FROM CRIME MAPPING TO CRIME FORECASTING: THE EVOLUTION OF PLACE-BASED POLICING

BY **JOEL HUNT**

Mapping law enforcement report data can be an effective way to analyze where crime occurs. The resulting visual display can be combined with other geographic data (such as the locations of schools, parks, and industrial complexes) and used to analyze and investigate patterns of crime and help inform responses.

The past decade, in particular, has seen advances in analytical capabilities within the criminal justice community, making it possible to add more geographic and social dimensions to statistical analyses to forecast where crimes are likely to occur.

NIJ has been a long-time investor in research on mapping and analysis. Over the years, the Institute has funded projects that explore, evaluate, and seed analytical techniques and technology to support law enforcement agencies that use place-based policing practices and strategies to help answer the question, "How do we best reduce crime and improve public safety?"

This article follows the field's evolution — from crime mapping to crime forecasting (and, in some cases, crime prediction) — and discusses NIJ's investments in research and future directions.

A Brief History

In 1829, Adriano Balbi and André Michel Guerry produced maps showing the relationships between educational level and violent and property crime in France. This is often cited as the first instance of crime mapping.[1] Following this work, Joseph Fletcher, in 1849, and Henry Mayhew, in 1861, produced maps that showed rates of male incarceration and county crime, respectively.[2]

In the early 20th century, Clifford Shaw and Henry McKay mapped thousands of incidents of juvenile delinquency and analyzed the relationships between delinquency and various social conditions.[3]

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In the 1950s, Jane Jacobs examined the built (urban) environment and the needs of city dwellers.[4] In her work, she introduced constructs that are still used in today's place-based research, such as "eyes on the street" and "social capital." Although Jacobs did not attempt to forecast crime, her work led to later research positing that crime has spatial patterns and thus should be able to be forecast.[5]

In the 1970s, criminologists began to emphasize the importance of place. Lawrence Cohen and Marcus Felson's routine activities theory (RAT) described how routine activities affect crime.[6] According to RAT, for a crime to occur, three things must coincide at the same place and time: a motivated offender, a suitable target, and a lack of capable guardianship. Due to the consistency in our routines, Cohen and Felson argued, we should be able to forecast crime: "The spatial and temporal structure of routine legal activities[7] should play an important role in determining the location, type and quantity of illegal acts occurring in a given community or society."[8]

Similarly, Paul and Patricia Brantingham put forward the environmental criminology theory, positing that crime is a complex event in which four things intersect at one time: a law, an offender, a target, and a place.[9] They defined this fourth dimension — place — as a discrete location where the other three dimensions intersect and provided seven propositions describing how, where, and why people decide to commit crimes.[10] These propositions provide a framework to argue that crimes may spatially cluster because either a criminal has already spent time and energy staking out a neighborhood (a form of "capital") or the learned behavior may result in a peripatetic cycle. The propositions lead to the idea that place — not people — is the key element in crime. As such, the Brantinghams believe that "it should be possible to predict the spatial distribution of crime and explain some of the variation in volume of crime between urban areas and between cities."[11]

In 1979, Herman Goldstein proposed a problem-oriented policing approach.[12] This approach advocated for law enforcement officers to follow a scanning, analysis, response, and assessment process (now known as the SARA approach) to identify, analyze, and solve problems.[13] In the 1990s,[14] Compstat emerged as an alternative policing practice to reduce crime.[15] Made famous by then-Chief Bill Bratton while at the New York City Police Department, Compstat is a truly data-driven approach to creating accountability for the police department. Although these practices and strategies did not necessarily rely on criminological theory, they used statistical analysis to solve problems associated with crime, indicating that they relied on either spatial or temporal patterns.

As these place-based theories and policing approaches continued to take shape, researchers began to test them. For example, Lawrence Sherman, Patrick Gartin, and Michael Buerger — with support from NIJ — examined 323,979 calls to the Minneapolis Police Department between December 15, 1985, and December 15, 1986, to test the spatial premise behind RAT.[16] Using actual addresses and intersections, the research team found that 50% of all calls originated from only 3% of all possible locations. Sherman also found a greater concentration of crime around microplaces than around individuals,[17] which led to the question, "Why aren't we thinking more about wheredunit, rather than just whodunit?"[18] These results marked the beginning of hot spots policing.[19]

Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations

Smart, effective, and proactive policing is clearly preferable to simply reacting to criminal acts. Although there are many methods to help law enforcement respond to crime and conduct investigations more effectively, predicting where and when a crime is likely to occur — and who is likely responsible for previous crimes — has gained considerable currency. Law enforcement agencies across the United States are employing a range of predictive policing approaches.

With support from NIJ, the RAND Corporation developed a reference guide for law enforcement agencies interested in predictive policing. *Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations* offers a focused examination of the predictive techniques currently in use, identifies the techniques that show promise if adopted in conjunction with other policing methods, and shares findings and recommendations to inform future research and clarify the policy implications of predictive policing. To read the guide, go to NIJ.ojp.gov, keyword: 243830.

From 1989 to 2007, researchers examined crime-specific responses, the effects of foot patrols, and trajectories of crime. Researchers also tested problem-oriented policing in Madison, Wisconsin; Baltimore, Maryland; and Newport News, Virginia, in the 1980s[20] and began testing Compstat and community-oriented policing in the 1990s and early 2000s. Today, we still have problem-oriented policing, Compstat, community-oriented policing, and hot spots policing, along with intelligence-led policing, community problem-oriented policing, and many other variations and combinations.

NIJ's Critical Role

During the 1980s, NIJ funded evaluations of place-based policing strategies, including the research by Sherman and colleagues as well as similar research in Chicago. NIJ also began funding the development of technologies that were later incorporated into crime-mapping software.[21]

In 1997, NIJ established the Crime Mapping Research Center, which surveyed law enforcement departments to determine how they used analytic mapping. The center began developing training programs to enhance departments' capability to use spatial maps and data sets. From 1997 to 2014,

NIJ funded the development of CrimeStat software to help practitioners and academics conduct spatial analyses.[22]

In the early 2000s, NIJ started to expand from evaluating place-based policing practices and strategies (e.g., hot spots policing) to exploring the statistical techniques used to forecast and predict crime and how that affects the effectiveness and efficiency of place-based policing practices and strategies. In 2008, Bratton — who by then was chief of the Los Angeles Police Department — began working with the acting directors of NIJ and the Bureau of Justice Assistance on a new approach called "predictive policing."[23] As a result, in 2009 NIJ funded seven agencies to create predictive policing models in their jurisdictions. In 2011, NIJ invited these agencies to propose implementation plans for the models, which would then be evaluated. NIJ funded models developed by the Chicago Police Department and the Shreveport (Louisiana) Police Department and also funded the RAND Corporation to provide technical assistance and evaluate the two models. (See sidebar, "Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations.")

RAND's evaluation of the Shreveport predictive policing model showed three key successes.[24] First,

the model improved community relations, which increased the community's willingness to interact with the police and led to better tips. Second, the Shreveport Police Department found that the predictions were actionable, even though they were not truly predictive. Finally, the model improved actionable intelligence — it led to better skills among analysts, which led to better pattern recognition and more relevant and timely data.[25]

As these awards were coming to a close, NIJ began releasing solicitations for research to test geospatial policing strategies and explore their relationship to criminological theories. For instance, NIJ funded an evaluation of risk terrain modeling in six cities.[26] The evaluation found that conjunctive analysis (an enhanced version of risk terrain modeling) could forecast areas that were at greater risk of a range of future crimes across five cities. The models also identified environmental factors that played a role in these areas, thus allowing law enforcement to develop strategies to address them.

NIJ-funded evaluations of near-repeat (NR) residential burglaries found that departments are likely to overestimate the number of NR burglaries and thus need to temper their expectations. The evaluations also found that providing notifications to people within likely NR regions leads to little or no reduction in NR burglaries; however, communities within the jurisdictions still favored being notified.[27]

NIJ also funded an operationally realistic evaluation of the predictive policing model. This evaluation was NIJ's first place-based, randomized controlled trial to explore the effect of varying police patrol strategies on the rates of violent crime and property crime. Examining the strategies of marked patrols, unmarked patrols, and an awareness patrol (having knowledge of high-crime areas but no dedicated patrol there), the researchers found that a marked unit may have a modest effect on property crime, but they found no other effects for property crime or violent crime.[28]

In 2013, NIJ supported research that compared the effectiveness of different crime forecasting software. The most effective software was then used to conduct a randomized controlled trial in Denver, Colorado, that tested the effects of a hot spots policing approach in forecast areas.[29] The research is ongoing.

In 2015, NIJ directed its attention to exploring the value of data to law enforcement. That year, NIJ funded research to create a flexible tool for departments to better understand the value of the data they collect. A major preliminary finding in this ongoing research is that the perceived value of data can vary widely within an office, even more than variations within and between entire police departments.

In 2016, NIJ released the Real-Time Crime Forecasting Challenge, which asked competitors to forecast where crime was likely to cluster in the future within the jurisdiction of the Portland (Oregon) Police Bureau. Competitors submitted forecasts for all calls for service, burglaries, street crimes, and motor vehicle thefts for the next week, two weeks, one month, two months, and three months. Initial analysis of the results seems to indicate that even the naive model can compete when there is enough crime to forecast. When crime is rare, however, even the more sophisticated models were unable to effectively or efficiently forecast crime. Additional analysis of the results is forthcoming.[30]

Future Directions

So, what has changed in place-based policing over the years? The short answer is everything — and nothing.

Technology has played a critical role in advancing the field and has become so affordable that most, if not all, law enforcement departments can now afford electronic records and some version of mapping software. Technology has also provided the computational power needed to run data analyses and has enhanced the education of analysts. All of this has allowed departments and outside researchers to conduct more research.

But we are still trying to answer the original question: How do we best reduce crime? We have learned that

crime does cluster in hot spots. We have learned that there is stability in these hot spots over longer periods of time, but far less stability when looking at short periods. We also know that the public is leery and that we know very little about how these strategies affect individuals, their neighborhoods, and the larger community.

To help address the research gaps, NIJ recently changed direction in its funding of place-based — and to an extent, person-based — policing research. In 2017, NIJ asked research applicants to look beyond administrative data (e.g., crime rates, calls for service, and arrests) and instead develop and use metrics that consider the potential impacts of police practices and strategies on individuals, neighborhoods, communities writ large, and policing organizations (including individual officers) to determine their success or failure.

In 2018, grant applicants were asked to propose research exploring and evaluating the effects of police practices and strategies on officer safety, investigation outputs, and prosecution outcomes while still measuring the effects on crime rates. Additionally, NIJ wanted applicants to consider the effects of focused deterrence, persistence of hot spots, and intervening variables (e.g., neighborhood and police department characteristics). The goal is to provide a more holistic understanding of the impacts of place-based policing practices and strategies.

About the Author

Joel Hunt is a computer scientist at NIJ.

Notes

1. Borden D. Dent, "Brief History of Crime Mapping," in *Atlas of Crime: Mapping the Criminal Landscape,* ed. Linda S. Turnbull, Elaine Hallisey Hendrix, and Borden D. Dent (Phoenix, AZ: Oryz Press, 2000), 4-21.

2. Sharon Chamard, "The History of Crime Mapping and Its Use by American Police Departments," *Alaska Justice Forum* 23 no. 3 (Fall 2006): 1, 4-8.

3. Clifford Shaw and Henry D. McKay, *Juvenile Delinquency and Urban Areas: A Study of Rates of Delinquents in Relation to Differential Characteristics of Local Communities in American Cities* (Chicago: The University of Chicago Press, 1942); and Clifford R. Shaw, Frederick M. Zorbaugh, Henry D. McKay, and Leonard S. Cottrell, *Delinquency Areas: A Study of the Geographical Distribution of School Truants, Juvenile Delinquents, and Adult Offenders in Chicago* (Chicago: The University of Chicago Press, 1929).

4. Jane Jacobs, *The Death and Life of Great American Cities* (New York: Random House, 1961).

5. See Chamard's (2006) abridged history of Dent's (2000) chapter, "Brief History of Crime Mapping," for a more thorough pre-1970 history.

6. Lawrence E. Cohen and Marcus Felson, "Social Change and Crime Rate Trends: A Routine Activities Approach," *American Sociological Review* 44 no. 4 (1979): 588-608.

7. In macro-time, when and how we go to work, when and where we eat, and when and where we go for entertainment tend to be routines.

8. Cohen and Felson, "Social Change and Crime Rate Trends," 590.

9. Paul J. Brantingham and Patricia L. Brantingham, *Environmental Criminology* (Thousand Oaks, CA: Sage Publications, 1981).

10. Paul J. Brantingham and Patricia L. Brantingham, "Environmental Criminology," in *Classics of Criminology,* ed. Joseph E. Jacoby, Theresa A. Severance, and Alan S. Bruce (Long Grove, IL: Waveland Press, Inc., 2004), 61-70.

11. Ibid., 69.

12. Although Goldstein originally proposed this in 1979, his 1990 book provides a stronger fundamental framework for problem-oriented policing (POP). Herman Goldstein, "Improving Policing: A Problem-Oriented Approach," *Crime and Delinquency* 25 no. 2 (April 1, 1979): 236-258.

13. Herman Goldstein, *Problem-Oriented Policing* (New York: McGraw-Hill, 1990).

14. Other practices and strategies began to emerge as well, such as community-oriented policing (COP). However, COP is predicated on community involvement in, at minimum, identifying the problem. Unlike POP and Compstat, identification of the problem may be driven more by community perceptions than by actual crime patterns. Community-Oriented Policing Services, https://cops.usdoj.gov/about.

15. Jerry Ratcliffe, *Intelligence-Led Policing* (Portland, OR: Willan Publishing, 2008).

16. Lawrence W. Sherman, Patrick R. Gartin, and Michael E. Buerger, "Hot Spots of Predatory Crime: Routine Activities and the Criminology of Place," *Criminology* 27 no. 1 (1989): 27-56.

17. Lawrence W. Sherman, "Hot Spots of Crime and Criminal Careers of Places," in *Crime and Place,* ed. John E. Eck and David Weisburd (Monsey, NY: Criminal Justice Press, 1995), 35-52. Weisburd similarly found that police in Seattle would have to target four times as many people as places to account for half of the crime incidents between 1989 and 2002. David Weisburd, "Place-Based Policing," *Ideas in American Policing* 9 (January 2008), Police Foundation Lecture Series.

18. Sherman, "Hot Spots of Crime," 36-37.

19. Spring and Block first used the term "hot spots" while identifying high-crime areas. James V. Spring and Carolyn R. Block, "Finding Crime Hot Spots: Experiments in the Identification of High Crime Areas," paper presented at the annual meeting of the Midwest Sociological Society, Minneapolis, MN, October 1988.

20. Center for Problem-Oriented Policing, "Mission and History of the Center for Problem-Oriented Policing," 2017.

21. More recent NIJ-funded geospatial tools — resulting from NIJ grant number 2009-SQ-B9-K101 — have been incorporated into ArcGIS software, perhaps the crime-mapping software most widely used by law enforcement agencies. See NIJ.ojp.gov, keyword: 2009-SQ-B9-K101.

22. CrimeStat IV (version 4.02) is the most recent version of CrimeStat, a spatial statistics program for the analysis of crime incident locations. (See https://nij.ojp.gov/topics/articles/crimestat-spatial-statistics-program-analysis-crime-incident-locations.) CrimeStat was developed by Ned Levine & Associates of Houston, Texas, under the direction of Ned Levine, Ph.D., and funded by grants from NIJ (grants 1997-IJ-CX-0040, 1999-IJ-CX-0044, 2002-IJ-CX-0007, and 2005-IJ-CX-K037).

23. Walter L. Perry, Brian McInnis, Carter C. Price, Susan C. Smith, and John S. Hollywood, *Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations* (Santa Monica, CA: RAND Corporation, 2013).

24. Priscillia Hunt, Jessica M. Saunders, and John S. Hollywood, *Evaluation of the Shreveport Predictive Policing Experiment* (Santa Monica, CA: RAND Corporation, 2014).

25. During this award, only an evaluation of the Shreveport experiment was produced.

26. However, it was fully evaluated in only five cities.

27. Elizabeth R. Groff and Travis A. Taniguchi, *Micro-Level Policing for Preventing Near Repeat Residential Burglary* (Washington, DC: Police Foundation, 2018); and Police Foundation, "Translating 'Near Repeat' Theory into a Geospatial Policing Strategy."

28. Jerry Ratcliffe website, "Philadelphia Predictive Policing Experiment," https://www.jratcliffe.net/philadelphia-predictive-policing-ex.

29. This research was originally going to be conducted in Columbia, South Carolina.

30. The results of the Challenge are available at NIJ.ojp.gov, keyword: forecasting challenge.