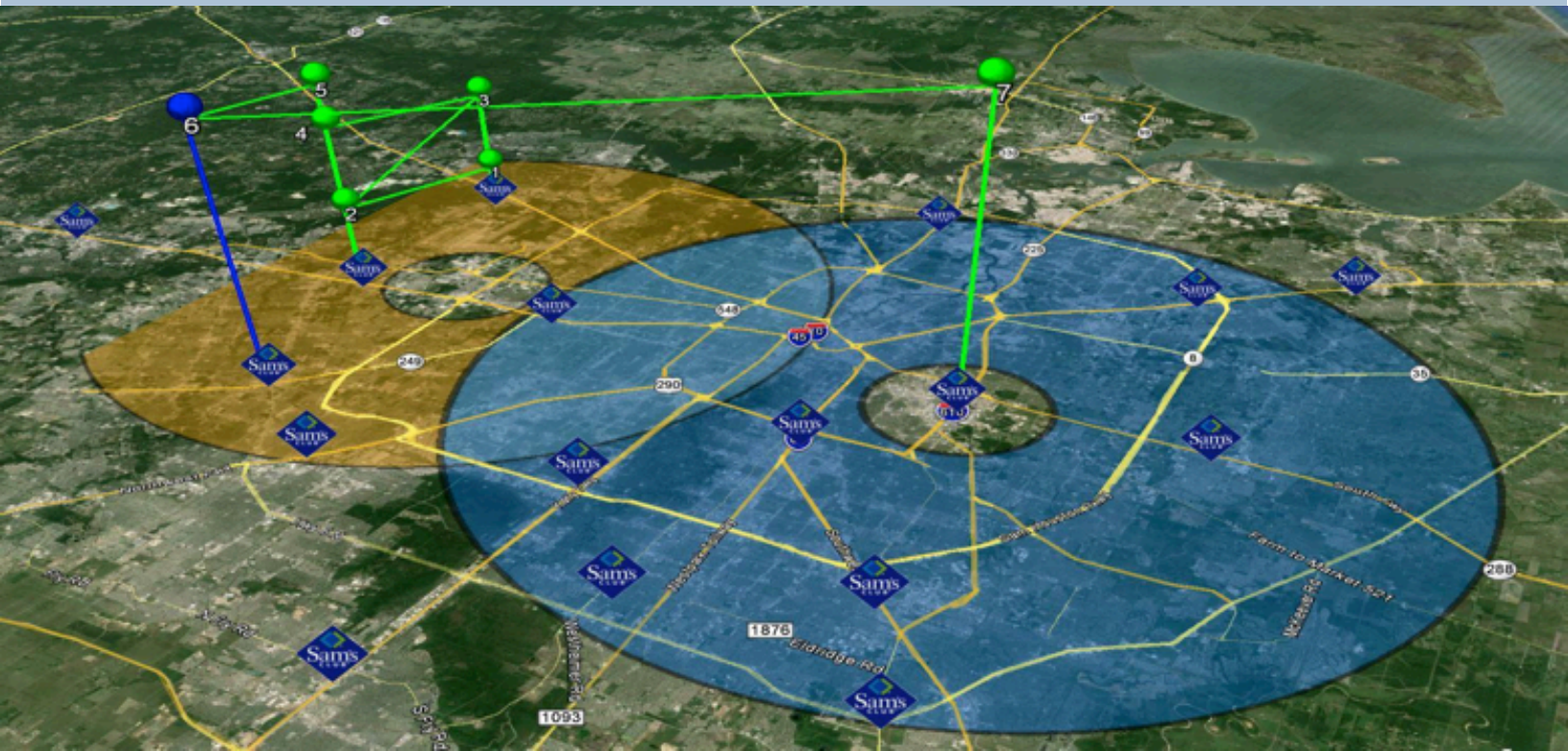


Crime Mapping & Analysis News

A POLICE FOUNDATION PUBLICATION

Issue 5: Fall 2016



- The Use of Geographic Profiling in Crime Analysis
- Investigating the Applicability of the Near-Repeat Spatio-Temporal Phenomenon to Shot(s) Fired Incidents: A City-Level Analysis
- Organized Retail Crime: Understanding and Mitigating the Risk with Geospatial Analytics
- New Mobile App Brings Evidence-based Policing and Tactics to Those “On The Front Lines” of Policing and Crime Prevention



A POLICE FOUNDATION PUBLICATION

Jim Bueermann, President

Shefali Tripathi, PhD, Editor-in-Chief

Karen L. Amendola, PhD, Editor

About the Police Foundation

The Police Foundation is the only nationally-known, non-profit, non-partisan, and non-membership-driven organization dedicated to improving America's most noble profession – policing. The Police Foundation has been on the cutting edge of police innovation for 45 years since it was established by the Ford Foundation as a result of the President's Commission on the Challenge of Crime in a Free Society.

The Police Foundation, relying on its in-house staff and a team of executive, policing, and research fellows, provides actionable technical assistance and conducts innovative research to accomplish its mission of improving policing through science and innovation.

Our Partners:



The opinions, information, and ideas presented herein are those of the authors and do not necessarily reflect the views of the Police Foundation. This newsletter offers an outlet for scholars, practitioners, and policy makers to learn, share, and collectively address topics of mutual concern.

Editor's Note

Greetings everyone! Welcome to the fall 2016 issue of the Crime Mapping & Analysis News.

Our fall issue explores a broad array of articles focusing on crime mapping and analysis practice and research. In the opening article, the author discusses the use of Geographic Profiling for Crime Analysis to help in the investigation of serial crimes. The second article talks about applicability of the near-repeat spatio-temporal pattern to crime incidents such as shots fired. Crime in today's world is not just limited to property or people. Organized retail crime is a kind of crime where the victims are large and small retailers. This type of crime costs the retail industry several billion dollars each year. The article on organized retail crime highlights the use of geospatial analytics to mitigate such crime. The last article is an introduction to a new mobile app, called the Evidence-Based Policing App created by the Police Foundation, in collaboration with George Mason University and The International Association of Chiefs of Police (IACP) for front line officers to access strategies, tactics and general recommendations for responding to common crime concerns. I am excited to bring these new topics to our readers and I believe that you will find them informative.

I sincerely appreciate the continued support of our contributors, readers, and our editorial staff. As always, we welcome your comments and your submissions. You may reach us at editors@policefoundation.org.

Sincerely,
Shefali Tripathi
Editor-in-Chief



Shefali Tripathi is a Florida Department of Law Enforcement (FDLE) Certified Analyst working as a Crime Analyst at the Gainesville Police Department. Dr. Tripathi is a subject matter expert in crime analysis and crime mapping and is a Senior Research Fellow at the Police Foundation. Dr. Tripathi works at the interface of law enforcement practice and applied research. She has over 15 years of advanced spatial analysis experience in law enforcement, criminal justice, urban planning and allied fields. She is an adjunct faculty and teaches graduate level courses in Geographic Information Systems for criminal justice and public safety. She is a trained Geographic Profiling Analyst. Dr. Tripathi holds a Doctorate in Urban and Regional Planning from the University of Florida.

Note from IACA President



Greetings from the IACA,

The International Association of Crime Analysts (IACA) welcomes you to the Police Foundation's Crime Mapping and Analysis News. This year's 2016 IACA conference, our 26th Annual Training Conference, is being held in Louisville, KY as this issue goes into publication. If you missed our conference, you can look over the presentations at <http://iaca.net/conference.asp>. The conference took place the week of September 19-23, 2016. We had over 400 attendees, representing 10 countries including the US, Australia, Austria, Canada, Chile, Columbia, Iceland, Mexico, Poland, South Africa & the United Kingdom with 40 U.S. states represented. The conference committee members are in the planning stages for the 2017 Annual Training Conference to be held in New Orleans, LA in September. Please accept this as an invitation for you to join us next year. The IACA is proud to announce that we have reached a new membership threshold of over 3,000 members this past year.

IACA has elected a new executive board, Noah Fritz—IACA President, Jim Mallard—VP of Administration, Christopher Bruce—VP of Membership, Brandi Christon—Secretary, and Eric Drifmeyer—Treasurer. You can reach them via email: Board@iaca.net. We have just recently begun a rotating election process, and VP of Membership and Secretary were up for reelection this past year with both standing board members winning the election by acclamation. Next year VP of Administration is up for election; and President and Treasurer will come up for election in 2018. Please consider running for a position. In the coming year, the IACA Executive Board will be reaching out to members to serve on various committees that assist us in providing specialized services to the profession.

If you are not an IACA member yet, we invite you to join, attend our annual conference, take part in our professional training series, our certification program, and become a member of our network. Go to www.iaca.net to get more information. Our new motto for police department's considering hiring a crime analyst is "if you hire an IACA crime analyst, you don't just get one crime analyst—you get a team of 3,000 innovative professionals." Come and join the IACA and become a part of this great team!

The IACA will have a booth at the 123rd International Association of Chiefs of Police (IACP) Conference in San Diego, CA, October 15-18, 2016; and will be attending several of the conference sessions. If your chief or someone else from your agency is attending IACP – tell them to stop by our booth. The IACA will meet with Chiefs and other attendees during the vendor exposition to share with them the value of having a crime analysis function within their agency. More and more agencies are turning to the IACA and the profession to improve their efficiency and effectiveness in policing.

As President, and on behalf of the IACA, I want to thank the Police Foundation for extending this partnership to reach out and educate crime analysts around the world. You all make a critical difference in providing safety and security. Thank you for your service.

Sincerely,

A handwritten signature in black ink that reads "Noah J. Fritz". The signature is written in a cursive style.

Noah J. Fritz, PhD
President,
International Association of Crime Analysts

The Use of Geographic Profiling in Crime Analysis

By Lorie Velarde

INTRODUCTION

Law enforcement agencies are always searching for better ways to identify and apprehend serial offenders, who commit disproportionately more crimes (Canela-Cacho, Blumstein, & Cohen, 1997). Geographic profiling is a suspect prioritization method that can assist with this process.

Geographic profiling is a tool that is especially suited for crime analysts as they are often already familiar with analytical techniques and the creation of crime maps. This article outlines the background of geographic profiling, discusses training in the methodology, and concludes with a case example that shows the application of geographic profiling in an operational case.

BACKGROUND

Geographic profiling is the process of determining the most probable area of an offender's base of activities through an analysis of his or her crime locations (Rossmo, 2000). It is used most often in investigations of serial crimes. This technology assists law enforcement by focusing limited resources, resulting in the apprehension of the offender faster with less time spent and resources expended, and fewer victims. In large investigations, these savings can be significant (Velarde, 2004).

Research has shown that the most important influence on where criminals offend is where they go during their non-criminal activities (Bennett & Wright, 1984). This can be represented through a mathematical model. Geographic profiling focuses the search for suspects using a combination of environmental criminology theory, research on offender spatial behavior, and mathematics, which has been incorporated into geographic profiling software called Rigel by Environmental Criminology Research Inc. (<http://ecricanada.com/products/rigel-workstation/>). Rigel uses an algorithm called criminal geographic targeting (CGT) to create a geo-profile, a two-dimensional probability surface that overlays on a street map and shows the most probable areas for the offender's base (Rossmo, 2013). The geo-profile map normally uses color to represent probability. While this may initially look similar to a hot-spot map of the crimes, it is actually showing different information: where the offender is likely based rather than where they commit their crimes.

A geographic profile is used to prioritize suspects based on their address information. Suspects are investigated in the order of prioritization

(MacKay, 1999). In some serial crime cases, the number of known suspects can be in the hundreds or thousands, and a geographic profile can help police manage this information (Rossmo, 2012).

There are a variety of investigative strategies that can be employed once a geographic profile has been prepared (Rossmo, 2013). Analysts can use a geographic profile to prioritize records the police department already has access to, such as arrest records, field interviews, and jail booking sheets. These files often include the offender's address, physical description, and prior arrest charges. Other databases may also be used in conjunction with a profile, such as parole, probation, and motor vehicle registration databases (Rossmo, 2006).

A geographic profile can also be used to prioritize areas for directed police patrols or area canvasses. This strategy can be especially effective if the offender is operating during a narrow time period. The profile can be used to provide specific information to local area residents and neighborhood watch groups. Police may also want to use the profile to direct community mailings and/or conduct a media campaign (Rossmo & Velarde, 2008).

Finally, geographic profiles can be used for the placement of specific tools that gather information about people or vehicles that pass through an area, such as pole cameras or license plate readers. The data obtained from the placement of these tools can be reviewed and investigated by detectives.

TRAINING

The form of geographic profiling used by crime analysts and detectives is called Geographic Profiling Analysis (GPA). GPA training is currently available nationally and internationally through various universities and police agencies. In some states, such as California, GPA training is reimbursable to law enforcement agencies through state Peace Officer Standards and Training (POST) funds.

GPA courses provide an overview of the geography of crime, crime linkage, environmental criminology, and the operational aspects of geographic profiling for property crime. Students learn to identify offender behavioral patterns, analyze crime series for spatial-temporal patterns, and create maps and profiles using geographic profiling software. The training program includes lecture-style learning, group, solo and field exercises, hands-on activities, and evaluation/mentorship. Students who take GPA training are typically crime analysts and property crime investigators (Velarde, 2004).

Implementation of GPA by law enforcement is achieved through the training of agency personnel and the acquisition of geographic profiling software. Students are encouraged to complete profiles on as many cases as possible during their mentorship period, and to brief both command staff and officers/detectives as to the con-

cepts of GPA and its potential use in the criminal investigative process (Velarde & Cooper, 2006).

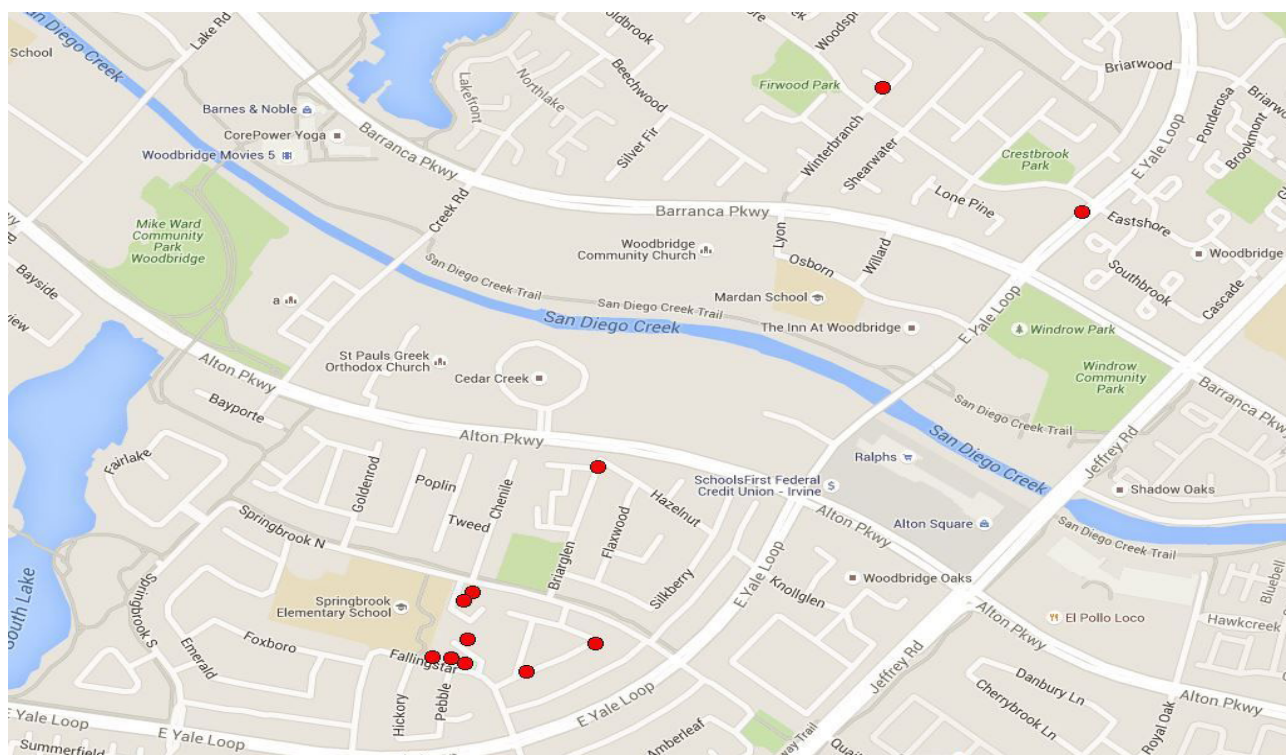
APPLICATION

The Irvine (California) Police Department (IPD) has used geographic profiling successfully for both local and outside agency cases. One case in which geographic profiling was effectively used by IPD is discussed below.

From 2010 to 2011, the City of Irvine experienced several arsons that IPD detectives believed were set by a single serial offender. The crimes were difficult to solve as there were no witnesses and most of the physical evidence had been consumed in the fires. In April 2011, IPD's Crime Analysis Unit (CAU) was asked to provide an analysis of the series, including maps of the fires, a next-crime forecast, and a geographic profile.

The fires were occurring during the early morning hours in a residential neighborhood. The offender was burning car covers and flags, as well as using items of opportunity such as pizza boxes to set trash dumpsters on fire. The offender showed a lack of criminal sophistication; the crimes were close together, suggesting the offender was likely walking to the crime locations.

Using Rigel, Irvine analysts created a geographic profile for this case. The profile identified a highly populated residential neighborhood as the most probable area for the offender base, and analysts determined that this base was likely to be the offender's home. Subjects living in the area whom had previously been arrested, had police contact, and/or were registered for arson were re-



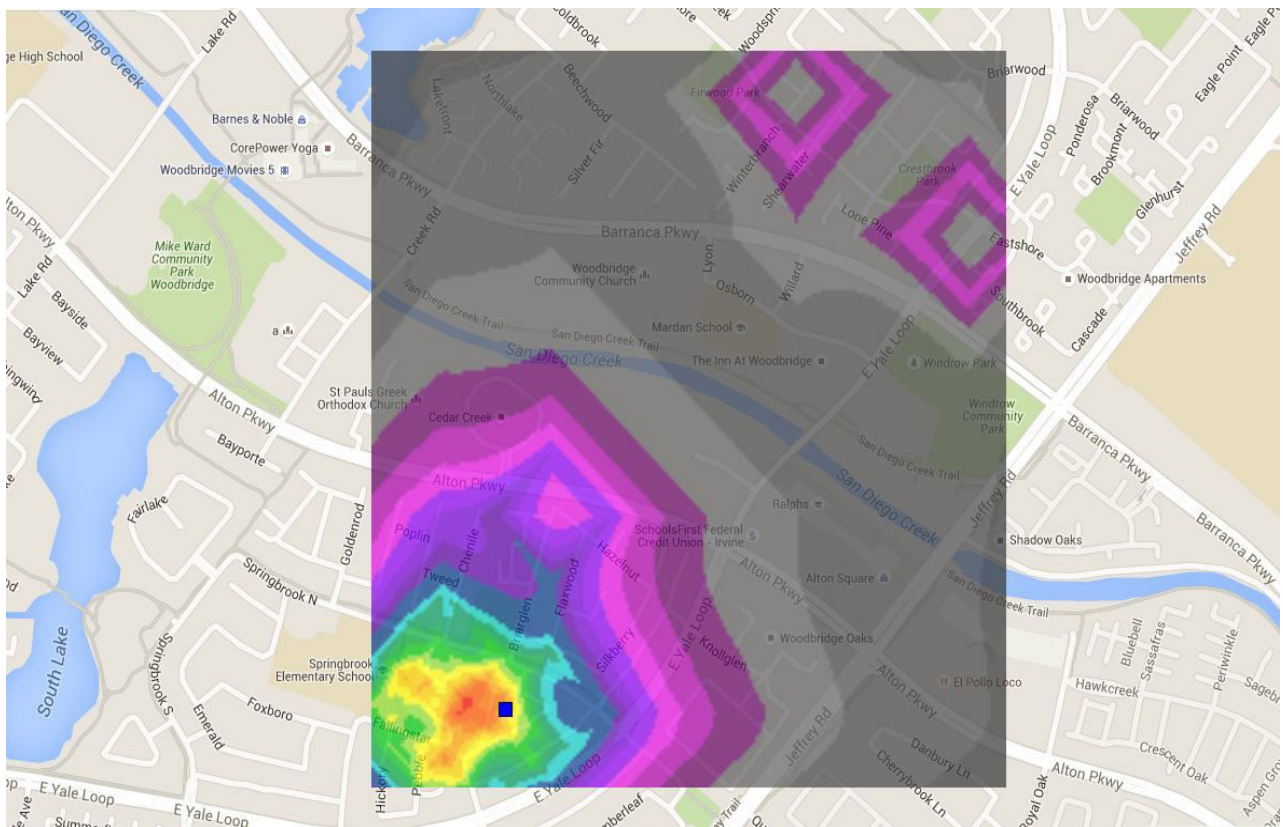
viewed, however this failed to identify the offender.

DNA swabbing of unburned material was conducted, and the Orange County Sheriff's Department DNA laboratory determined that three pieces of evidence contained genetic material from the same person, a female. This was the first physical evidence in the investigation and it was helpful because any suspect who was identified in the investigation could now be compared to the scene DNA.

A meeting with detectives and crime analysts was held to determine a case strategy. It was decided the best use of resources would be to try to intercept the offender as she hunted for her next target. The geographic profile outlined an interception area, and the crime fore-

cast, based on descriptive statistics of the previous arsons, provided the most likely day of week and time of day for the offender's future activity.

This information was used to deploy undercover officers. After several weeks of surveillance, one of the detectives saw a woman walking her dog as she entered a nearby elementary school during the early morning hours. When the detective saw smoke coming from behind a pillar at the school, he realized this woman was the serial arsonist. The detective put out the fire and followed the woman to her home where she was arrested. Her home was in the peak area of the geographic profile (marked by a blue square on the map).



CONCLUSION

While it does not directly solve cases, geographic profiling can spatially focus an investigation and help manage large volumes of information. It is well suited for crime analysts because of their experience using analytical techniques and generating maps. Through the acquisition of GPA training and geographic profiling software, a law enforcement agency can add an important tool to help in their investigation of serial crime.

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Lorie Velarde is a GIS Analyst with the Irvine Police Department. She holds a MS in Criminology, a BA in Social Ecology, a California State Teaching Credential, and a Certification in Crime and Intelligence Analysis. Lorie has developed and taught training courses in crime analysis, crime mapping, and geographic profiling. Lorie has received several awards for her work including the International Association of Chiefs of Police/ChoicePoint Award for Criminal Investigative Excellence.

Investigating the Applicability of the Near-Repeat Spatio-Temporal Phenomenon to Shot(s) Fired Incidents: A City-Level Analysis

By Charles Anyinam, PhD

1. INTRODUCTION

In the last few decades, studies have demonstrated that in addition to the fact that crimes do concentrate spatially, certain locations are repeatedly victimized or tend to experience elevated risks for subsequent crimes during a relatively short period of time (Bernasco, 2008; Bowers & Johnson, 2004; Johnson & Bowers, 2004; Sherman & Weisburd, 1995; Weisburd, Morris, & Ready, 2008). These phenomena are generally referred to as “repeat” and “near-repeat” patterns. Attention has been drawn particularly to the need to identify “near-repeat” patterns of crime in order to enhance police proactive, preventive and other strategies. Early studies of the near-repeat phenomenon focused on burglaries (Bernasco, 2008; Bowers & Johnson, 2005; Johnson & Bowers, 2004; Johnson et al., 2007; Sagovsky & Johnson, 2007; Townsley, Homel, & Chaseling, 2003). All of the studies suggested that incidents of burglary tend to show a near-repeat phenomenon because after an initial occurrence, nearby locations

run increased risks of becoming burglary targets within a relatively short period of time. These studies identified not only locations where there was an elevated risk of crime, but also the specific time bands in which the risks were unusually high.

Results of these studies heightened interest in finding whether such phenomena also existed in the distribution of other crime incidents. Researchers have employed the concept to analyze and examine the spatial and temporal distributions of other incidents such as shootings (Ratcliffe & Rengert, 2008; Wells & Wu, 2011), gun assaults (Wells, Wu, & Ye, 2012), robberies (Grubestic & Mack, 2008; Haberman & Ratcliffe, 2012), motor vehicle theft (Block & Fujita, 2013; Lockwood, 2012; Tonkin, Grant, & Bond, 2008; Youstin, Nobles, Ward, & Cook, 2007), and insurgent activity in Iraq (Townsley, Johnson, & Ratcliffe, 2008).

To date, scarcely any research exists that has distinctly investigated the extent to which near-repeat patterns are discernible in the spatio-

temporal distribution of shot(s) fired incidents (unlawful discharges of firearms). Many police departments deal with these incidents of shot(s) fired; incidents that fortunately do not result in killing people (murders or homicides) or hurting or assaulting people (non-fatal shootings). As research has not yet explicitly examined the existence of near-repeat patterns for unlawful firearms discharges, little is known about whether near-repeat patterns exist for these incidents. Analyzing the near-repeat nature of unlawful firearms' discharges, therefore, may have value for proactive policing, crime prevention and crime reduction.

The study reported here seeks to expand upon what is known about near-repeat patterns by determining the extent and nature of near-repeat patterns for an offense that has not yet been tested: unlawful discharges of firearms ["shot(s) fired"]. The study examines the extent to which shot(s) fired incidents concentrate in space and time simultaneously. If such patterns exist, do they differ from patterns demonstrated for other types of incidents? The present study seeks to extend existing empirical research by not only applying the near-repeat phenomenon to a relatively unexamined crime incident type, but also to quantify the extent to which the near-repeat phenomenon is influenced by the time of

day in which the incidents occur. Research on the near-repeat phenomenon has generally focused on the dates incidents occurred. Not much is known about how these patterns differ by the time of day; i.e. how they differ by day and night. This study examines the extent to which near-repeat patterns identified in shot(s) fired incidents differ by day and night. Understanding what near-repeat patterns exist in unlawful firearms discharges and how the patterns differ by day and night could not only enhance the literature on near-repeats, but also help police formulate more efficient and effective prevention strategies in dealing with reports of shot(s) fired in many city neighborhoods. The brief report focuses exclusively on near-repeat patterns at the city-level in New Haven, Connecticut.

II. SETTING AND DATA

The study relies upon data from the New Haven, Connecticut Police Department. New Haven is the second-largest city in Connecticut with a population of 129,779 people in 2010. The data used in this study consist of reported incidents of verified unlawful firearms discharges from January 1, 2013 to December 31 2015, using a total of 507 shot(s) fired incidents. The study uses incidents in which police found evidence of shell casings at the location of occurrence. The data analysis was undertaken by using the Near-

Repeat Calculator (Ratcliffe, 2008, go to: <http://www.cla.temple.edu/cj/center-for-security-and-crime-science/projects/nearrepeatcalculator/>) and as such consisted of three values: the x-coordinate, the y-coordinate, and the date of the incident. The data was further grouped into daytime (0600 – 1759) and nighttime (1800 – 0559) incidents.

III. METHODOLOGY

Using the Near Repeat Calculator requires determination of which temporal and spatial bandwidths to use. For this study, 445 feet was selected as the spatial bandwidth because it is the average block length of New Haven streets. Although research on near-repeat patterns has used temporal periods of up to 2 months, the temporal bands selected for this analysis were 14 days, 7 days, and 4 days. The study is intended to identify patterns that would be more practical, meaningful and useful for the police in preventing and reducing occurrences of unlawful firearms' discharges in the city.

The Near-Repeat Calculator software combines the revised Knox test and Monte Carlo simulation process to detect near-repeat crime (Johnson et al, 2007; Ratcliffe & Rengert, 2008). For this study, 999 Monte Carlo simulations were conducted. The Near-Repeat Calculator creates an observed pattern of event pairs within a spatio-temporal matrix (also called a Knox table) defined

by the temporal and spatial bands selected. The spatial distance between events was calculated using Manhattan distance, a method that "... most accurately replicates the actual distance traveled by urban residents to get from point to point" (Ratcliffe & Rengert, 2008, p. 65). The Knox test is used to evaluate whether the number of incident-pairs that are both "close" in space and time is significantly larger than what is expected if the incidents were randomly distributed in space and time across the entire city. The space-time clustering identified in the data is compared against the null-hypothesis of a random distribution of incidents.

IV. ANALYSIS

The Near-Repeat Calculator was employed to find out whether the near-repeat phenomenon prevails in the occurrence of incidents of shot(s) fired in New Haven. The three selected time periods for analysis (14-day, 7-day, and 4-day) are each analyzed separately under sections A, B, and C below.

A. 14-DAY TIME-SPAN

Table 1 presents city-level results of the analysis which uses a 445-foot spatial bandwidth, a 14-day temporal bandwidth, and Manhattan distances. The table shows the significance level and observed over mean expected frequency across all the spatial-temporal bands. The significance levels of clustering are based on a pseudo p-value.

The lowest significance level for running the Near-Repeat Calculator is 0.05 while the highest significant level used is 0.001. The value in each cell is the ratio between the number of observed space-time pairs and the average expected pairs in the corresponding spatial-temporal band. It is the comparison of the observed frequency to the expected frequency that determines whether there is an overrepresentation of event pairs. Larger values indicate greater differences between an observed risk level and the risk level determined under the assumption of space-time randomness.

Table 1. Observed over mean expected frequencies (14-day)

	0 to 14 days	15 to 28 days	29 to 42 days	43 to 56 days	57 to 70 days	More than 70 days
Same location	3.93*	4.69*	1.55	3.37*	2.49	0.64
1 to 445 feet	2.33**	1.08	1.53*	0.79	1.12	0.94
446 to 890 feet	1.49*	1.33*	1.36*	1.40*	0.85	0.95
891 to 1335 feet	1.31*	1.10	1.32*	1.41*	1.02	0.96
1336 to 1780 feet	1.12	1.20	1.15	1.24*	1.21	0.97
1781 to 2225 feet	1.17	1.17	1.22*	0.96	1.16	0.98
More than 2225 feet	0.98	0.99	0.98	0.99	0.99	1.00

* indicates that the statistical probability is .05 for 999 iterations

** indicates that the statistical probability is .001 for 999 iterations

As shown in Table 1, a significant and meaningful near-repeat pattern was found. The results show that after an occurrence of shot(s) fired incident, there is evidence of an over-representation of events in the local area for a certain amount of time. Within 1 to 445 feet of an initial incident, near-repeats are overrepresented for up to 14 days. Within 446 to 890 feet of an initial incident, near-repeats are

overrepresented for up to 56 days and within 891 to 1335 feet of an initial incident, near-repeats are overrepresented for up to 14 days. Thus, in the immediate space-time vicinity to a source event, for example, the most over-represented space-time range that is significant is the zone from 1 to 445 feet and from 0 to 14 days from an initial incident. The 2.33 value is interpreted to mean that once a location experiences a shot(s) fired incident, the chance of a second one taking place within one street block and within the next 14 days is about 133 percent greater than if there were no discernible pattern.

Table 1 also confirms a significant and meaningful near repeat pattern. After a shot(s) fired incident, there is evidence of an over-representation of events at the same location up to 28 days after an initial incident. The most over-represented near repeat pattern range that is significant is the zone from 15 to 28 days from an initial incident. The chance of another incident occurring is about 369 percent greater than if there were no near repeat pattern.

B. 7-DAY TIME-SPAN

Table 2 presents city-level results of the analysis which uses a 445-foot spatial bandwidth, a 7-day temporal bandwidth, and Manhattan distances. Here too, a significant and meaningful near-repeat pattern was found. After a shot(s) fired incident, there is evidence of an over-

representation of events in the local area for a certain amount of time. Within 1 to 445 feet of an initial incident, near-repeats are overrepresented for up to 14 days. Within 446 to 890 feet of an initial incident, near-repeats are overrepresented for up to 7 days and within 891 to 1335 feet of an initial incident, near-repeats are also overrepresented for up to 7 days. As can be seen from the table, in the immediate space-time vicinity to a source event, the most over-represented space-time range that is significant is the zone from 1 to 445 feet and from 0 to 7 days from an initial incident. The chance of another incident happening is about 179 percent greater than if there were no discernible pattern.

Table 2. Observed over mean expected frequencies (7-day)

	0 to 7 days	8 to 14 days	15 to 21 days	22 to 28 days	29 to 35 days	More than 35 days
Same location	7.70*	0.00	4.68*	4.70*	0.00	0.81
1 to 445 feet	2.79**	1.88*	0.83	1.35	1.92*	0.94
446 to 890 feet	1.87**	1.13	0.98	1.69*	1.29	0.97
891 to 1335 feet	1.47*	1.15	1.11	1.09	1.18	0.98
1336 to 1780 feet	0.93	1.31	1.19	1.20	1.00	0.99
1781 to 2225 feet	1.11	1.24	1.24	1.09	1.27	0.98
More than 2225 feet	0.97	0.98	0.99	0.98	0.98	1.00

* indicates that the statistical probability is .05 for 999 iterations

** indicates that the statistical probability is .001 for 999 iterations

A highly significant and meaningful repeat pattern was also found. After an incident, there is evidence of an over-representation of events at the same place up to 7 days after an initial incident. The most over-represented near repeat

range that is significant is the zone from 0 to 7 days from an initial incident. The chance of another incident occurring at the same location after shot(s) fired incident is about 670 percent greater than if there were no near repeat pattern.

C. 4-DAY TIME-SPAN

Table 3 presents city-level results of the analysis which uses a 445-foot spatial bandwidth, a 4-day temporal bandwidth, and Manhattan distances. A significant and meaningful near-repeat pattern was also found for this shorter time span. After an incident, there is evidence of an over-representation of events in the local area for a certain amount of time. Within 1 to 445 feet (one street block) of an initial incident, near-repeats are overrepresented for up to 8 days. Within 446 to 890 feet of an initial incident, near-repeats are overrepresented also for up to 8 days, and within 891 to 1,335 feet of an initial incident, near-repeats are overrepresented for up to 4 days. In the immediate space-time vicinity to a shots fired event, the most over-represented space-time range that is significant is the zone from 1 to 445 feet and from 0 to 4 days from an initial incident. The chance of another shot(s) fired incident is about 179 percent greater than if there were no discernible pattern.

Table 3. Observed over mean expected frequencies (4-day)

	0 to 4 days	5 to 8 days	9 to 12 days	13 to 16 days	17 to 20 days	More than 20 days
Same location	11.38*	2.39	0.00	5.61*	2.81	0.85
1 to 445 feet	2.79**	2.46*	1.83	1.57	0.94	0.96
446 to 890 feet	1.78*	1.84*	0.95	1.08	0.90	0.99
891 to 1335 feet	1.65*	1.33	1.00	0.93	1.39	0.99
1336 to 1780 feet	0.98	1.04	1.43	1.18	1.17	0.99
1781 to 2225 feet	0.97	1.40	1.14	1.00	1.48*	0.99
More than 2225 feet	0.97	0.97	0.99	0.99	0.98	1.00

* indicates that the statistical probability is .05 for 999 iterations

** indicates that the statistical probability is .001 for 999 iterations

With regard to the level of near repeat patterns, again a significant and meaningful pattern was found. After an incident, there is evidence of an over-representation of events at the same location up to 4 days after an initial incident. The most over-represented near repeat pattern range that is highly significant and meaningful is the zone from 0 to 4 days from an initial incident and the chance of another incident is about 1,038 percent greater than if there were no near repeat pattern.

DAYTIME AND NIGHTTIME PATTERNS

As indicated earlier, we were also interested in finding out the extent to which repeat and near-repeat patterns differ between day and night occurrences of shot(s) fired incidents. Most near-repeat pattern studies have not examined whether differences in the pattern identified at the city-level continue to exist when the time periods of incident occurrence are broken down by daytime (0600-1759) and by nighttime (1800-0559). To examine

the question of whether the citywide near-repeat patterns identified for shot(s) fired differ between day and night, we used the following parameters: 4-day time span, 445-foot spatial bandwidth and Manhattan distance to demonstrate the nature of repeat and near-repeat patterns during daytime and nighttime. The same citywide data of shot(s) fired were categorized into day and night. While near-repeat patterns still exist, there are some significant differences in the patterns identified (see Tables 4 and 5). These differences have some important implications for police operations in terms of engaging in both preventive and proactive activities to reduce incidents of shot(s) fired.

Table 4. Observed over mean expected frequencies for day time period

	0 to 4 days	5 to 8 days	9 to 12 days	13 to 16 days	17 to 20 days	More than 20 days
Same location	0.00	0.00	0.00	0.00	0.00	1.05
1 to 445 feet	8.26*	0.00	0.00	2.54	3.63	0.89
446 to 890 feet	0.00	0.00	2.10	0.00	0.00	1.03
891 to 1335 feet	1.31	1.49	1.68	3.32	0.00	0.98
1336 to 1780 feet	0.00	0.00	2.28	0.00	0.00	1.03
1781 to 2225 feet	0.00	5.91**	1.84	0.00	0.73	0.97
More than 2225 feet	0.99	0.93	0.95	1.01	1.03	1.00

* indicates that the statistical probability is .05 for 999 iterations

** indicates that the statistical probability is .001 for 999 iterations

Table 5. Observed over mean expected frequencies for night time period

	0 to 4 days	5 to 8 days	9 to 12 days	13 to 16 days	17 to 20 days	More than 20 days
Same location	14.07*	4.73	0.00	3.95	4.48	0.80
1 to 445 feet	2.27*	2.70*	2.21	1.57	1.08	0.96
446 to 890 feet	1.80	1.73	0.34	1.05	0.66	1.00
891 to 1335 feet	1.95*	1.14	1.00	0.42	1.33	0.99
1336 to 1780 feet	1.19	1.06	1.24	1.13	1.02	0.99
1781 to 2225 feet	0.92	1.15	1.31	1.26	1.76*	0.99
More than 2225 feet	0.97	0.98	0.99	1.00	0.98	1.00

* indicates that the statistical probability is .05 for 999 iterations

** indicates that the statistical probability is .001 for 999 iterations

Comparison of daytime and nighttime patterns shows some significant differences in near repeat patterns. First, there is no indication of repeat pattern over-representation during the daytime (Table 4). This means that shot(s) fired incidents do not appear to cluster in a statistical and influential way immediately after a prior event during the day time. However, a significant and meaningful repeat pattern is found during the nighttime. After a shot(s) fired incident, there is evidence of an over-representation of events at the same place up to 4 days after an initial incident. The most over-represented repeat range that is significant during the nighttime is the zone from 0 to 4 days from an initial incident (Table 5). The chance of another incident is about 1,307 percent greater than if there were no repeat pattern.

Second, a comparison of Tables 4 and 5 indicates some important differences in the near-repeat patterns during daytime and nighttime. A significant and meaningful near-repeat pattern exists in the occurrence of shot(s) fired during the daytime. After an incident there is evidence of an over-representation of events in the local area for a certain amount of time. Within 1 to 445 feet of an initial incident, near-repeats are over-represented for up to 4 days. For example, the 8.26 value is interpreted to mean that once a location

experiences a shot(s) fired, the chance of a second one taking place within 1 to 445 feet and within the next 4 days is 726 percent greater than if there were no discernible pattern. This finding reveals a clear near-repeat of shot(s) fired. Also shown in Table 5, near-repeats are over-represented for up to 8 days during the nighttime, within 1 to 445 feet of an initial incident. In the immediate space-time vicinity to a source event, the most over-represented space-time range that is significant is the zone from 1 to 445 feet and from 5 to 8 days from an initial incident. The chance of another incident is about 170 percent greater than if there were no discernible pattern.

OBSERVATIONS AND FURTHER RESEARCH

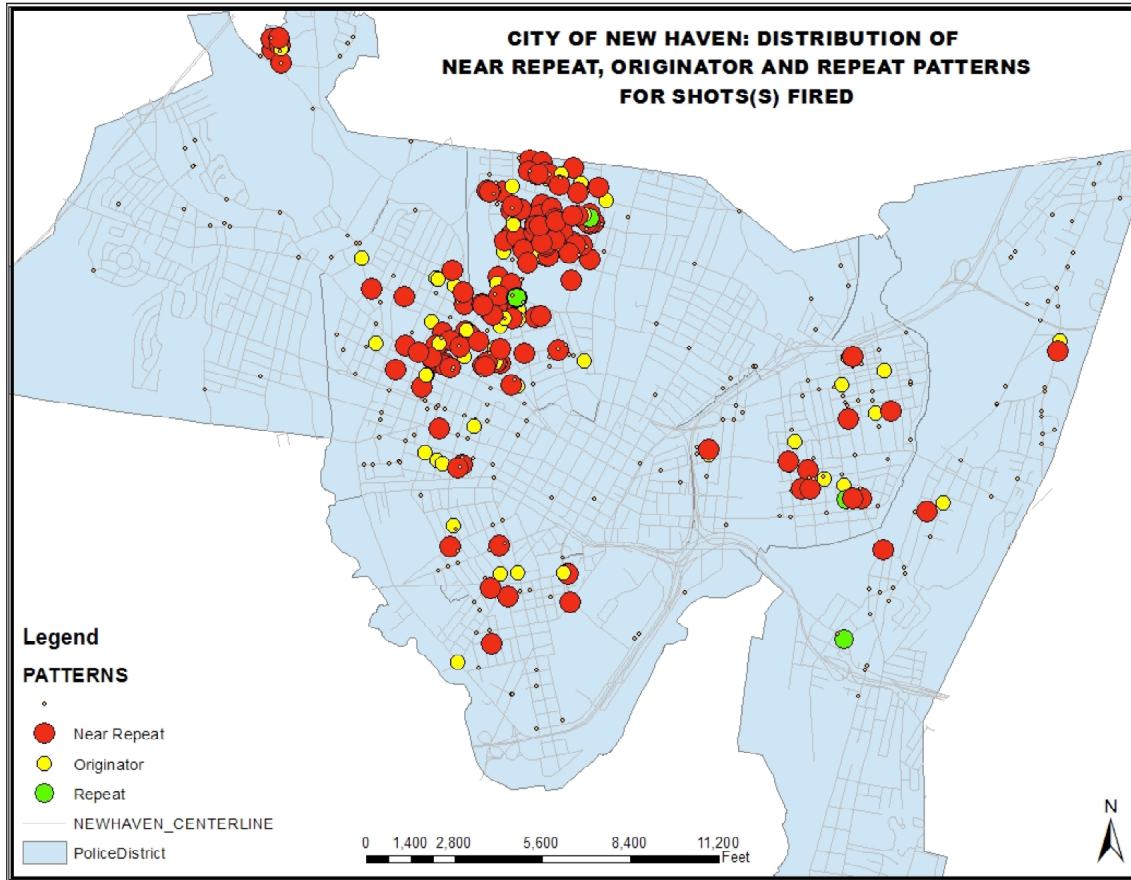
This study applied the near-repeat phenomenon to shot(s) fired incidents, an unexamined crime type, using the city of New Haven as a case study. It focused on the city-level analysis of the extent to which the near-repeat phenomenon of shot(s) fired occurs. Statistically, whether one examines this phenomenon at a 14-day, 7-day or 4-day time-span, there is a definitive spatial-temporal pattern. The chance of another incident of shot(s) fired within one street block ranges from 133 to 179 percent greater than if there were no discernible pattern. Similar to findings of other studies, it is also evident that there is a clear spatial and temporal decaying pattern of the

ratios. Looking at the observed-expected ratios in Table 3, for instance, the risk of additional shot(s) fired incidents is 179 percent greater within one street block of the original incident for 4 days following the original incident. That risk drops to 78 percent greater when considering an incident one to two blocks away for the same time period, and the level of risk continues to drop to 65 percent for incidents occurring even further away.

The relevance of analyzing daytime and nighttime near-repeat patterns has been emphasized in this study. The daytime and nighttime analysis demonstrates the importance of this level of examination for the occurrence of crime especially those for which time of occurrence can be precisely determined [e.g. shooting, robbery and shot(s) fired incidents]. During the daytime, the city of New Haven generally does not expect repeat patterns at the same location to occur within a short time because the analysis shows incidents do not appear to cluster in a statistical and influential way immediately after a daytime shot(s) fired incident. This is not, however, the case during nighttime when a significant and meaningful repeat pattern is found. This means, at the city level, when considering incidents of shot(s) fired at nighttime, officers should be conscious of the fact that repeat patterns are quite possible

at some locations within a short time period.

Even though the city-level analysis has shown significant and meaningful near-repeat patterns, it must be emphasized that the risk of near-repeats appears unevenly distributed in space in the city. It is, therefore, important to further examine how the near-repeat patterns that have been identified in the context of the city of New Haven operates at the local-level. This local-level analysis will provide a description of “initiator” and “follow-up” incidents and examine the extent of geographic clusters of events within and across the city. The map below shows an example of the distribution of originators, near repeat and repeat patterns for 7-day time span. The map was produced using Esri’s ® new crime analysis toolbox that support crime prediction using repeat and near repeat analysis.



Those “initiator” incidents (or “originators”) are those that occur first and those that occur later in time are referred to as “follow-ups.” It will be very informative to know, for example, the number of times a shot(s) fired incident is an initiator, follow-up, or both, as well as the percentage of the number of shot(s) fired incidents that are part of near-repeat sets or near-repeat pairs. Some studies have indicated that a small portion of crime incidents are actually responsible for the significant near-repeat pattern at the local level. In New Haven, near-repeat patterns of shot(s) fired incidents

are more clustered locally and are unevenly distributed in the city as the map above illustrates.

Further studies are needed to undertake a thorough local-level analysis of each incident site and gather information on the timing of initial shot(s) fired incidents and nearby follow-ups. This local-level analysis will make it possible to gain a more thorough understanding of the interactions among the shot(s) fired incidents and such knowledge will enhance place-based police strategies to reduce and prevent future incidents.

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Organized Retail Crime: Understanding and Mitigating the Risks with Geospatial Analytics

By Scott Peacock

With more than a million apprehensions worth over \$159 million annually, shoplifting is a significant problem affecting the retail industry (Jack Hayes International, Inc., 2015). While the numbers are staggering, there are other more hidden costs as well. Specifically, research suggests the retail industry loses an estimated \$11 billion annually due to shoplifting (Hollinger & Adams, 2011). Shoplifting not only affects retail establishments but also affects law enforcement with 1.2 million reports/responses annually (Federal Bureau of Investigation, 2015). Yet, while shoplifting is a significant and costly challenge, it is dwarfed in terms of scale and severity by another more pervasive form of criminal activity: organized retail crime.

While similar in practice, organized retail crime or ORC is distinguished from shoplifting by intent. For example, ORC is primarily committed to convert the stolen or fraudulently obtained goods into financial gain while a shoplifter steals primarily for personal use. In addition to intent, ORC is further distinguished through the methods of oper-

ation and quantity or value of the targeted goods. For instance, ORC typically involves the theft of large quantities of products by a group of criminals in a coordinated effort while shoplifting is typically committed by a single person taking a small amount of product (National Retail Federation, 2013).

Though there are many ways to convert stolen wares into financial gain, working through a fence is one of the most common. Fences are stolen goods dealers who operate behind the guise of a legitimate business. Fences are central figures in ORC schemes by recruiting thieves and providing “shopping lists” of the types of items they want for their stores. Though some inexperienced thieves attempt to act as their own fence by selling stolen items out of the back of a car or on a street corner, professional ORC groups often operate through an eCommerce or physical storefront “fence.”

Secondary market research indicates fences are classified into one of three levels. In a Level 1 scenario, a thief sells stolen product to a storeowner or second level broker (i.e. pawn shop,

flea market, or corner store). The storeowner then sells the goods within the business to unsuspecting consumers or to another fence. In contrast, a Level 2 Wholesale fence buys goods from a Level 1 fence and repackages the goods to make them appear as if they came from the original manufacturer. While the first two are subversive, a Level 3 fence is particularly insidious because not only do they receive goods from a Level 2 Wholesale fence but they sell the goods back to legitimate merchants which can result in a retailer unknowingly buying back the same goods that were originally stolen from their own stores (Sutton, 2010).

Though difficult to quantify, estimates suggest ORC is pervasive and prevalent with financial impacts to retail ranging from \$30 to \$37 billion in annual losses (Federal Bureau of Investigation, 2007), or about three times that of shoplifting. Though the direct financial impact to retailers is substantial, the true cost of ORC extends beyond the walls of a store. Reduced inventory resulting from products that are no longer on the shelf because of theft means consumer demand cannot be met. The inability to meet economic demands has a trickle-down affect across the economy.

For example, the lack of available product at a legitimate business means a taxable sale was not

made. The non-sale affects not only profits but it also impacts tax coffers. Estimates suggest government taxing authorities fail to collect approximately \$1.6 billion annually because of sales lost due to ORC (Coalition Against Organized Retail Crime, 2007). On a more granular level, consumers are negatively impacted through higher costs, approximately \$400 annually for an average household, because retailers are forced to raise prices to compensate for the lack of sales on popular ORC items (Checkpoint Systems, 2013). Across the long term, depressed inventory levels and inflated prices are detrimental to the overall health of the economy.

While ORC's financial implications are substantial, other risks are also present. For example, ORC products often end up back in the marketplace via a fence. Repackaging or improper handling of ORC items (i.e. over-the-counter medications or other perishable items) during the fencing process means unsuspecting consumers can potentially be exposed to expired or hazardous goods during a resale. Exposure to unsafe products can lead to illness or other personal injury (National Retail Federation, 2013). The risk of exposure to unsafe merchandise through the resale of stolen items is of particular concern to retailers and product manufacturers who are focused on maintaining the integrity of their brand.

Retailers of all sizes are victimized by ORC (National Retail Federation, 2013). Walmart, the world's largest retailer with more than 11,500 stores operating under 65 banners in 28 countries, offers a unique operational environment (Walmart Stores, Inc., 2016). Due to its scale, Walmart is at particular risk of being impacted by ORC. In response to the threat, Global Investigations was formed to proactively identify and mitigate the most significant risks through conducting investigations and leveraging analytics. One of the primary tools utilized by Global Investigations in the fight against ORC is geospatial analytics. Through geospatial analytics Global Investigations is able to identify areas at risk, assess the impact of a fence, and disrupt serial offenders.

IDENTIFYING THE RISKS

To identify ORC, it is imperative to understand which items are at risk. Research suggests the most commonly stolen goods are Concealable, Removable, Available, Valuable, Enjoyable, and Disposable or CRAVED (Gill, 2004). Using the CRAVED model, items at risk for ORC activity can be identified. Understanding consumer demand for popular products also helps identify ORC items. While new products always come to market, certain items remain a staple of ORC. Cigarettes, energy drinks, infant formula, over-the-

counter medicine, diabetic testing strips, razors, and electronics are commonly impacted by ORC due to their high resale value and demand (National Retail Federation, 2013).

Once potential ORC items have been identified, Global Investigations can conduct research to determine negatively affected areas. Using transactional databases to search inventory and product sales, discrepancies can be identified and scored accordingly. Geospatial analytics allows the analyst to visually identify emerging patterns that may indicate ORC activity is occurring. Moreover, third-party data (i.e. crime or demographics) can be overlaid to further enrich the analytical product.

Figure 1 illustrates how low inventory levels (elevated points) of a popular ORC item can be combined with third-party data (high retail density areas) to highlight stores at risk. By using geospatial analytics in conjunction with inventory data, an analyst can focus on the highest risk locations.

ASSESSING A FENCE

As discussed, a fence is a central piece of the ORC equation. Through directed thefts of CRAVED items, a fence can significantly impact stores in the area. Leveraging various investigative techniques (i.e. open source intelligence, field surveillance, and offender interviews), Global Investigations

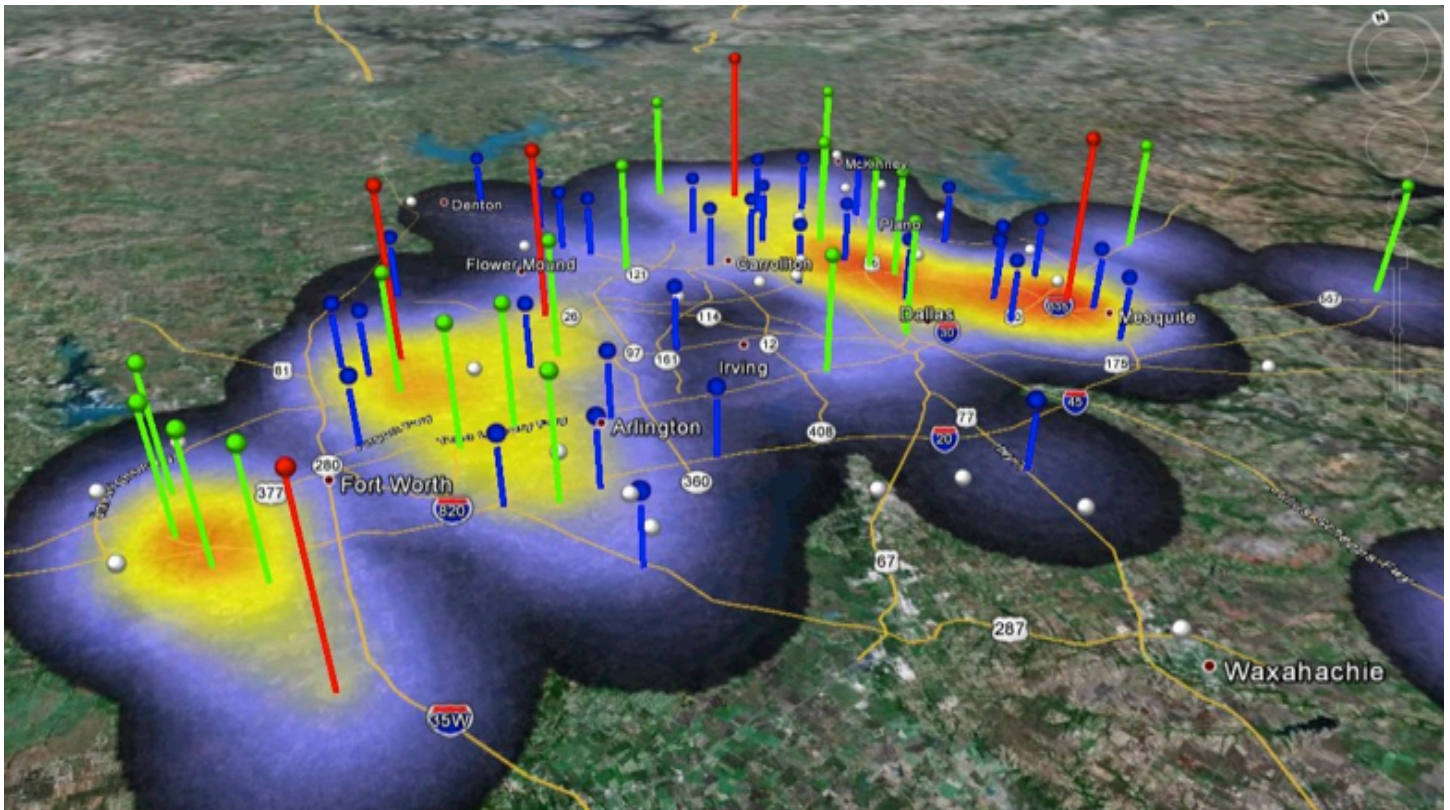


Figure 1. ORC item level inventory data with third-party data enrichment

is able to develop leads into suspected fencing locations. However, simply identifying a possible fence is only the first step and determining the potential impact of that fence and documenting losses becomes imperative.

One way Global Investigations assesses the impact of a fence is by leveraging geospatial analytics in conjunction with statistical tests. By integrating intelligence about the fence and the types of stolen products, Global Investigations can research inventory levels and/or sales of those items. Geospatial analytics allows the analyst to identify stores within a given range of the fence and compare inventory levels of the items in question

to stores outside of the range of the fence. Statistics can then be leveraged to determine if there is a significant difference between inventory levels of the items at stores near the fence in comparison to stores out of range. While not conclusive in terms of causality, this technique does establish a possible correlation between the fence and corresponding inventory levels at nearby stores. Figure 2 illustrates store inventory levels on a popular ORC item (elevated points) in relation to suspected fences (green circles).

DISRUPTING SERIAL OFFENDERS

Wolfgang et al. (1972) found that a relatively small number of offenders were responsible for

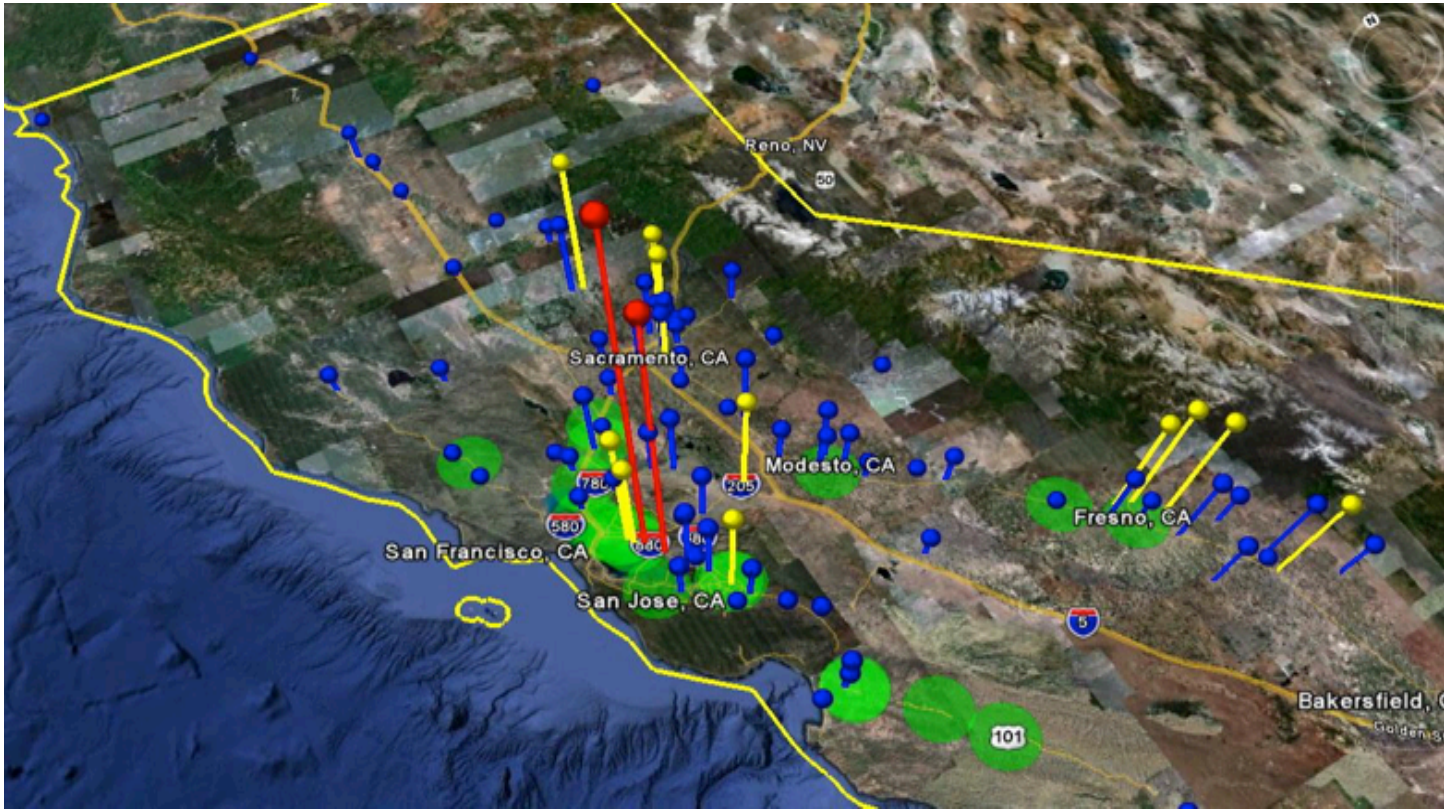


Figure 2. Inventory level of an ORC item in relation to suspected fencing locations.

a majority of crime. Building upon this assertion, Global Investigations has developed strategies to identify and disrupt serial offenders in an effort to make the most significant impact against organized retail crime. By leveraging the fundamentals of tactical crime analysis (i.e. temporal analysis, hotspot analysis, sequential movements, etc.), Global Investigations is able to mitigate the impact of serial offenders by directing resources to the most at-risk locations at the appropriate times to either deter activity or facilitate an apprehension when applicable.

Once a serial offender or an organized group working in conjunction with one another

has been identified, Global Investigations analysts utilize tactical crime analysis techniques to analyze affected locations and identify patterns. Additionally, a forecast for possible future targets can often be formulated based upon previous activity in the series. Local resources can then be directed toward at-risk facilities in an attempt to mitigate the problem through deterrence, apprehension, or intelligence gathering. Figure 3 is an example of how Global Investigations analyzes the movements of a serial offender and formulates projections for where the next event in the series may occur.

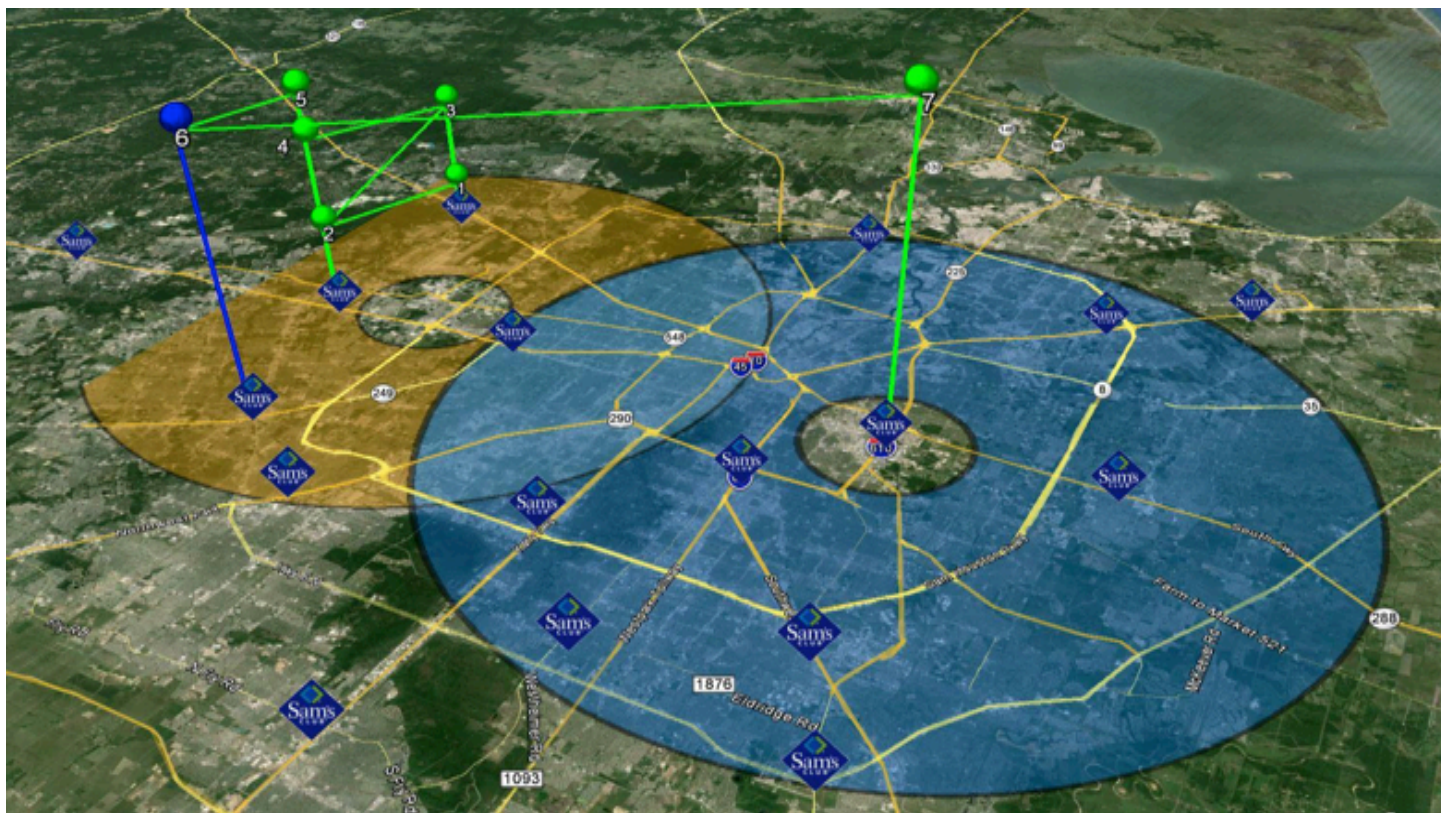


Figure 3. Serial ORC offender's activity and projected risk zones for future activity.

In conclusion, organized retail crime is a significant risk affecting not only Walmart, but the retail industry as a whole. Left unchecked, ORC has the potential to significantly impact retailers in ways beyond a line on a profit and loss sheet by injecting doubt and risk into the minds of consumers who trust the safety and quality of the products they are buying. Walmart has recognized these risks and the Global Investigations team actively works to mitigate them. Geospatial analytics is a powerful tool and allows Global Investigations to mitigate the loss of company assets and reduce reputational harm as a result of ORC.

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Scott Peacock has over 14 years of crime analysis and investigative experience in diverse areas to include both the public and private sector. Scott is currently a Senior Intelligence Analyst with Walmart Global Investigations and is based out of Bentonville, Arkansas. Scott provides advanced analytical support to mitigate loss and risk associated with organized retail crime and fraud across Walmart business units to include eCommerce, Health & Wellness, International, and over 5,000 Walmart stores and Sam's Clubs throughout the United States. Prior to beginning his career with Walmart, Scott served as a crime analyst with the Scottsdale, AZ Police Department and worked on a variety of projects, including tactical analysis of serial offenders, intelligence analysis, strategic planning, administrative reporting, citizen outreach, and crime prevention. Scott also had the privilege of serving on the Board of the Arizona Association of Crime Analysts as the Vice-President, where he worked to provide professional development opportunities for association members. Scott is a member of numerous industry associations to include the International Association of Crime Analysts, and is a three time winner of the association's annual Crime Mapping Award. Scott holds a Master's in Education from the University of Georgia along with a Master's in Public Administration, a Bachelors of Science in Administration of Justice, and a Bachelors of Arts in Integrative Studies from Arizona State University.

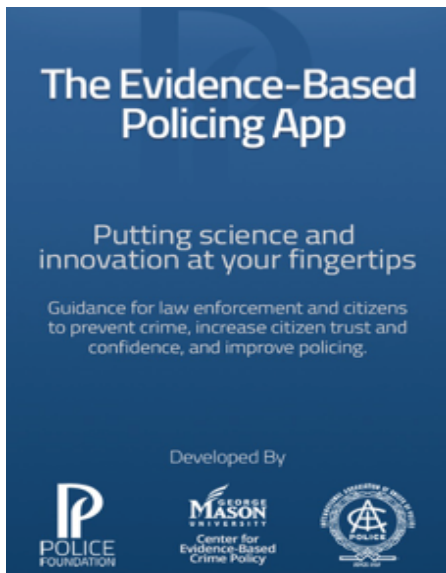
New Mobile App Brings Evidence-based Policing Strategies and Tactics to Those “On the Front Lines” of Policing and Crime Prevention

By James Burch

In late 2015, the Police Foundation, George Mason University’s Center for Evidence-Based Crime Policy (CEBCP), and the International Association of Chiefs of Police (IACP) collaborated to develop and release the first version of the Evidence-Based Policing App.

Matrix Demonstration Project and many of the Police Foundation’s research and policy reports.

Users who download the app can access strategies, tactics and general recommendations for responding to common crime concerns. Information is first organized by type of crime concern. Then, within each general category of crime, users can choose from a wide range of specific concerns they may need to address.



The App, available for download from App Stores supporting iOS, Android, and Windows devices, is free to all users. The three organizations collaborated closely on the design and content, borrowing heavily from CEBCP’s



Different from other websites and tools related to evidence-based programs, this App explains the process required to implement an evidence-based strategy in simple and easily digestible steps, similar to what one might find in an officer's "playbook."¹ (see e.g. Lum & Koper, 2015).



The Police Foundation has conducted critical incident reviews of the Christopher Dorner Incident/Response as well as the Stockton Bank Robbery/Hostage Taking Incident. The Police Foundation's website also provides a Critical Incident Review following are some lessons learned included in these incident reviews:

1. Agencies should develop response plans for high-risk locations that are unique to specific locations.
2. Agencies should determine the technological capabilities of high-risk locations, such as closed circuit television (CCTV) cameras, and prepare response protocols that incorporate the use of that technology.
3. Scenario-based training is necessary to expose and prepare officers for situations that are outside of normal law enforcement operations, such as hostage and active-shooter situations.



¹Like a football playbook, the Evidence-Based Policing Playbook is a working document, created by researchers and law enforcement personnel to provide tangible ideas for officers to use in patrol or specialized units for common problems that they face. The Playbook draws from the Evidence-Based Policing Matrix, CrimeSolutions.Gov, Campbell Collaboration Systematic Reviews, the Center for Problem Oriented Policing, and other knowledge. Additionally, the Playbook was created in collaboration officers from multiple agencies to ensure that suggestions are tangible and able to be implemented in actual policing settings.

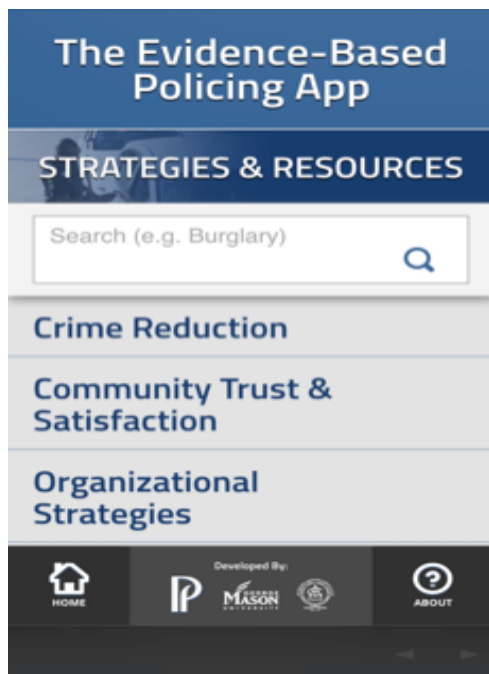
Users can search by keyword or topic in lieu of exploring crime concern categories, and all of the evidence-based recommendations include links to CEBCP's Matrix website, where research summaries and expanded information can be found.

It is important to note that although the App is called the Evidence-based Policing App, not all of the information and recommendations included should be considered evidence-based, but at a minimum, they represent best practices. For example, despite accolades by many when a law enforcement agency releases open data about its operations, there is no scientific evidence that releasing open data improves policing outcomes. Despite this, the App points to releasing open data as one way to improve community engagement.

Although additional information will soon be added, the App is now ready for use and contains valuable information for police officers, community members, analysts and others.

For example, an officer attending a neighborhood meeting may be confronted with complaints about how to respond to open air drug markets in the community. Although the officer could conduct her or his own research, the App provides quick and easy access to a list of steps to be considered to address this very problem, based

on studies conducted by a variety of researchers on drug market intervention strategies, such as those involving partnerships between police and municipal departments, community groups, or regional task forces. To access these steps, the officer opens the App, selects “Crime Reduction.”



2. Simply increasing police presence or intervention (e.g. arrests) at drug hotspots is less effective than (1) focusing on forging productive partnerships with others, (2) targeting drug hotspots rather than spreading intervention efforts across neighborhoods, and (3) making efforts to alter the underlying conditions that exist in places that may contribute to street-level drug market problems.

3. Some recent research indicates that patrol cars with license plate cameras on them seem to reduce drug calls in crime hot spots.

NOTE: Problem solving approaches in this review also include nuisance abatement, closing down problem locations, and improving the quality of life in these areas by contacting appropriate municipal agencies regarding code violations.



As shown in the screenshot, those two clicks provide the officer, community members or policymakers with the following evidence-based recommendations to address open-air drug markets: implement geographically targeted problem-oriented policing interventions, focus on forging productive partnerships, target drug hotspots, make efforts to alter underlying conditions, and deploy patrol cars with license plate cameras.

If further information is needed on these suggestions, a link is provided to access a full-page summary of the research and additional reading is recommended via bibliography.



We encourage practitioners, researchers, policymakers, community members and others to download the free app (no advertising and no in-app purchases to be wary of) and let us know your thoughts on how to improve it. New content will be added as it becomes available and new features and functions are possible.

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Jim Burch served more than 20 years at the U.S. Department of Justice, being appointed to various senior executive and leadership positions, including Acting Director of the Bureau of Justice Assistance (2009-2011), Deputy Assistant Attorney General (2011-2014) of the Office of Justice Programs (OJP), and Acting Assistant Director at the Bureau of Alcohol, Tobacco, Firearms and Explosives (2014-2015). During his career at the DOJ, Mr. Burch developed, supported, and led many key initiatives to advance policing and criminal justice. Mr. Burch worked directly with local law enforcement and criminal justice agencies to develop, implement, and test crime prevention and reduction strategies. He had responsibility for ATF's public, congressional, and intergovernmental affairs divisions as well as other external relations functions. Prior to 2011, While serving as the Acting Director of the Bureau of Justice Assistance, he advised OJP's Assistant Attorney General and DOJ leadership on local law enforcement and justice priorities and issues, testifying and working with congress, and helping to shape Departmental initiatives. Mr. Jim Burch has received countless awards and recognition throughout his career, and served as a member of the National Academy Advisory Board before leaving federal service in 2015. He is an accomplished speaker, has conducted local and national training, participated in local and national media interviews, guest lectured at the FBI National Academy and in academic settings, and has authored publications and articles on various criminal justice topics.

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