot spot is first identified. By the agency's policy, each micro-time hot spots has at least 2 crimes. However, many micro-time hot spots were initially identified with more than 2 crimes, thus this variable measures the relative intensity of the initial micro-time hot spot.
- Time span: Number of days between the first crime and the last crime in the initial micro-time hot spot. The time span provides an idea of the temporal scope of the micro-time hot spot when it was identified.
- Number of known offenders: Number of known residential burglary offenders who currently live within the radius. Crime analysts provided these on the bulletin as part of the agency's evidence-based police response. Research on short-term clustering of crime finds burglars are more likely to commit crimes relatively close to where they live (Bernasco, 2010).

## Treatment Variable



the amount of crime occurring in about a two-block catchment area around the hot spots area within the response period. Using a relatively similar distance, the dependent variable for spatial displacement was the amount of crime within a 0.2-mile catchment area around the initial micro-time hot spot radius. The agency responded for a minimum of 14 days after the last crime in the last update of a micro-time hot spot, so the period examined here is from the initial date of the first police response until 14 days after the last crime in the last update.

### Quasi-Experiment: Group Selection

Treatment group Due to constraints and variation in resources over the 5 years of the

SD (0.81) clearly indicates the distribution was no longer skewed. The 53 cases that did have response but were not selected were totally removed from the analyses and were not used as comparison cases since they did have at least one response per day.

## Comparison Group: Propensity Score Matching

We use propensity score analysis to determine the experimental groups (Rubin, 2006). The propensity score is a conditional probability that expresses how likely a participant is to receive “treatment” given certain observed theoretically important characteristics (Rosenbaum & Rubin, 1983) and is estimated with the eight control variables and the dummy treatment variable using the following logistic regression formula:

$Ln$







weighted, but one directed patrol response entry with additional activity is weighted as one, thus the total N here is 4,303.

- 76.15%: Directed patrol only (i.e., no additional contact).
- 20.47%: Directed patrol with additional activity (e.g., citizen contact and field interview).
- 3.37%: Known offender contacts, citizen contact by volunteers, and Reverse 911.

Thus, nearly 97%

Table 2. Independent-tests for Treatment Effectiveness.

Measure at Time 2	Treatment Mean (SD)	Comparison Mean (SD)	Mean Difference	SE Difference	t-Statistic	df (N)
Crime	1.04 (1.01)	2.19 (1.68)	1.148	0.267	4.300*	106 (54)
Time span	5.52 (5.35)	13.20 (7.97)	7.680	1.307	5.882*	106 (54)
Radius	0.32 (.13)	0.35 (.12)	0.348	0.025	1.418	106 (54)

\* $p \leq .001$ .

the mean difference between the groups of 1.148 was statistically significant and that the difference is in the predicted direction in that the treatment group's mean is significantly lower. These findings suggest that police response to residential burglary micro-time hot spots is effective and resulted in 1.15 fewer crimes per micro-time hot spot.

The average time span for the treatment group was 5.52 days in which the crime occurred and for the comparison group was 13.20 days. Similar to crime at Time 2, the SD for the treatment group was relatively larger indicating more variation than the control group. Yet, similar to crime, micro-time hot spots with response had significantly shorter times spans at Time 2. Thus, the micro-time hot spots that did not receive police response both lasted longer and had more crime incidents. It is an expected result that the micro-time hot spots lasted longer when there were more crimes because the actual time period at Time 2 varied across micro-time hot spots based on how long it took each micro-time hot spot to cool off (i.e., the absence of any additional crime for 21 days). The test of the final radii of micro-time hot spots of the two groups indicates that the means are not significantly different ( $p$  value = .159) and the SDs are similar as well.

In a quasi-experiment that uses propensity score matching, even one that uses a high number of coefficients to accomplish matching, there is the possibility that the observed characteristics are not adequate for developing a robust model of equivalence and that unobserved characteristics result in a hidden bias making the results questionable. Rosenbaum (2002) developed a sensitivity test, commonly called "Rosenbaum bounds," to provide a specific statement about the magnitude of hidden bias. The Appendix shows a table with the results of the RBOUNDS test, which indicate that there is not an issue with hidden bias in the analysis.<sup>6</sup>

Finally, the spatial displacement variable reflects the amount of crime occurring within a 0.2-mile catchment area around the initial radius within 14 days of the last crime. In the treatment and comparison groups, four (7.4%) and six (11.1%) micro-time hot spots had at least one crime in the

catchment area, respectively. The independent t-test of the two groups confirms that these amounts are not significantly different. The means for the number of crimes in the catchment area are 0.07 for the treatment and 0.11 for the comparison group. They yielded a t-value of  $-.659$  and a p value of  $.511$ . Thus, these findings show that there was no spatial displacement of crime as a result of the police response.

## Discussion and Conclusion

Our results show that tactical police response in micro-time hot spots leads to significant reductions in residential burglary without spatial displacement of crime in one jurisdiction. Using a practice-based approach by evaluating an agency's standardized crime reduction efforts over 5 years, we found that when police responded with about six responses per day and for between 2 and 3 weeks, there was around one less residential burglary in a micro-time hot spot. Overall, the micro-time hot spots with police response were resolved in half the time than those without a response (i.e., 5 vs. 13 days). In both groups, crimes occurring after the initial micro-time hot spots tended to be spatially clustered very close to the original crimes. Finally, we found no spatial displacement of crime after the response.

To translate the findings to real reductions in crime, the mean difference in crime between those micro-time hot spots and those without is

most promise for reducing crime in long-term hot spots is in taking a multifaceted problem-solving approach in which police tailor their responses to the underlying causes of the problem versus using only tactical approaches such as directed patrol.

We maintain that police response to clusters of residential burglaries that concentrate quickly and for short periods of time is equally important as responding to crime in long-term stable hot spots. When those long-term hot spots experience crime flare-ups within them, it is an ideal time to initiate a tactical response. Doing so over a long period of time could essentially eliminate the long-term hot spot. A cursory look at this agency's micro-time hot spots of residential burglary over the 5 years showed that most of the micro-time hot spots occurred outside of the city's long-term hot spots (i.e., no overlap). Also, in areas where repeated micro-time hot spots did occur, there were long periods of time between them (i.e., months of cooling off between each micro-time hot spot). Thus, developing long-term solutions that address root causes of crime in the long-term hot spots while, at the same time, implementing tactical responses in the short-term flare-ups of residential burglary, seems to be a more efficient use of resources and a comprehensive approach for more effective crime reduction efforts overall.

Another practical implication is that responding to micro-time hot spots can be a way for police to increase their clearance rates and arrest offenders for these crimes. Investigations of property crime, specifically residential burglary, consistently result in low clearance rates of around 15% (FBI, 2014). Research shows residential burglaries that cluster in space over a short time are often committed by the same offenders. As noted earlier, Bernasco (2008) and Johnson, Summers, and Pease (2009) found that most near repeat burglaries that occur within a week are caused by returning offenders, and we infer that micro-time hot spots are also likely committed by the same offenders. Importantly, in practice, most residential burglaries are not assigned for investigation because there is little to no evidence, and the solvability for the crime is low. Consequently, if detectives look at all crimes in a micro-time hot spot together, when an arrest is made for one crime, they might determine if those other crimes in the micro-time hot spot can be linked to that offender. A consistent use of micro-time hot spots for investigations could arguably lead to a higher clearance rate for those targeted crimes.

Evidence-based police research has shown that implementing tactical responses in long-term hot spots is effective (Braga et al., 2014). While this

employing these strategies for short-term hot spots is also effective. As practice-based research, these findings now provide some evidence for a

## Appendix

Table A1. Rosenbaum Bounds Test for Sensitivity.

G	p Critical	Hidden Bias Equivalent
1.00	.000022	-1.00
1.10	.000071	-1.00
1.20	.000191	-1.00
1.30	.000442	-1.00
1.40	.000903	-1.00
1.50	.001677	-1.00
1.60	.002876	-1.00
1.70	.007501	-1.00
1.80	.007036	-0.50
1.90	.010229	-0.50
2.00	.014304	-0.50
2.10	.019344	-0.50
2.20	.025413	-0.50
2.30	.032557	-0.50
2.40	.040800	-0.50
2.45	.045337	-0.50
2.50	.050148	-0.50

Note. N= 54.

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### Notes

1. The agency employs stratified policing as its organizational framework for implementing evidence-based crime reduction strategies into the police organization's day-to-day practices by providing actionable crime analysis products and a foundation for the accountability of problem solving through a structured set of meetings (Santos & Santos, 2015b). The Port St. Lucie Police Department's success has been documented by a process and impact evaluation (Santos, 2013b) and has received a prestigious policing award, the International Association of Chiefs of Police Law Enforcement Research Award (International Association of Chiefs of Police, 2010).





favors the comparison group, which means the results of the treatment would be even stronger than they appear. The first row shows  $G = 1$ , that is, no confounding bias. Each line below presents alternative values for  $G$  from 1 to 2 in increments of .1 except at 2.45. In the table, where  $G$  is between 2.45 and 2.50, the significance level exceeds .05, thus to explain away the observed characteristics

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