CRIME MAPPING AND THE POLICING OF DEMOCRATIC SOCIETIES

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Introduction

In democratic societies, the police maintain a distinctive and direct relationship with the public. They are not only accountable to commanders, as police in authoritarian governments are, but also to the legislature, the courts, individuals who seek assistance, and society as a whole through the press and through relations with associations of citizens.

How do police officers in a democracy interact with all these interested parties and communicate successfully about crime problems? And how do police demonstrate their progress in solving these problems? Without a systematic way to describe crime and public safety concerns, one that both police and members of the public can understand, there is a danger that interventions from legislative oversight to news coverage to neighborhood meetings will focus only on the sensational crime of the moment. Without a common understanding of crime patterns, police and the public cannot engage the real safety challenges facing their community.

Crime mapping offers a powerful way for police and the public to define the patterns of crime that the police must address and track how police actions affect crime. The maps allow constables and street officers, their senior commanders, and public representatives to develop a common picture of crime in an area, incorporate other information that may help explain crime patterns and suggest solutions, and then monitor changes over time. In short, crime mapping can make democratic policing not only possible, but practical.

For decades, police agencies have relied on wall maps to detect patterns in the locations of certain crimes, but the recent use of computers to map crime has greatly increased the value of mapping. Standard commercial computer mapping programs allow users to examine patterns of particular crimes, at certain times of day, and in relation to other geographic, economic, and social data, and also allow the maps to be widely shared and quickly updated with the latest information.

Computerized crime mapping also allows the application of more sophisticated statistical techniques to the analysis of crime data. Techniques used widely in analyzing health data and environmental conditions can be used to understand the ways in which various enforcement strategies, demographic changes, and other social phenomena affect crime.

The Basics of Computerized Crime Mapping

From the user's point of view, computerized crime mapping is a flexible and efficient tool for organizing and displaying large volumes of data about crime in its context. What makes this possible is the use of geographical information systems (GIS) that integrate geographic coordinates with records in traditional computer databases. Computerized crime mapping depends, therefore, on the existence of a computer database of crime reports, information about the location of those crimes, information about other items that may help explain crime patterns, and the availability of digital base maps onto which the computers can map these data.

Crime data and its limitations
No crime map reflects all crime. In order to appear on a map, a crime must be reported, have a geographic reference, and be of sufficient priority to be put on the map.

The fact that unreported crimes cannot be mapped influences which types of crime police and researchers try to map. Categories of crime that are reported to the police with some regularity, such as homicide and auto theft, are more frequently mapped than categories that are rarely reported, such as drug sales and simple assault. Of course, not all homicides and car thefts are reported to police, but criminologists believe that enough of them are reported to make the patterns reliable. A police agency might also map drug sales that police witness or that citizens report, but these may not represent all drug sales in any community, and enforcement activities based on these maps will likely miss a large portion of drug sales. Requirements by police that crimes be reported at specific police stations and times or under other restrictions also can substantially reduce the reliability of reported crime data.

Among crimes that are reported to police, some do not have geographic references. Financial fraud, extortion, and many forms of conspiracy do not occur at fixed locations and are therefore rarely mapped. It may be possible to associate these crimes with a broad area of a state or country, but rarely with a specific address. Even for crimes that occur at specific locations, such as armed robbery and sexual assault, police agencies do not always record the location with enough detail to allow the incident to be mapped. This is especially common when someone reports a crime at a police station days after the event.

All of these factors restrict the range of crimes that are usefully mapped. Beyond these practical limitations, however, police agencies also make choices about which crimes are important enough to map. Even some jurisdictions with sophisticated crime mapping programs choose not to map some forms of domestic violence, crimes among juveniles, threats, defacing public property, and other criminal offenses. The choice of which crimes to map may reflect and support a police department's crime-fighting priorities.

In addition to crimes, police may choose to map other events that they record. Some departments that respond to many telephone requests for service map the locations of these callers, even if most of the calls are not about crimes. Similarly, some departments may map the locations of arrests.

The geographic context of crime
Crime maps are most useful when they display a variety of geographical features that place crime data in context. Major transportation centers (train or bus stations) and places

where pedestrians congregate (parks or squares, subway and bus stops) are often important reference points, as are schools, business areas, and recreation centers. Some of these contextual elements can be classified as crime generators or crime suppressors. Crime generators may include shops with liquor licenses, shopping malls, gambling establishments, concert venues, and the like. Crime suppressors may include police stations, neighborhood watch areas, or designated safety corridors.

Demographic information may also be mapped to further reveal the context of crime. For example, areas of the map can be shaded to indicate the level of poverty or the proportion of residents of a particular age range. Some police departments indicate the residences of ex-offenders or of people under parole or probation supervision. Some mark the locations where police have seized many guns.

Finally, the jurisdictions of police and other government agencies must be included. In New York City, for example, crime maps show the boundaries of the police department's 76 precincts, as well as the 10 to 15 sectors within each precinct. In Belo Horizonte, Brazil, the maps show the boundaries of the five *batalhãos* and each of their numerous *companias*.

Discussions about what features the maps should include are also opportunities to shape crime prevention strategies. When these discussions include community residents, merchants, elected officials, or others with an interest in the neighborhood, the conversation can generate important information while also strengthening ties between police and the communities they serve.

Digital base maps and geocoding

All of these data elements must be placed on some kind of base map, usually depicting street patterns. In general, crime mapping projects rely on digital base maps created by government departments other than the police. In many countries, government planning agencies have sponsored the creation of such maps, at least for cities, and often these maps have been enhanced by private firms for commercial purposes.

The base maps themselves vary in the level of detail they provide. For example, many cities contain informal settlements without planned streets or services, and addresses in these areas may not have standard names or numbers. The level of detail is important not only for display and analysis, but also for locating crime incidents and contextual features on the maps in the first place, a process known as "geocoding."

The geocoding process translates standard street address information into latitude and longitude coordinates so that the locations of criminal incidents and contextual features such as parks and schools, boundaries of police and neighborhood watch districts, and census tracts can be displayed on the maps. A basic geocoding engine is included in most mapping software. Most engines automatically review the coordinates of whatever is to be plotted and compare that information to a reference or base file reflecting the underlying streets. When the software is able to find a single match, it automatically geocodes the address. When it cannot make a single match, often because the address has been entered in a nonstandard format, the software prompts the operator to edit the address or select one of several possible locations. The process is efficient only to the extent that most addresses are recognized and geocoded automatically. To achieve this efficiency, base files must represent all possible addresses and the crime data must have been entered with standard address formats. Even with the best underlying data, geocoding usually requ0ires some manual processing.
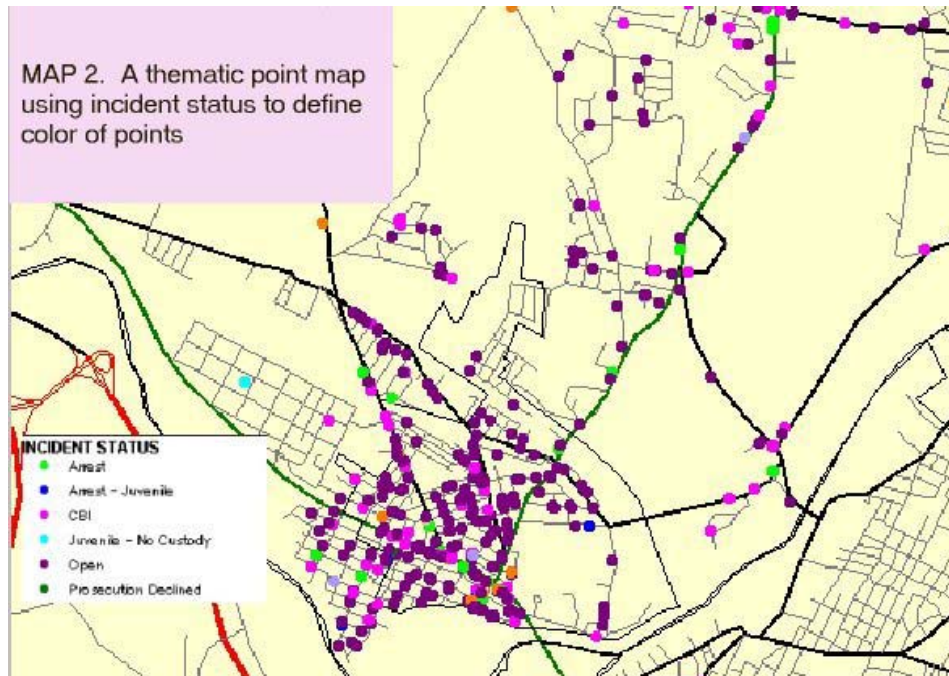
Map layers

A common feature of all crime mapping systems is that the data are organized into layers. Think of the layers as a series of transparencies that can be viewed in a variety of combinations. The user determines which layers to make visible at any one time.

The illustration below presents three layers common to most crime maps: criminal incidents, streets, and police districts. The simplest crime maps contain this kind of collection of points (crimes), lines (streets), and polygons (police districts).

The figure below is an example of how the layering described would look on an actual map. On this map, crimes that occurred in a particular village are plotted alongside similar crimes that occurred in the surrounding town. Such a map would be useful to encourage collaboration between the police agencies in each of these municipalities, particularly where crime patterns appear across jurisdictional boundaries.

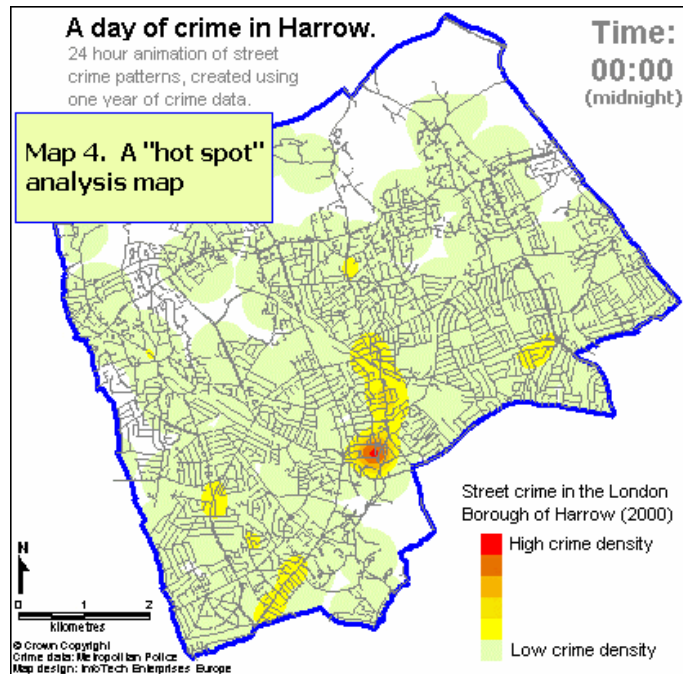MAP 1. Simple map of crime points in a village and the surrounding township
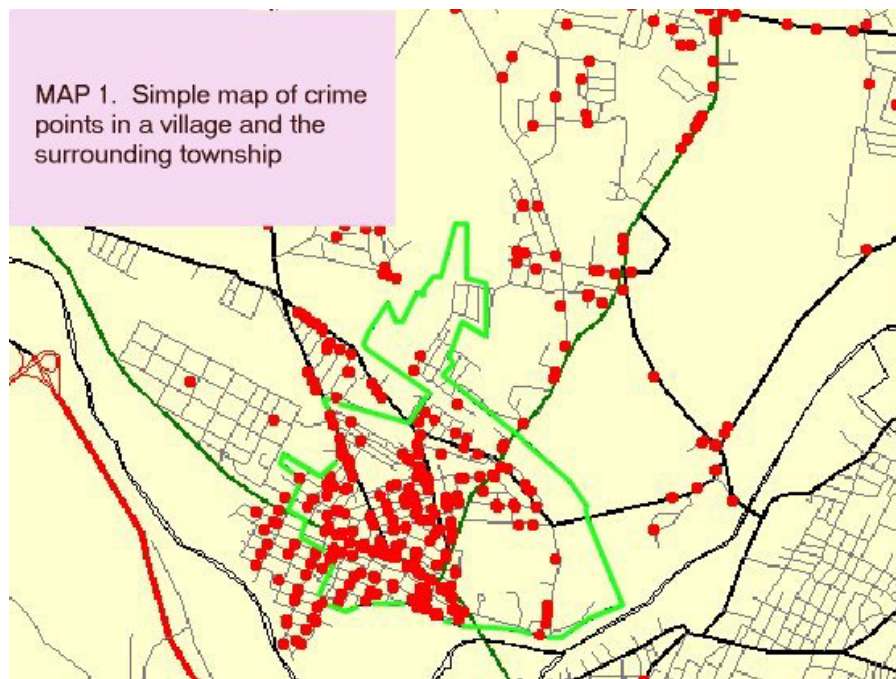
One can add another dimension to a simple point map by plotting crimes using different colors or shapes to show variation among the criminal incidents. In the map below, crimes are differentiated according to their outcome. A thematic point map could just as easily differentiate among crimes committed at different times of the day or week, for example.

MAP 2. A thematic point map using incident status to define color of points

INCIDENT STATUS
- Arrest
- Arrest – Juvenile
- CBI
- Juvenile – No Custody
- Open
- Prosecution Declined

Somewhat more complex, graduated symbol maps (such as the one below) plot crimes using points of different sizes to correspond the number of crimes at specific locations.

MAP 3. Graduated symbols show variations in the number of crimes per location
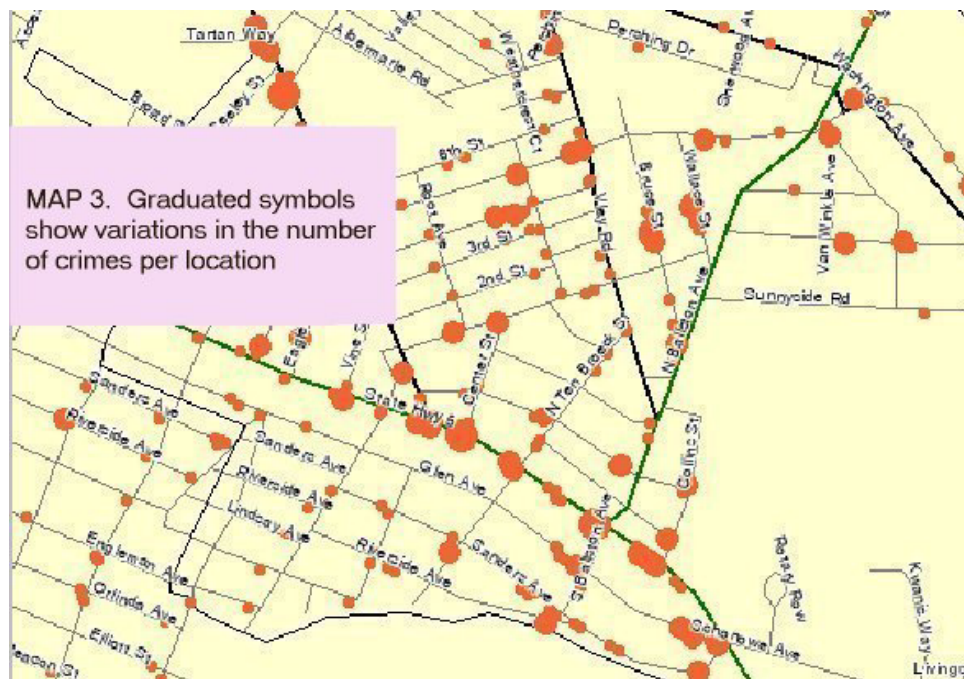
Other maps present the crime data not as individual points but as small shaded squares in a density grid. Squares with higher crime counts are shaded more intensely than those with lower counts or with no crime, producing a map, such as the one below, that looks like an elevation contour map and highlights crime "hot spots."

A day of crime in Harrow.
24 hour animation of street crime patterns, created using one year of crime data.

Map 4. A "hot spot" analysis map

Time: 00:00 (midnight)

Street crime in the London Borough of Harrow (2000)

High crime density

Low crime density

N

0   1   2
kilometres

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Crime data: Metropolitan Police
Map design: InfoTech Enterprises Europe

Source: Spencer Chainey, InfoTech Enterprises Europe.
Used with permission.

These density maps can be constructed for a sequence of weeks or months, then run together in an animation to show changes in the density of crime across large areas over time. To see how the hot spot in the map above changes over a 24-hour-period, go to www.agi.org.uk/cdsig/hotspots-space-time-animation.htm.

Some crime maps now include aerial pictures of the actual site produced through orthophotography, which corrects for any distortion caused by differences in elevation and the earth's curve. The map below shows the locations of burglaries in a residential area near a train station.
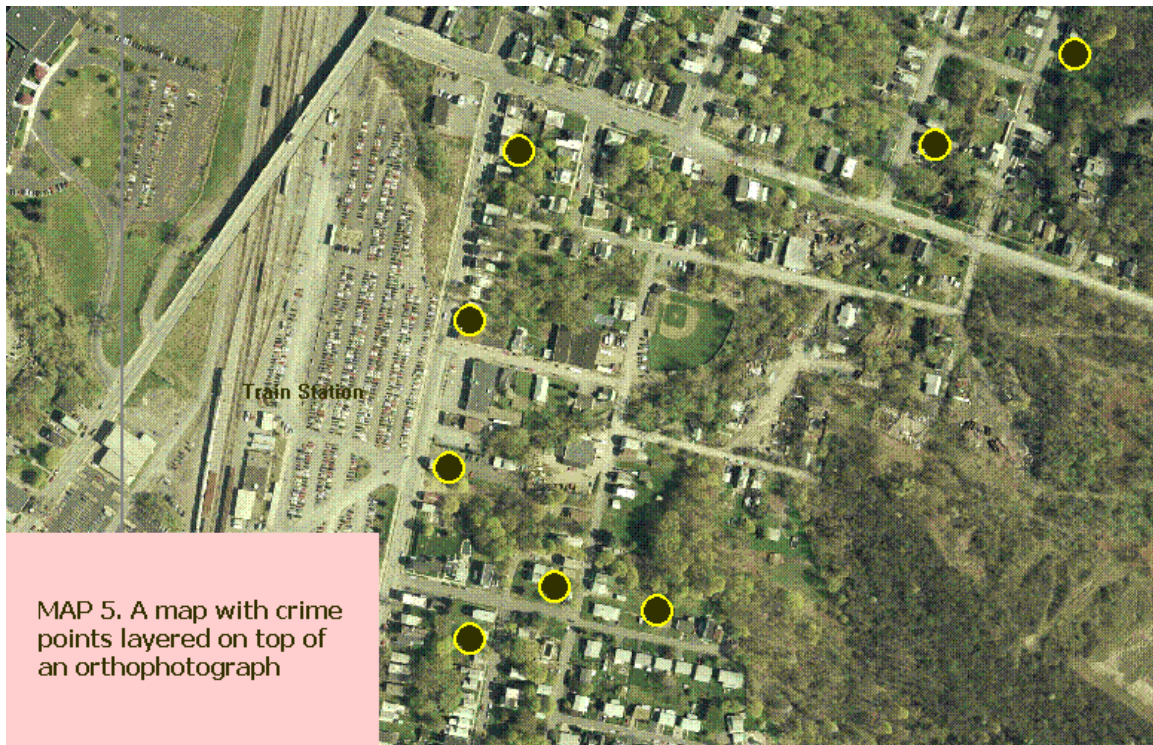
MAP 5. A map with crime points layered on top of an orthophotograph

Uses of Computerized Crime Mapping

Although many crime mapping systems are used initially for a single purpose, the best systems are designed to serve many functions. The three most common uses of computerized crime mapping are to measure police performance, solve specific crime problems, and inform the public. Police agencies that use maps to measure their own performance and hold themselves accountable are typically trying to monitor changes in crime over time or to compare crime levels in different districts. Those agencies that use maps to analyze and solve specific crime problems are more interested in placing crime data in context, usually comparing crime patterns in the same place at different times and overlaying a wide variety of non-criminal data and geographic conditions to understand crime patterns. Those police agencies that use maps to disseminate information about crime to the public are particularly interested in protecting the privacy of names and precise addresses and allowing members of the public to use the mapping system to answer their own questions about crime. Each of these three uses has particular technical requirements. Who can access the system, the interface they use to select and map various elements, and the specific information they are able to display will be different. Yet a well-planned system can serve all three functions.

None of these three uses requires that crime maps be computerized. The familiar wall map with colored push pins indicating recent crimes displayed in a police station can serve as a crude measure of performance, help police officers see patterns of crime, and show recent crime trends to citizens who visit the station. Computerized maps, however, serve each of these purposes far more effectively and efficiently.

Performance measurement and accountability
Because computerized crime maps capture a wide array of crime data and allow users to display changes in the level of different crimes over time and neighborhood-by-neighborhood, they are an effective way to show progress (or the lack of progress) in reducing crime. A map of a police district can show which sectors are experiencing an increase, and which a decrease, in any particular crime in the system. A map of a city or state can show the equivalent patterns across several police districts.

Perhaps the best known use of computerized crime mapping to measure performance is the CompStat system developed by the New York City Police Department in the mid-1990s. The term "CompStat" is used to refer to both the management practices implemented in those years and the associated computer system that integrates maps, charts, and statistical tables to show changing patterns of crime in each police precinct or district. At CompStat meetings, held twice weekly, the chief of the police department uses the maps and other data to hold precinct commanders accountable for reducing crime in their districts. Each of the 76 precinct commanders in the city is scheduled to appear at a CompStat meeting about once every six weeks. When their day comes, the commanders are asked to describe to their superiors and to the other precinct commanders problems they have noticed since the last meeting and the strategies they are using to solve those problems. They are also asked to report on their attempts to solve persistent problems identified at previous meetings. Commanders who are unprepared or unable to answer the detailed questions their superiors ask suffer a range of consequences, from embarrassment in front of their peers to demotion or loss of command.

In order to make a CompStat system function well, the data in the system must be up-to-date, and both the top commanders who pose the questions and the district commanders who answer them must be able to use maps effectively to find patterns in the crime data. The data in New York City's CompStat system is usually only a day or two old. Before each CompStat session, crime analysts on the chief's staff carefully examine the maps of the precinct, looking for patterns about which their boss can quiz the precinct commander. At the same time, the precinct commander's staff is generating its own maps, helping to prepare the commander for questions that might come up at the CompStat meeting.
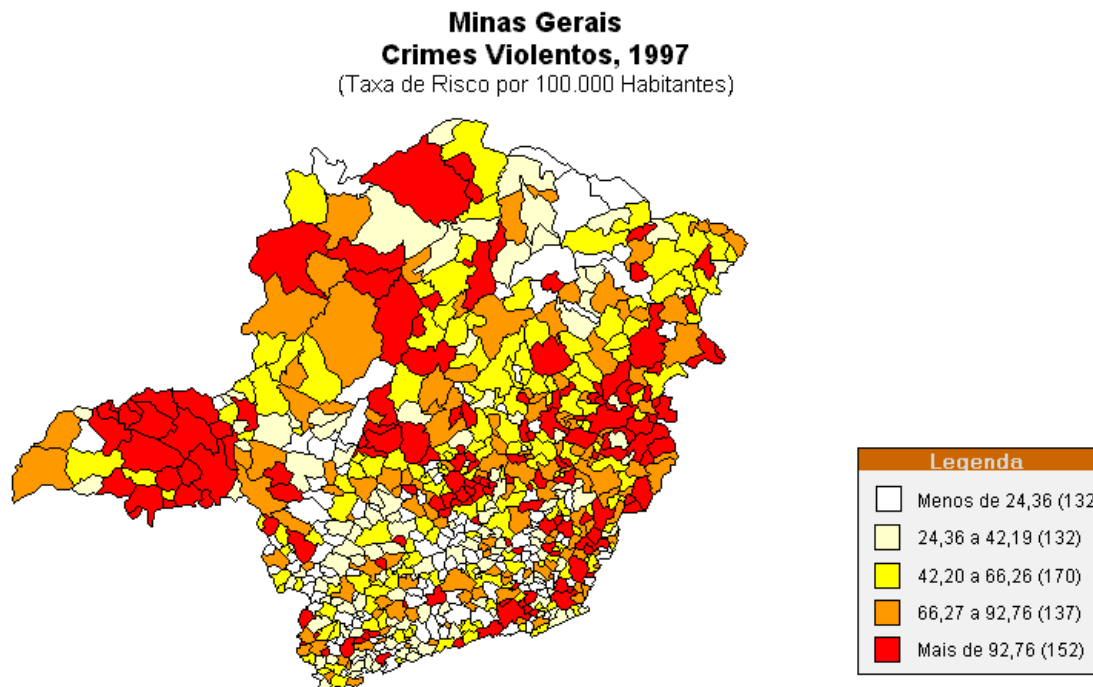
The CompStat system in New York City is used principally by department managers to measure performance of precinct commanders, but the same system can be used by others to hold police accountable. Legislative committees, journalists, and elected officials in New York City have all used maps generated through the CompStat system to review the performance of the police department, and NGOs could also use the maps for this purpose.

Crime analysis and problem solving
Just as epidemiologists have used computerized mapping to identify and respond to hot spots of cancer and other diseases, police analysts can identify crime hot spots and can analyze how they move over time in response to specific enforcement tactics or other social interventions.

One of the most sophisticated of these crime-mapping applications has been developed for the police in Minas Gerais, Brazil, by the Centro de Estudos de Criminalidade e Segurança Pública (Center of Studies of Crime and Public Security or

CRISP). The application allows researchers and police to easily produce shaded maps that compare the raw levels or per capita rates of violent crime across police districts and over time in the state of Minas Gerais. The sample map below was produced using this application.

Minas Gerais
Crimes Violentos, 1997
(Taxa de Risco por 100.000 Habitantes)

Legenda	
☐	Menos de 24,36 (132
☐	24,36 a 42,19 (132)
☐	42,20 a 66,26 (170)
☐	66,27 a 92,76 (137)
☐	Mais de 92,76 (152)

CRISP is engaged in other collaborative work with the police in Minas Gerais. The center recently assessed the effects of newly installed high visibility police observation and surveillance stations in the central business district of Belo Horizonte, the largest city in Minas Gerais and the third largest city in Brazil.

The South African Police Service has also used mapping to analyze crime and solve individual crimes within much smaller geographic areas. To deal with a concentration of car hijacking cases in Johannesburg, for example, the South African police created a special unit that included not only enforcement officers but crime analysts who used mapping tools to detect patterns in the hijackings and help guide the deployment of officers.

Computerized crime maps can also be used by individual police officers responsible for reducing crime on their own beat. In Chicago, for example, the police department expects individual officers to be intimately familiar with local patterns of crime and disorder, and the department's Information Collection and Mapping System (ICAM) is designed for their use. The ICAM system allows even the least technically proficient beat officers to produce standard crime maps and reports of their patrol areas with just a few clicks of a mouse. Yet the system is flexible enough for experienced users to produce customized maps at the beat, district, and citywide levels.

Finally, computerized crime mapping can help overcome the fragmentation of knowledge in a region where responsibility for crime reduction is split among numerous police agencies. In New York State, for example, a cross-jurisdictional mapping

application will eventually link the more than 700 individual police agencies that operate at the city, town, village, and county levels. Such cross-jurisdictional systems do have special requirements, including the need to standardize the terms used to record crimes and the need for one agency to host the system. The benefits, however, are substantial and include:

- extending computerized crime mapping to police agencies that could not afford the technology on their own,

- identifying crime patterns that stretch across jurisdictional boundaries, and

- encouraging communication across police agencies to identify and solve crime problems, and to generally improve coordination.

Public information and participation

Computerized crime maps offer police departments a valuable tool for communicating with the public. In a 1998 survey of U.S. police agencies, about 13 percent of the 2000 agencies that responded to the survey report using some form of crime mapping. Of these agencies, just under half share their maps with the public.[1]

Unlike wall maps with push-pins, computerized crime maps are easily disseminated. In Chicago, for example, the police department regularly prints maps from its ICAM system to share with NGOs and individual members of the public. Recently, the Chicago Police Department launched Citizen ICAM, a web site that allows civilians to produce their own custom maps of crime incidents within any specified distance of an address they choose. Citizen ICAM and other public police department maps can be reached through a web site maintained by the Crime Mapping Research Center of the U.S. Department of Justice at www.ojp.usdoj.gov/cmrc/weblinks/welcome.html.

Some cities provide the entire mapping system to nongovernmental organizations. For example, in 1998 the city of Hartford, Connecticut, gave 18 neighborhood organizations a crime mapping and analysis application called the Neighborhood Problem Solving System (NPS). Three years later, a study of the NPS system found that 14 of the 18 organizations use the system at least monthly and value their ability to identify crime hot spots, raise awareness of crime in their communities, increase citizen participation in crime prevention, and secure police and other government resources to help solve crime problems.[2]

As the Hartford example suggests, crime mapping need not remain under the primary control of police departments. Seattle, Washington, is one of three American jurisdictions participating in a new initiative sponsored by the U.S. Department of Justice in which crime mapping systems are used by a consortium of government agencies and community organizations to reduce crime. In these COMPASS (Community Mapping, Planning, and Analysis for Safety Strategies) initiatives the police department is only one of several government agencies coordinating resources to revitalize high-crime neighborhoods. The

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[1] Cynthia Mamalian. and Nancy LaVigne*, The Use of Computerized Crime Mapping by Law Enforcement Agencies: Survey Results* (Washington, DC: Crime Mapping Research Center, 1999).
[2] Thomas Rich, *Crime Mapping and Analysis by Community Organizations in Hartford*, *Connecticut* (Washington, DC: National Institute of Justice No. NCJ-185333, March 2001).

COMPASS initiatives also include researchers from local universities as part of the problem-solving consortium.

Conclusion

Computerized crime-mapping advances policing in democratic societies in at least four ways.

First, even when confined entirely within a police service, crime mapping focuses the attention of the police on reducing crimes against civilians. And when the crime maps become part of an internal accountability system, they improve the quality of police services.

Second, when shared with government officials and the public, crime maps provide intuitive pictures of crime problems that can form the basis of civilian oversight of police performance. By reviewing these maps regularly, journalists, legislators, and executive officials develop a common understanding of the crime problems police contend with as well as a common interpretation of the effects of various crime reduction strategies.

Third, when the technology itself is shared with the public, crime mapping engages neighborhood organizations and other NGOs in collaboration with government police agencies. Not only can nongovernmental organizations use the technology to increase the involvement of citizens and to focus available resources on real problems, but institutions of civil society are drawn into long-term partnerships with police.

Fourth, when academic researchers join these consortia and gain access to the data, the knowledge generated through crime mapping can become part of the fields of criminology, sociology, political science, and public management. These researchers bear a responsibility to integrate this growing body of knowledge into publications and courses so that crime policy and law enforcement strategies can advance on the basis of experience and reflection.

While the most elaborate computerized crime mapping systems depend on expensive hardware, sophisticated science, and a large amount of digital data, there are relatively simple and inexpensive crime mapping programs that can achieve all four of these goals.