Geography & Public Safety

A Quarterly Bulletin of Applied Geography for the Study of Crime & Public Safety

Volume 2 Issue 4 | March 2011

Police Legitimacy and Predictive Policing

Tom Casady, Chief of Police
Lincoln Police Department
Lincoln, Nebraska

As law enforcement agencies have adopted computerized records management systems and geographic information systems, their ability to assemble and analyze data about crime and disorder has soared. Widely-available large data sets and new analytical tools are transforming policing. Our technological capabilities have grown faster than our capacity to understand and react to the ethical implications of these new capabilities. As place-based policing, hot spot policing, intelligence-led policing, and information-based policing merge into the science and practice of predictive policing, police will confront increasingly complex ethical issues.

An excellent example of these issues concerns the relationship between income, housing, and crime. While the literature long ago established the nexus between poverty, substandard housing, and crime, geocoded crime data now allow police to visualize the relationship more clearly, and provides information so that the police can better deploy resources and target crime. Moreover, predictive policing principles suggest that given known factors,[1] we can predict those areas where crime and disorder are likely to emerge.

We also know more about people who are most likely to commit crimes. Parolees, probationers, and registered sex offenders have been identified in computer databases, and their homes, workplaces, and treatment centers can be geographically mapped. We can visualize, measure, and define concentrations of such past offenders. We can also predict who is at greatest risk for criminal behavior—unemployed young men, gang members, or chronic truants, for example.

What police strategies emerge from such knowledge? Hot spot policing is one common outcome. If police predict that a certain neighborhood is headed toward a spike in crime and disorder, we may be tempted to apply the same kinds of strategies that have dominated crime reduction efforts in troubled neighborhoods in the past—zero tolerance enforcement, saturation patrols, high-visibility arrest warrant sweeps, or field interrogations. However, allocating law enforcement resources to areas predicted to have increasing crime and disorder is filled with ethical trapdoors.

These kinds of strategies can create significant risks for differential policing based on income, age, race, immigration status, national origin, and other variables. Intensive policing of the activities of young men in poor neighborhoods is a recipe for deteriorating community relations between police and the community, a perceived lack of procedural justice, accusations of racial profiling, and a threat to police legitimacy.

Contents

NIJ National Institute of Justice

maps

COPS
COMMUNITY ORIENTED POLICING SERVICES
U.S. DEPARTMENT OF JUSTICE

How can predictive policing empower policing strategies that minimize this ethical conundrum?

The answer lies in broadening the choice of police strategies when dealing with those places where law enforcement can predict crime and disorder. Rather than relying solely on a "cops-on-dots" approach, police departments need to create strategies that change the conditions of the potential crime environment. Problem-oriented policing projects in areas identified as crime-prone, for example, may be able to address issues such as litter, truancy, or liquor license density and operations.

Rather than using our growing knowledge of where crime is likely to occur to guide crackdowns on hot spots, maybe we can use that knowledge to empower prevention strategies—or at least to add prevention strategies to law enforcement's repertoire. Neighborhoods where crime occurs are often the ones that most need recreational opportunities, mentor programs, community organizing, lever-pull strategies, and youth sports programs. These areas must be designated as a priority for the limited public dollars available for municipal services such as park maintenance, curb repair, codes enforcement, graffiti removal, expanded swimming pool and library hours, and other community activities.

Moreover, police should focus on building relationships with other stakeholders in these areas. Working collaboratively to enhance the collective efficacy[2] of a neighborhood and to prevent crime is far less likely to contribute to a schism between the police and residents than crime suppression and law enforcement activities alone.

The knowledge gained from modern technologies should be used to advance strategies in policing that ameliorate crime and disorder without participating in overzealous policing, racial profiling, and ageism. As predictive policing evolves, we will need a constant focus on assuring and preserving police legitimacy as we seek to intervene in the causal chain of crime and disorder.

Notes

1. Such as housing density, population density, age, percentage owner occupied dwelling units, single parent households, and average income.
2. Collective efficacy is a people's willingness and mutual trust to work for the common good of a neighborhood.

The Predictive Policing Symposium: A Strategic Discussion

Modern policing, even with the development of information-based and mapping technologies, has been largely reactive rather than proactive. Rather than working to anticipate new crimes, officers often patrol locations where crimes have been already been committed. With recent technological advances, software systems can now use advanced algorithms to allow police agencies to predict locations where a certain type of crime is likely to occur and direct appropriate resources to those areas. This effectively stops crimes before they occur. Recent initiatives using this "predictive" approach have shown great success. As a result, predictive policing has made its way to the forefront of strategic law enforcement, and many policing experts believe that it may be a prominent direction in the future.

The first Predictive Policing Symposium was held in November 2009 in Los Angeles, California. The symposium, which was hosted by the National Institute of Justice (NIJ) and the Bureau of Justice Assistance (BJA), brought together researchers and practitioners to discuss the concepts involved in predictive policing. They examined how using analytic strategies could affect how crime will be monitored and prevented in the future. Specific focuses included: defining predictive policing, discussing its current use in the field, examining its implications in terms of privacy and civil

liberties, discussing current research projects, and assessing challenges. These focuses are discussed below:

Defining predictive policing. Predictive policing, as defined by NIJ's Deputy Director of the Office of Science and Technology, John Morgan, refers to "any policing strategy or tactic that develops and uses information and advanced analysis to inform forward-thinking crime prevention." Experts at the conference examined this definition, suggesting that predictive policing must be balanced with intelligence-led policing and community policing, particularly until the criminal justice system develops better tools and research databases. Police who engage in predictive analytics must keep safety, crime reduction, and quality of life in mind.

Use in the field. Currently, predictive policing has been used for crime mapping, data mining, geospatial predictions, and social network analysis. In the future, panelists suggest it be used for managing budgets and personnel, monitoring offenders, and planning safe and economical neighborhoods.

Issues of privacy and civil liberties. Conference participants expressed concern that the general public would think predictive policing may encroach on civil liberties, using information in a way that violates the Constitution. Therefore, police must carefully determine what kinds of information are protected and how information can be legally shared or published. Conference participants suggested that departments must keep their processes transparent, and must communicate regularly with the public if they want to ensure that the community accepts and supports predictive initiatives.

Current research projects. NIJ sent out a request for proposals for predictive policing projects in March 2009. A number of police departments across the country were selected, and will develop predictive policing projects. A group at RAND Corporation will evaluate the projects. A list of the grantees and their awards is available at: www.ojp.gov/funding/pdfs/FY2009221.pdf.

Challenges. Predictive policing faces a number of challenges. One main challenge is determining how to compile valid and reliable data and measurements. Police analysts must understand what data can complement a predictive analysis, how to obtain access to that data, and how that data can best be integrated into a successful analysis. Examples of useful data include census data, public health data, foreclosure listings, and city planning information. Moreover, crime analysts should work to incorporate proven criminological and crime prevention theories into predictive policing to help broaden and solidify the predictions.

In sum, conference participants showed enthusiasm for predictive policing initiatives, and many feel that this kind of strategy can transform the policing field in the future. As predictive policing tends to concentrate resources in areas of greatest need, it may be an excellent strategy for departments who face limited financial resources in the current economic crisis. As a follow up to the conference, NIJ planned to work with grantees in early 2010 to discuss the projects that had been funded and initiate work. NIJ hopes to bring the results of the projects to the table for discussion at a future conference.

This summary is based on:
Uchida, Craig D. *A National Discussion on Predictive Policing: Defining Our Terms and Mapping Successful Implementation Strategies.* Washington, D.C.: U.S. Department of Justice, National Institute of Justice, 2010. NCJ 230404.

Access the full report at: www.ncjrs.gov/pdffiles1/nij/grants/230404.pdf.

Proactive Policing: Using Geographic Analysis to Fight Crime

Colleen McCue, PhD
Law Enforcement Program Manager
SPADAC
McLean, Virginia

In an analysis of police interventions designed to reduce violent crime conducted by Dr. Cynthia Lum and her colleagues, Cody Telep notes that "[t]he most effective police strategies are focused and highly proactive, relying on crime analysis…police tend to be particularly successful when tailor-made efforts are concentrated on specific high violence street blocks, corners, and address clusters."[1] In other words, knowledge and insight regarding when, where, and what type of crime to expect can be leveraged into more effective, proactive, and targeted approaches to crime prevention.

Several years ago, researchers at the Medical College of Virginia began to explore the use of statistical modeling to characterize violent crime and in support of information-based approaches to prevention.[2] This work was conducted in the public health/emergency medical response setting, but researchers also believed that there was potential value for the public safety community. The results of this early research were promising and underscored the value of advanced analytics when modeling complex problems like violent crime. It also

showed how advanced analytics can support information-based approaches to treatment and prevention. The immediate value to the public safety community, particularly in the operational environment, was less clear.

Sensing both interest and promise, these researchers began to work closely with the law enforcement community in an effort to translate this research to law enforcement practice; to use statistical models to support police operations and responses. Visualizing the models in a spatial environment helped law enforcement make informed deployment decisions, significantly increasing the value of this work.

This early law enforcement research was supported by Project Safe Neighborhoods (PSN), and focused on gun-related violence. One of these first projects involved creating a model for robbery-related aggravated assaults.[3] The PSN Team developed models that helped determine what caused an armed robbery to escalate into an aggravated assault. These models could then be used to address this crime pattern through proactive deployment strategies and to influence public safety outcomes in the community.

The most obvious finding from this first exercise was a marked difference between the location of armed robbery incidents and the areas associated with a higher risk for a robbery-related aggravated assault. If the goal of deployment is to proactively allocate police resources when and where they likely to be needed (through either law enforcement presence or rapid response to incidents), then deploying based on the frequency and spatial distribution of armed robberies would result in police assets being in the wrong place at the wrong time if the objective is to prevent robbery-related aggravated assaults.

Testing the Model

Although the results of the research on armed robberies generated considerable enthusiasm, the researchers needed to determine whether this approach worked in practice and wanted to demonstrate its value.

On New Year's Eve in 2004, the PSN Team tested their strategy, now called "Risk-Based Deployment," on a model based on incidents of random gunfire.[4] Their goal was to create a model of crime and proactively place resources when and where those resources were likely to be needed so that they could prevent crime and respond to incidents more rapidly. The results demonstrated a 47 percent reduction in complaints for random gunfire and a 246 percent increase in weapons seized. The efficient resource allocation also required fewer personnel assets, saving $15,000 during the 8-hour initiative.

Using maps to depict the statistical models turned out to be game changing. Not only could researchers better convey the "when, where, and what" of crime in that environment, but this method also allowed law enforcement officers to easily understand and interpret complex statistical relationships and to provide ideas about how to support this style of crime prevention and response.

How Geospatial Statistical Analysis Works

To illustrate the difference between traditional density mapping and geospatial statistical analysis, a series of auto parts thefts from vehicles have been analyzed, depicted visually, and compared. Hot spot or density mapping is used frequently in law enforcement to visualize locations where crime incidents have occurred. Geospatial statistical analysis, however, characterizes the locations associated with past events and creates a model that incorporates environmental factors statistically associated with past incidents. This model can then be used to identify similar locations where future incidents are likelier to occur. Ultimately, this approach enables law enforcement to act proactively to prevent crime and influence outcomes.

Figure 1 shows known incidents of auto parts thefts (black dots), areas associated with an increased likelihood for a future incident (dark areas), and auto theft incidents that occurred after the model was created (triangles).

Figure 1. Map of auto theft incidents.

Figure 2. Comparison between a traditional density map and geospatial statistical analysis.

In this particular analysis, thieves stripped vehicles of valuable auto parts.[5] Law enforcement wanted to identify the locations associated with future incidents to deploy resources more accurately, prevent crime, and catch perpetrators. Figure 1 illustrates the known events (shown as black dots), and the area that statistical modeling suggests may be associated with future incidents (the red areas). As the figure shows, the area associated with an increased likelihood for future events includes the original incidents, but also extends well beyond the area associated with the original series. The green triangles illustrate incidents that occurred after the original model was created, and thus validate the model.

Figure 2 includes all incidents and the geospatial statistical analysis, as well as traditional density mapping, to further illustrate the difference between the two methods of geospatial analysis. By deploying resources only where previous incidents have occurred or by employing standard density mapping techniques, other areas associated with an increased likelihood for future incidents would have been missed. Using geospatial statistical analysis, analysts can identify areas statistically similar to locations where prior incidents occurred. These new areas would not be identified using traditional methodologies.

In addition to depicting complex crime-environment relationships, these approaches help law enforcement understand the factors associated with crime incidents. Certain environmental factors attract or enable crime, while other features may serve as deterrents. These factors can be ranked based on their relative contribution to the likelihood of future incidents and used for analysis. This factor analysis provides unique opportunities for information-based or "tailor-made" crime prevention.

In essence, approaches using geospatial statistical analysis allow law enforcement to proactively prevent and disrupt crime. The ability to identify and characterize threats and anticipate crime represents a game-changing shift in law enforcement. Ultimately, the ability to characterize the environment, identify factors associated with known incidents, and apply these statistical models to new spaces supports an information-based response. Law enforcement can use this information to create solutions suited to a particular crime series, pattern, or cluster, and ultimately keep communities safer.

Notes

1. Telep, C.W. 2009. Police interventions to reduce violent crime: A review of rigorous research. Presented February 3 at Congressional briefing: "Reducing Violent Crime at Places: The Research Evidence," Washington, D.C.
2. McLaughlin, C.R., J. Daniel, S.M. Reiner, D.E. Waite, P.N. Reams, T.F. Joost, J.L. Anderson, and A.S. Gervin. 2000. Factors associated with assault-related firearms injuries in male adolescents. *Journal of Adolescent Health* 27:195–201.
3. McCue, C. and P.J. McNulty. 2004. Guns, drugs and violence: Breaking the nexus with data mining. *Law and Order* 51:34–36.
4. McCue, C., A. Parker, P.J. McNulty, and D. McCoy. 2004. Doing more with less: Data mining in police deployment decisions. *Violent Crime Newsletter* 1:4–5.
5. The author thanks David Grason at SPADAC for the example.

Experimenting with Future-Oriented Analysis at Crime Hot Spots in Minneapolis

Sgt. Jeff Egge
Minneapolis Police Department
Minneapolis, Minnesota

Police leadership around the country is beginning to advance the idea of predictive policing, a policing strategy that uses information and advanced analysis to inform forward-thinking crime prevention. Once this concept has been subjected to rigorous experimental evaluation, predictive policing has the potential to focus resources proactively to reduce crime.

Crime analysis in Minneapolis, Minnesota, originated in the wake of several evidence based research projects by noted criminologists Lawrence Sherman and David Weisburd in the 1980s. When a COMPSTAT program was instituted in the 1990s, it led to a 34 percent reduction in crime in the following decade. The Minneapolis Police Department (MPD) is currently working with predictive policing as a way of identifying potential crime locations and allocating resources to prevent crime.

The foundation of Minneapolis's predictive policing efforts is a report management system created 20 years ago, that has become the driving force behind the weekly CODEFOR (COMPSTAT-like) meeting. One important attribute of CODEFOR is that it provides an opportunity for several levels of leadership to use crime analysis and participate in improving public safety. The Minneapolis Crime Analysis Unit has been conducting predictive policing research in exploratory applications.[1] This article presents the results of this research and discusses the value of predictive policing.

Early Applications of Predictive Policing

Many experienced crime analysts feel predictive analysis is a natural evolution of crime analysis methods, which increasingly uses analytic thresholds and statistical forecasting to identify patterns, trends, and anomalies.

Figures 1 and 2 show examples of initial attempts by the MPD Crime Analysis Unit to react to crime incidents that occur in patterns. Figure 1 displays an analysis of the next likely armed robbery in a series of fast-food restaurant holdups in 2009. The limitation of this metropolitan-areawide prediction is the uncertainty of complete data sets beyond jurisdictions. Nonetheless, the analysis found a predicted regression point within a half mile of the next robbery. Unfortunately, that prediction fell far outside the city limits.

Figure 2 illustrates the use of predictive analytics to develop a list of potential targets for a robbery spree. On being released from prison, the suspect planned to rob small boutique businesses or laundries where lone females worked without video surveillance.

In both cases, MPD analysts attempted to translate contemporary evidence-based research into actionable knowledge through advanced analysis, data mining, and considering the factors that affect crime. They created the following formula to explain predictive policing analysis: the crime triangle (suspect/victim/location) multiplied by x/y factors (i.e., the factors that affect the type of crime being analyzed) equals crime prediction.

MPD recently used this formula to create patrol zones to reduce gun violence. Analysts identified three layers of proximity to micro hot spots. The first layer was based on places where suspects discharged weapons. The second identified places where suspects were more prone to be arrested with guns. A third layer identified the places where victims were shot or shot at. Analysts captured data for the analysis layers by data mining in places where gun violence historically had occurred and factoring those data with recent spatial trends in each criterion.

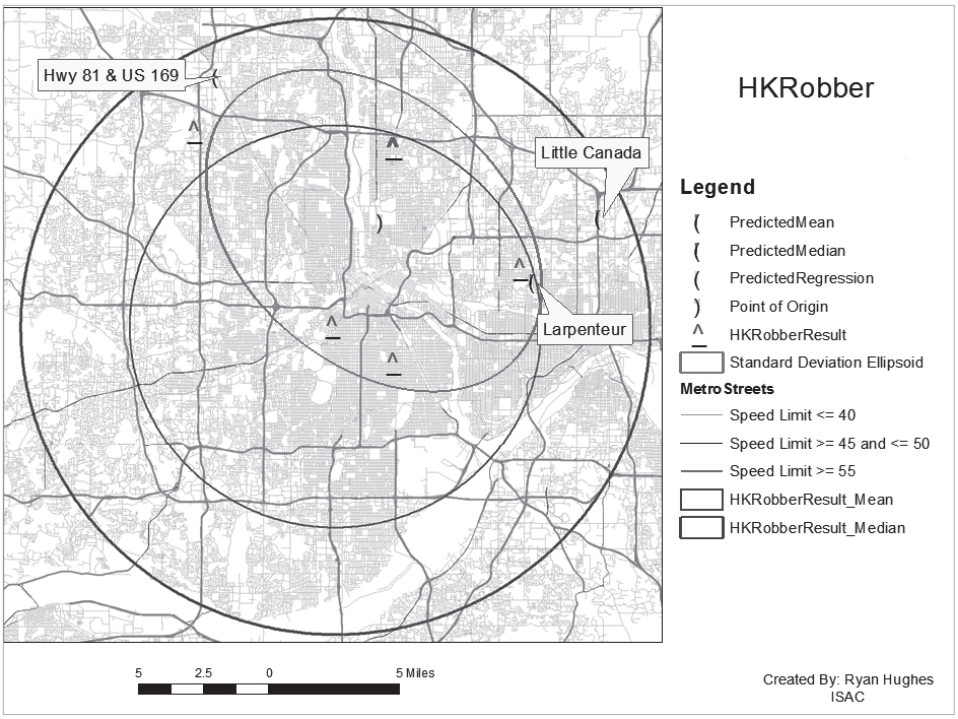


Figure 1. Analysis of potential armed robber activities.

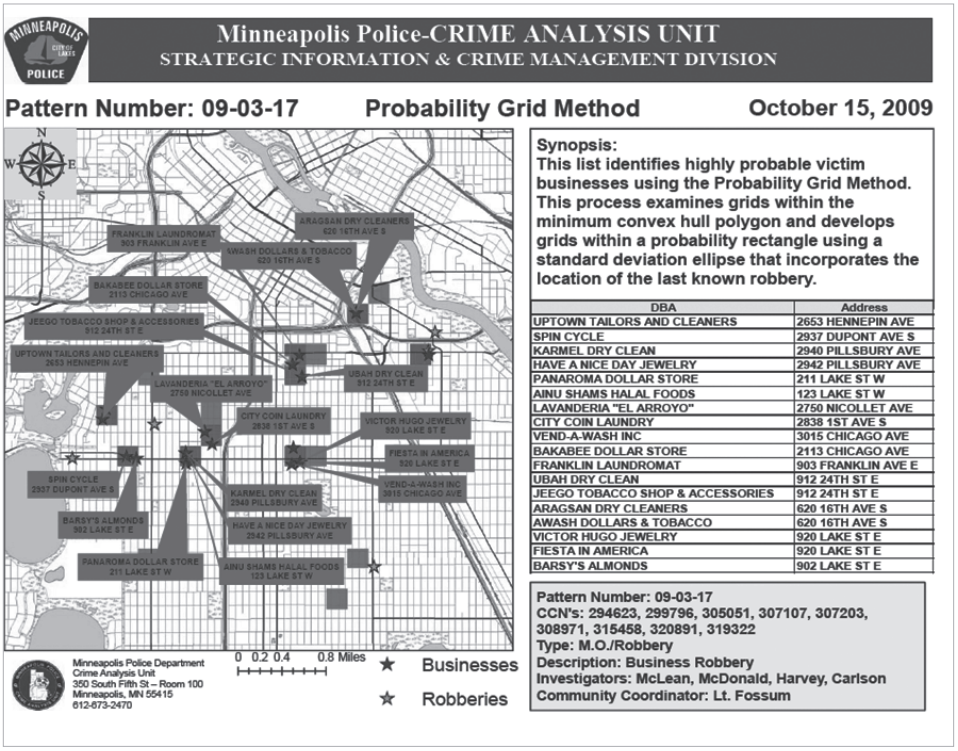


Figure 2. Analysis of potential targets for a robbery spree.

Predicting Crime in Specific Places: Putting Theory Into Practice

Research has shown that hot spots policing effectively reduces violent crime. A recent study by the Police Executive Research Forum (PERF),[2] for example, identified the effectiveness of problem solving and situational crime prevention in reducing street violence in hot spots. Earlier research by Sherman, Gartin, and Buerger[3] showed that in Minneapolis and other cities 5 percent of addresses produced nearly 100 percent of the calls for police service for predatory violent crimes such as robbery and rape. Sherman[4] also concluded that future crime is six times more predictable by address than by individual, which gives credence to the theory of place-based predictive policing.

MPD wanted to create a hot spot analysis that was easy to understand and apply. Analysts considered common elements between crimes, connected patterns, and available data. For analysts to predict the trajectory of crime accurately, they must understand the patterns that indicate a higher risk of victimization or danger. They must be able to distinguish trends from anomalies.

Thus, to put predictive policing into practice, MPD started by mapping data using accurate x and y coordinates (or geospatial markings). The analysts then worked to capture high-risk offenders by examining the locations of suspects, victims, the associates of both, and arrests.

To improve the consistency and predictability of the mapping, analysts compared the maps to locations of problem addresses, parks, and street corners. Specifically, they used Structured Query Language queries of police reports created following Sherman's last Minneapolis study of repeat call addresses, aligning maps from the current study with the problem addresses and places they had identified earlier, in an effort to predict the locations of violent crime.

Analysts then attempted to localize crime to micro hot spot grids that could be monitored by a single patrol car. Once probable patterns had been isolated into manageable one-, two-, or three-block areas, a report was given to patrol supervisors. The report included a map, recommended times for intervention, problem persons in the geographic area, and other facts that could improve an officer's situational awareness.

MPD then examined outcomes and consequences of the initiative to determine whether predictive analysis improved police intervention. This was a particularly important part of the project—because the mission of contemporary police is based on reducing crime and improving public safety. MPD's research illustrates the success of proactive and focused problem solving by police using predictive hot spots analysis.

One example of MPD's successful analysis is illustrated in Figure 3, a geographic analysis of violent street corner gangs. Over the last 5 years traditional gangs in Minneapolis have been replaced by small, splintered street-corner cliques. These gangs at first appeared to be random, because members go in and out of incarceration or may be incapacitated, so intelligence efforts had been mostly reactive. Over time, however, the apparently random and opportunistic patterns became geographic incidents, which could be identified as place-based behaviors. Thus, these behaviors could be anticipated and predicted. MPD is currently using this analysis to make more accurate predictions that identify zones for focused and proactive policing, in order to reduce robbery and illegal weapons and increase traffic stops. MPD hopes to use this kind of prediction to put cops on the dots of the places where gangs are active and to stop crime.

Predictive Policing as a Part of COMPSTAT

To conform to the needs of COMPSTAT and similar strategies, police management must balance resources between historically chronic violent hot spots and statistics based on the current ebb and flow of crime.

The COMPSTAT response to aggregate crime spikes has often been described as "whack-a-mole," for the board game where a mallet (traditional police tactics) is used to strike at moles (crime and criminals) emerging from holes (places). In order to promote more sustained interventions and reductions in crime, MPD strives to discuss and engage in predictive policing tactics during COMPSTAT meetings, with the view that predictive analysis can lead to safer neighborhoods.

Moreover, police must improve information sharing. For predictive analysis to best analyze crime trends, patterns, and anomalies across jurisdictional boundaries, crime analysts need to be able to transcend longstanding silos, sandboxes, and intelligence hoarding in the police sworn ranks and within political boundaries.

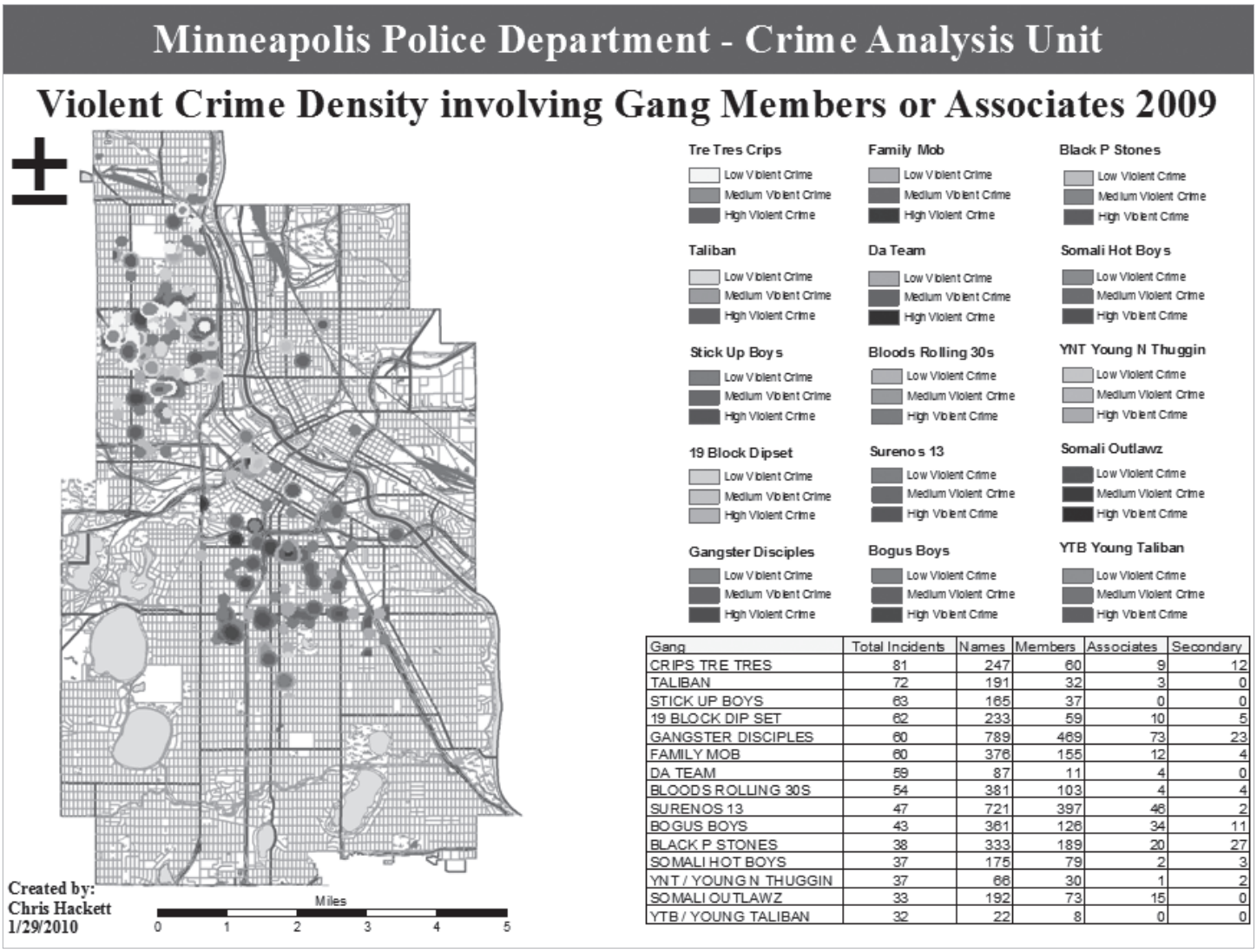
Conclusion

Predictive analysis involves anticipating questions. Questions lead to the search for evidence, evidence helps officers establish facts, and facts in turn support and substantiate action. Throughout the process, officers must ask, "How can this be made better and can we show the results?"

Police must keep moving the science forward, making predictions, and acting on the results. The goal should always be to reduce crime and improve service.

Notes

1. Taylor, Bruce, Christopher S. Koper, and Daniel J. Woods. 2010. A randomized controlled trial of different policing strategies at hot spots of violent crime. *Journal of Experimental Criminology*.
2. Police Executive Research Forum. 2008. *Violent Crime in America: What We Know About Hot Spots Enforcement*. Washington, D.C.
3. Sherman, L.W., P.R. Gartin, and M.E. Buerger. 1989. "Hot Spots of Predatory Crime: Routine Activities and the Criminology of Place." *Criminology* 27:27–56.
4. Sherman, Lawrence. 1995. Hot Spots of Crime and Criminal Careers of Places. In *Crime and Place: Crime Prevention Studies,* vol 4, ed. John Eck and David Weisburd, 35–52. Monsey, New York: Willow Tree Press.



Gang	Total Incidents	Names	Members	Associates	Secondary
CRIPS TRE TRES	81	247	60	9	12
TALIBAN	72	191	32	3	0
STICK UP BOYS	63	165	37	0	0
19 BLOCK DIP SET	62	233	59	10	5
GANGSTER DISCIPLES	60	789	469	73	23
FAMILY MOB	60	376	155	12	4
DA TEAM	59	87	11	4	0
BLOODS ROLLING 30S	54	381	103	4	4
SURENOS 13	47	721	397	46	2
BOGUS BOYS	43	361	126	34	11
BLACK P STONES	38	333	189	20	27
SOMALI HOT BOYS	37	175	79	2	3
YNT / YOUNG N THUGGIN	37	66	30	1	2
SOMALI OUTLAWZ	33	192	73	15	0
YTB / YOUNG TALIBAN	32	22	8	0	0

Figure 3. Violent Crime Density Involving Gang Members or Associates, 2009.

Geospatial Technology Working Group (TWG): Meeting Report on Predictive Policing

Introduction

The Geospatial Technical Working Group (TWG) is a committee of practitioners, applied researchers, and academics supported and organized by the National Institute of Justice (NIJ). The Geospatial TWG specifically works with NIJ's Mapping and Analysis for Public Safety (MAPS) program in order to help determine criminal justice technology needs specific to geospatial technologies. Furthermore, the Geospatial TWG helps determine grant funding priorities, identify concerns in the field, and review the progress of existing grants.

The Geospatial TWG meets bi-annually. As part of the Fall meeting, the TWG spent several hours discussing the topic of predictive policing. Specifically, the TWG discussed different aspects of predictive policing, including how geographic analysis assists in predictive policing, what challenges officers face, what tools and technologies help officers identify crime, and how predictive policing can be incorporated into future strategies.

Defining Predictive Policing

The TWG members defined crime prediction in two ways. First, prediction describes a forward-looking effort that assesses risk of broader, long-term trends. Second, prediction addresses short-term

factors that can cause crime to occur. As such, predictive policing identifies not just crime incidents, but the factors that lead to them, and the trends they initiate.

Identifying Challenges

The TWG members identified a number of challenges officers face when implementing predictive policing efforts:

- **Limited resources.** Budget and staffing constraints can affect an agency's ability to collect relevant data, implement effective intervention/prevention strategies, provide analysis, and research the outcomes of new strategies.
- **Political pressure.** The political pressure on police departments to lower the crime rate and show immediate results is not always conducive to the more methodologically rigorous evaluation process that predictive policing requires.
- **Information management.** Departments may be asked to increase data sharing. Some departments may feel pressured to provide data in a different format or with levels of consistency they have not previously achieved.
- **Data overload.** Some agencies might feel overwhelmed by the amount of data they collect because of new technologies and procedures.
- **Data quality.** Data should be timely, accurate, and reliable.
- **Adaptation.** Predictive policing approaches must be adaptable and responsive to changes in a department's operational environment, new agency policies or directives, and community demographics.

Unit of Analysis

Police departments who wish to begin using predictive policing will not benefit from a one-size-fits-all approach. No standard unit of analysis can be used to make predictions for all communities. As such, police must identify and refine units of analysis in clear and precise ways. The TWG recommended that predictive policing efforts focus on improving processes for developing units of analysis that would enable more precise data examination and prediction.

Technology's Effect on Crime

Predictive policing efforts must understand how advancing technologies can affect crime. Researchers and practitioners should examine the risks of the new technology. This knowledge can predict how technology can or will be used for criminal activity or how desirable technology products can become targets of theft. Changes in technology can have a profound and immediate effect on crime opportunities and modus operandi.

A Predictive Policing Toolbox

The TWG ended the session by making suggestions for a predictive policing "toolbox" that would provide a flexible framework for each agency to develop its own methodology. For instance, the TWG suggested that departments could:

- Identify data from other agencies (e.g., schools and hospitals) that may be useful for predictive policing analyses.
- Create predictive policing task forces.
- Create Memorandums of Understanding (MOU).
- Develop or enhance software for use in predictive policing.
- Examine qualitative and quantitative data during analysis.
- Create guidelines on how to make use of the predictive outcome.
- Improve practices for collaboration across local, state, federal, and international law enforcement agencies.

Conclusion

Predictive policing must combine an analysis of short-term activities and long-term trends to identify the locations where crime may occur in a community. Agencies should focus on using predictive methods to prevent crime. While predictive policing may represent a decisive paradigm shift in the law enforcement field, agencies must focus on refining existing practices and developing new techniques to examine the data that already exist.

Predicting Demand for Service for Future Developments

Philip Mielke
GIS Supervisor
Redlands, California

When police management wants to understand where officers spent time or needs to predict how a new housing or business development will require a need for police service, analysts must determine how much time officers spend per incident, by location. This type of analysis can help assess development impact fees, which allows a police department to voice considerations or concerns about the city's growth policy. This article guides an analyst through preparing data, joining data, summating input data, and interpreting the results.

Data Preparation

An analyst must prepare three kinds of data:

- Land use data.
- Incident data.
- Time spent data.

Land Use Data

The best source for land use data is the city's planning department or regional land use planning commission. These organizations may also have information on zoning layers,[1] and/or other types of land use or related data, such as zoning data or general planning data. Research what the differences are. Keep in mind what each layer represents in the real-world scenario, and decide whether a land use layer may be more accurate or timely.

Zoning and general plans can represent how the city intends to grow with time, but these may not accurately depict the present reality. If a city has a GIS department, they will likely maintain this layer of information and can describe the timeliness and accuracy of the data. Ultimately, if an analyst needs to determine what kind of demand for service a new development will bring, a standard land use layer is best for the study.

Incident Data

Analysts should work to acquire the best assessment of incident data, which may come from a combination of Computer-Aided Dispatch (CAD) systems or the agency's Records Management System (RMS). The analyst should to be able to join multiple officer time-signatures[2] per geocoded incident. Make sure that incident data are geocoded with an offset[3] because land use data may be subdivided by parcels or street centerlines. Incident data must be attributed to the correct land use.

Time Spent Data

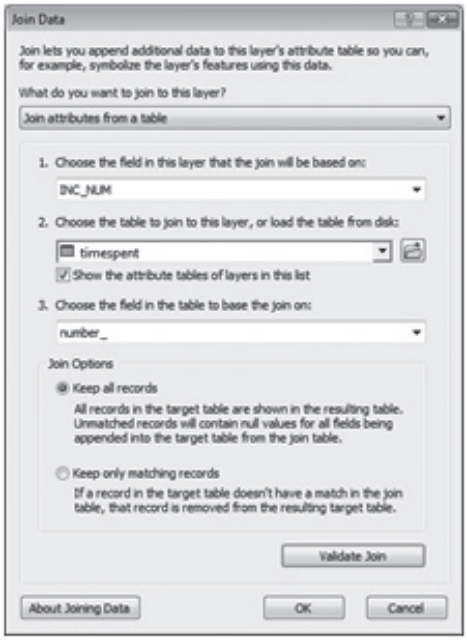
Analysts must create a database of the time each officer spends on each call, from time of assignment to the time when the officer left or closed the incident. These data can be a challenge to pull from any RMS or CAD. Every system can be different, but the analyst should account for as much time spent in an area as possible. Create a database with fields collecting times for when the officer was assigned (or en route to the scene), when the officer arrived, and when the officer left or closed the incident. If multiple officers responded, those time signatures should be contained in separate fields for the same incident number.

"Time spent per officer" can be discerned through a series of field calculations (Officer1closetime – officer1enroutetime), and "total time spent" can be calculated by summing the fields containing "Time spent per officer." The analyst may need to account for officer-initiated incidents where there may not be an "officer1enroutetime" value, and replace it with the proper time signature. All of these data need a common ID to perform a join from the time spent database to the incident data.

Process

Step 1: Join the time-spent database to the incident feature class.

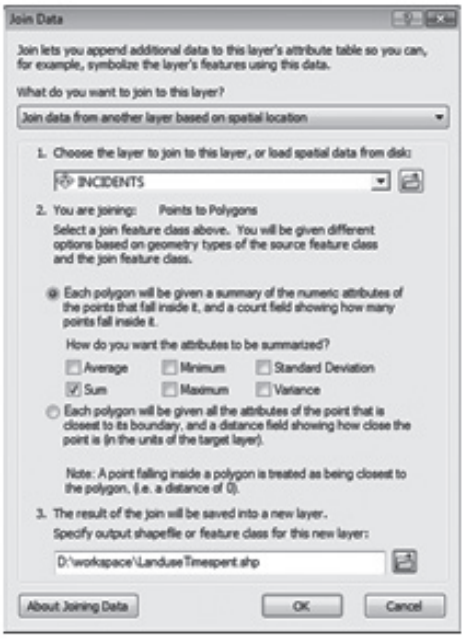
- Right-click on incident feature class.
- Click "Joins and Relates >", and then "Join…". The following dialogue box should appear:
- Join the time spent database to the incident data, and use the common identifier to make this join. For the first dialogue, "What do you want to join to this layer?" select "Join attributes from a table."
- For the following dialogues, select the field on the incident database that is the common identifier, select the time spent table, and then select the field on the time spent database that this the common identifier. Select "Keep all records" under "Join Options." This will allow you to check the data



to make sure the entirety of each dataset matches the other. Right-click the incident data. The time spent fields should be joined to the incident data. You should be able to scroll to the right side of the database to see information in all fields for all records.

Step 2. Spatially join[4] incident data and the joined time spent database to the land use layer.

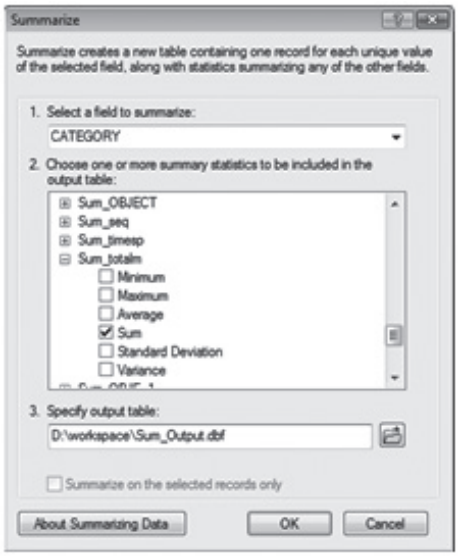
- Right-click on the land use layer in ArcMap's table of contents.
- Select "Joins and Relates >" and then "Join…" This will bring the join dialogue to the screen (see figure below).
- Change the initial parameter to "Join data from another based on spatial location." This will bring a different set of parameters to the join dialogue box.



- Choose the Incident layer that was used for the tabular join for step 1. This will be a "points to polygon" spatial join, meaning that the point data can be summarized by the polygons that contain it. A "count" field is automatically created, and the analyst also has the option to produce the average, sum, minimum, maximum, standard deviation and variance for every numeric field. Ultimately, this process will determine the sum of the 'total time spent' per incident field, and this sum will be calculated for each polygon of the land use layer.
- Identify where the new layer should be saved, and click "OK."

Step 3. Create a sum table from the outputs of step 1 and step 2.

- The resulting attribute table should have the sums of time spent by incident per land use polygon. The analyst can produce a choropleth map[5] on the resultant 'time spent' field to depict the data and check for outliers. Check whether any land use types that seem like they are receiving an inordinate amount of time. Identify any large 'public and institutional' land use types that may have an excessive amount of incident geocoded to police stations because of faulty address reporting. If data accurately represent where time is being spent by field officers, the following sum table operation will yield "time spent" per acre of "land use type."
- Right-click the resulting feature class from step 2 and select "Open Attribute Table."
- Right click on the "land use type" or category field and select "Summarize…" The following dialogue will appear:



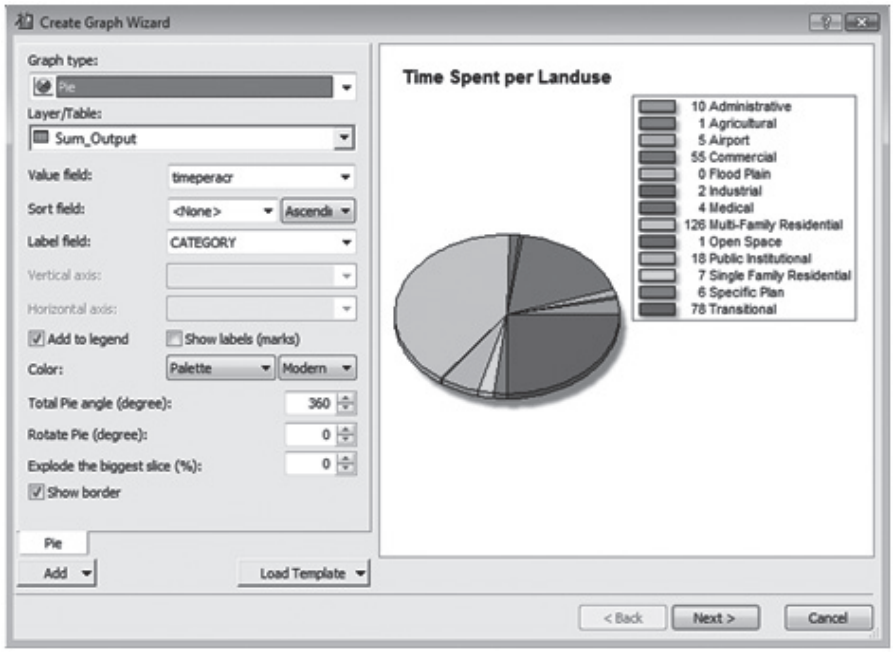
- The "Select a field to summarize:" dialogue should already be populated by the previous step. Three fields should be summed: the resultant spatial join sum of the "total time spent" field, the "Shape_area" field, and the "Count_" field.
- Select the numeric "Sum" function by scrolling through the fields and expanding the numeric functions. This requires clicking the "[+]" left of the three fields. Specify the output table name and location and click "OK."
- To finalize this sum table you must convert area units. It is likely that the coordinate system you are working with is in some form of "State Plane" coordinate system, and the base unit of measurement is in feet. In order to standardize the ratios of "Time spent per land use type per acre," square feet should be converted to acres.
- Under the "table options" icon on the top-left of the sum table,[6] select "Add Field…"
- Select "Short Integer" for the 'Type.' Enter "Acres" for the name. Enter a precision of two. One acre is 43,560 sq. ft. This measurement can be used to convert sq. ft. to acres.
- Right-click on the "Acres" field and select "Field Calculator…"
- In the "Acres=" dialogue, enter "Sum_Shape_Area"/43560 and click "OK."

Interpreting the Results

The resulting summarization table provides the analyst with information about the relationship between land use types, area, number of incidents, and time spent per land use type. Each land use type may influence the type of incidents that will occur in the area. For example, commercial land uses are a prerequisite for commercial burglaries or shoplifting, and the amount of time required to handle incidents varies by the crime type (and ultimately by the requirements unique to each incident). Add another field and use the field calculator to represent the time spent per acre.

The "Create Graph Wizard" can depict the ratio of time spent per acre by land use. To use it, follow these instructions:

- Click the "Table Options" icon in the top-left of the sum table, and click "Create Graph…" The following wizard dialogue should appear:



- Select 'timeperacre' as the "Value field" and select the appropriate land use type for the Label Field. This shows the relationship between a land use type and the amount of time that it takes to respond to incidents in these types, by area.

The ratio that is calculated allows the analyst and city staff to predict the demand for police service when a new development is proposed. Development impact fees can be assessed and justified using this process, and administrative time per field officer should be determined by the jurisdiction. Managerial decisions can be improved if management can quantitatively see where officers spend time.

Police can determine how department services will be affected after city developments have been built if they analyze the resources police commonly allocate by land use type. Analyzing crime location ultimately helps officers decide on tactical and strategic patrol initiatives. Combining location and timely resource allocation gives governing bodies an opportunity to better understand the impacts of the decisions they make, and this allows police the ability to justify service level predictions.

Notes

1. Zoning data is a GIS layer that identifies what developers can build in a certain area.
2. Computer-aided dispatch systems store multiple time signatures for when an officer is assigned to a call, is en route, has arrived, and is closing the call.
3. Offsets in geocoding occur when geocoded points are placed a certain distance from the street, and not on the street itself.
4. The "Spatial Join" function is a very useful tool for crime analysts. It allows incident data to be summed by polygons, and for choropleth maps to be produced. Risk models can be developed by joining incident data to census data and discerning the number of "crimes per population." In this use, the analyst determines the amount of time spent by officers in the field based on land use. This amount is used to determine the necessary ratio of time spent per acre based on land use. This calculation can then be used to determine future service demands or cost of service by future land use development.
5. Choropleth maps add the total number of incidents in polygons.
6. This is a new location to access table options in ArcGIS Desktop 10.

Transitioning to the Age of Predictive Policing

In today's limited economic conditions, many police departments must learn to deploy resources more effectively to save both time and money. As police management works to make each agency more efficient, predictive policing strategies have emerged as a way to optimize scarce resources, targeting crime before it happens.

Predictive policing has been described as the next era in policing, evolving from intelligence-led policing, which is a modern vision emphasizing research-based decision making, information sharing, and accountability. Predictive policing, as pioneered by the Los Angeles Police Department, uses analytic technology and new algorithms to analyze crime patterns, predict locations where similar crimes may occur, and deploy patrol cars and other resources to fight crime preemptively.

This strategy comes from e-commerce and marketing, which have learned to use analytic, intelligent methods to predict what consumers might want to buy. A common example of this strategy is used by Amazon.com with the phrase, "Customers who bought this item also bought…." Similar to this style of marketing, predictive policing determines how one crime may affect similar crimes in the future. It identifies trends, patterns, and relationships found in data associated with criminal behavior or activity, and uses that information to deploy resources and affect policy.

Predictive policing strategies have been successfully used to reduce gunfire complaints on New Year's Eve by nearly 50 percent, prevent violent crimes, and link a number of DNA cold hits with burglaries. However, use of this approach in Los Angeles is revealing that no one approach, technology, or algorithm will universally address all of law enforcement's challenges. Police departments across the country must work to match individual solutions with specific problems.

As the world moves away from the 2008 recession, law enforcement must work to find the best strategies to create safe neighborhoods and budget wisely. Predictive policing helps maximize the use of available resources.

For more information, see:
Beck, Charlie, and Colleen McCue. "Predictive Policing: What Can We Learn from Wal-Mart and Amazon About Fighting Crime in a Recession?" *Police Chief Magazine,* 2010.

Chicago Police Department Adopts Predictive Crime-Fighting Model

In April 2010, the Chicago Police Department began piloting a crime prevention strategy called predictive analytics.

Predictive analytics uses advanced analysis and mathematical algorithms to determine locations where crime is likely to occur. The department deploys patrols to these locations to deter crime and respond effectively to need.

The department has been partnering with a local university, Illinois Institute of Technology, to create a predictive policing model. Officers have also created an analysis group. Thus far the new strategy has shown positive results in reducing crime and targeting areas where crime will occur.

For more information, see: http://abclocal.go.com/wls/story?section=news/local&id=7599221.

Albuquerque Police Use Predictive Policing to Target Car Thefts

In anticipation of the popular Balloon Fiesta, the Albuquerque Police Department has been using predictive modeling to target car thefts at the festival.

Officers have planted cars in places that algorithmic predictions suggested may be prime locations for theft, and plan to monitor these locations for thieves. License plate scanners, mounted throughout the city, will instantly tell officers when a car has been stolen, so police can send an immediate response.

Police hope that these predictive, analytic techniques will help them ensure that no cars are stolen this year.

www.kob.com/article/stories/S1753167.shtml?cat=500

Predictive Policing Helps Tennessee Officers Reduce Violent and Property Crimes

Use of a new policing strategy in Memphis, Tennessee, has helped lower the rate of violent, property, and UCR Part I crimes by an average of 15.8 percent. This decreasing crime rate has come without an increase in the need for officers.

The reduced crime rate comes from a strategy known as predictive policing, which uses advanced analytic software to predict locations where crimes may occur. In this way, police can stop crime proactively rather than simply reacting to crimes as they occur.

Departments across the country, like the one in Memphis, have been installing this analytic software, which can cost as much as $100,000. Many hope that the change from reaction to prediction may even make the public feel safer.

"It's a nice warm feeling that, for the most part, police officers are exactly where they need to be, based on what's anticipated to happen that evening," software director Bill Haffey told CBC reporters.

www.cbc.ca/smartshift/2010/09/fighting-crime-with-data.html

Geography and Public Safety Events

Dealing with crime problems in a local law enforcement agency sometimes means reaching out to other local agencies to come up with a solution. The events listed here are good opportunities to learn what mapping professionals and those in related areas are doing, get new ideas, and present your work.

ESRI Federal User Conference (FedUC)
February 2–4, 2011
in Washington, D.C.
www.esri.com/events/feduc/index.html

National States Geographic Information Council (NSGIC) 2011 Midyear Conference
February 27–March 2, 2011
in Annapolis, Maryland
www.nsgic.org/events/future.cfm

Academy of Criminal Justice Sciences
March 1–5, 2011
in Toronto, Ontario, Canada
www.acjs.org/pubs/167_668_2915.cfm

Society for Applied Anthropology (SfAA)
March 29–April 2, 2011
in Seattle, Washington
www.sfaa.net/sfaa2011.html

Association of American Geographers (AAG) Annual Meeting
April 12–16, 2011
in Seattle, Washington
www.aag.org/cs/annualmeeting/register_to_attend

GIS in Action—2011
March 29–30, 2011
in Portland, Oregon
www.orurisa.org/Events?eventId=208635&EventViewMode=EventDetails

The Eleventh Crime Mapping Research Conference
April 11–15, 2011
in Miami, Florida
www.ojp.usdoj.gov/nij/events/welcome.htm

ASPRS 2011 Annual Conference
May 1–5, 2011
in Milwaukee, Wisconsin
www.asprs.org/meetings/upmeeting.html

Jerry Lee Crime Prevention Symposium
May 2–3, 2011
in Washington, D.C.
http://gemini.gmu.edu/cebcp/JerryLee.html

Society for Prevention Research 19th Annual Meeting
May 31–June 3, 2011
TBD
www.wix.com/sprmeeting/2011

NIJ Conference
July 20–22, 2011
in Arlington, Virginia
www.ojp.usdoj.gov/nij/events/welcome.htm

ESRI International User Conference
July 11–15, 2011
in San Diego, California
www.esri.com/events/index.html

118th Annual International Association of Chiefs of Police (IACP) Conference and Exposition
October 22–26, 2011
in Denver, Colorado
www.theiacp.org/Conferences/tabid/69/Default.aspx

e011113329

COPS Editorial Staff

Nicole Scalisi
Social Science Analyst
Office of Community Oriented Policing Services

Marian Haggard
Editor
Office of Community Oriented Policing Services

Sandra Sharpe
Graphic Designer
Office of Community Oriented Policing Services

MAPS Editorial Staff

Ron Wilson
Program Manager/Social Science Analyst
National Institute of Justice

Timothy Brown
Research Associate (Contractor)
National Institute of Justice

Ariel Whitworth
Communications Editor
National Criminal Justice Reference Service

G&PS readers:

You may have noticed that although the Geography & Public Safety newsletter is a quarterly publication, the COPS Office and NIJ had a delay in publishing Volume 2, Issue 4 due to a transition in management and production roles. However, the COPS Office and NIJ remain committed to producing this quarterly newsletter, and you can expect to see the next edition in July 2011. If you would like to be featured as an author or highlight your agency's GIS efforts, please contact John Markovic at john.markovic@usdoj.gov or Nicole Scalisi at nicole.scalisi@usdoj.gov.

U.S. Department of Justice
Office of Community Oriented Policing Services
Two Constitution Square
145 N Street, N.E.
Washington, DC 20530

To obtain details on COPS programs, call the
COPS Office Response Center at 800.421.6770

Visit COPS Online at www.cops.usdoj.gov

Visit NIJ Online at www.ojp.usdoj.gov/nij