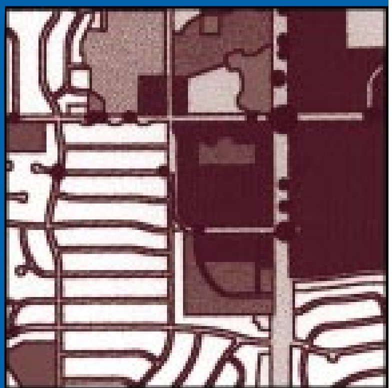

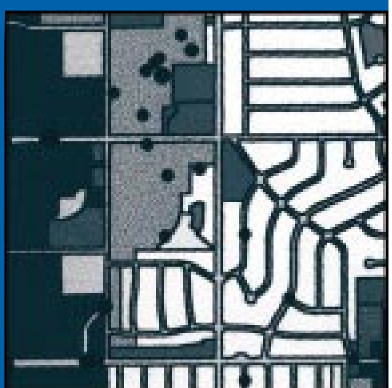

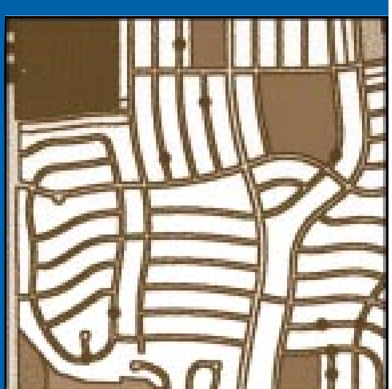

Chapter 6:

Crime Mapping Futures

Applications in crime mapping are becoming increasingly sophisticated and integrated. The hallmark of the first decade or so of the modern era of crime mapping was the use of geographic information systems (GIS). Perhaps the next decade will see the integration of previously separate technologies such as global positioning systems (GPS), orthophotography, digital photography, digital videography, and a wide range of local databases with relevance to policing—and the World Wide Web. Another realm of potential progress lies in forecasting. A remarkable indication of the level of interest in crime mapping and related technologies was contained in President Clinton's State of the Union Address on January 19, 1999, in which he said:

> Tonight, I propose a 21st century Crime Bill to deploy the latest technologies and tactics . . . [to] put up to 50,000 more police on the street in the areas hardest hit by crime, and *then to equip them with new tools—from crime-mapping computers to digital mug shots.* [Emphasis added.]

While it is not possible to explain or even identify all the innovative crime mapping applications in the field or under development, the following are outlined below to provide a sense of the kinds of methods and technologies that are likely to find increasing acceptance in the years ahead: geographic profiling, which has already found wide recognition and is representative of a method that creatively combines various tools of spatial analysis; high-resolution GIS; statistical methods and forecasting; digital aerial photography; and the integration of GIS and GPS.

Geographic profiling[1]

Geographic profiling is an investigative methodology that uses the locations of a connected series of crimes to determine the most probable area that an offender lives in. Although it is generally applied in serial murder, rape, arson, robbery, and bombing cases, geographic profiling also can be used in single crimes that involve multiple scenes or other significant geographic characteristics.

Developed from research conducted at Simon Fraser University's School of Criminology and rooted in the pathbreaking work of Brantingham and Brantingham (1981), the methodology is based on a model that describes the hunting behavior of the offender. The criminal geographic targeting (CGT) program uses overlapping distance-decay functions centered on each crime location to produce *jeopardy surfaces*—three-dimensional probability surfaces that indicate the area where the offender probably lives. The distance-decay concept (see chapter 1) conveys the idea that people, including criminals, generally take more short trips and fewer long trips in the course of their daily lives, which may include criminal activities. Thus *overlapping distance-decay functions* are sets of curves expressing this phenomenon and suggesting, for example, that it is more likely that offenders live close to the sites of their crimes than far away. Probability surfaces can be displayed on both two- and three-dimensional color isopleth maps, which then provide a focus for investigative efforts (see chapter 1 for a description of isopleth maps).

This research has led to the development of *Rigel*, a computerized geographic profiling workstation that incorporates an analytic engine, GIS capability, database management, and powerful visualization tools. Crime locations, which are broken down by type (e.g., victim encounter, murder, and body dump sites for a murder), are entered by address, latitude/longitude, or digitization. Scenarios wherein crime locations are weighted based on certain theoretical and methodological principles are created next and examined. The addresses of suspects can then be evaluated according to their "hit" percentage on a probability chart known as a z-score histogram, which can prioritize registered sex offenders, other known criminals, task force tips, and other information contained in databases.

Geographic profiling can be used as the basis for several investigative strategies. Some of the more common ones include:

- Suspect and tip prioritization.
- Address-based searches of police record systems.
- Patrol saturation and surveillance.
- Canvasses and searches.
- Mass DNA screening prioritization.

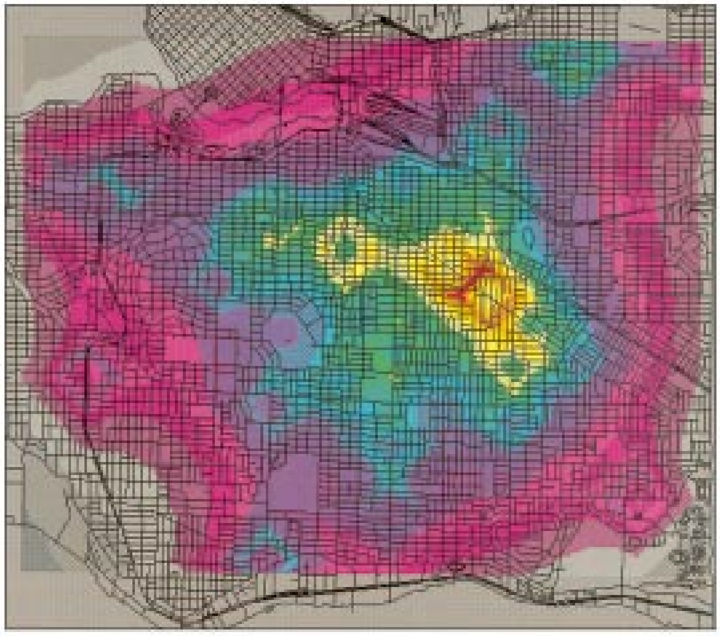

Figure 6.1

A geoprofile of a series of armed robberies in Vancouver, British Columbia, Canada.

Source: Det. Insp. D. Kim Rossmo, Vancouver, British Columbia, Police Department. Reproduced by permission.

- Department of motor vehicles searches.
- ZIP Code prioritization.
- Information request mailouts.

Figure 6.1 displays the geoprofile produced from the analysis of 32 armed robberies that occurred over a period of approximately 12 months in the city of Vancouver, British Columbia, Canada. The purple areas around the periphery are less likely to include offenders' residences, and the yellow and orange areas in the center are more likely to include offenders' residences. Three strategies were predicated on the geographic profile in this case. First, a search was conducted of the Vancouver Police Department's Records Management System for known robbery offenders who matched the criminals' descriptions and resided within the top 5 percent of geographic areas identified in the geoprofile. This did not produce any viable matches, as neither offender had had a previous conviction for robbery.

Second, a simplified geoprofile, displaying only the top 2 percent (0.7 square miles) of potential offender residences, was produced for patrol officers. Previous research determined that robbery offenders usually return home after committing a crime. It was therefore suggested that, in addition to responding to a crime scene after the report of a new robbery, patrol members should also search the most likely area of offender residence, paying particular attention to logical routes of travel. This also was unsuccessful as the offenders were using stolen cars and no reliable vehicle descriptions were ever obtained (even though the geoprofile was used by police units to search for stolen automobiles that might be abandoned prior to a new robbery).

Third, the results of the geoprofile were released on the television show "CrimeStoppers." This approach was successful, producing results that allowed the detectives to identify the offenders responsible for the series of robberies. The primary offender's address was located within the top 1 percent of the peak area of the geoprofile.

It is important to stress that geographic profiling does not solve cases, but rather provides a means for managing the large volume of information typically generated in major crime investigations. It should be regarded as one of several powerful decision support tools available to the detective and is best employed in conjunction with other police methods. Geographic crime patterns are clues that, when properly decoded, can be used to point in the direction of the offender.[2]

Currently, geographic profiling services are available from the Vancouver Police Department, Geographic Profiling Section, Vancouver, British Columbia, Canada; the Royal Canadian Mounted Police, Pacific Region ViCLAS Section, also in Vancouver; and the Ontario Provincial Police, Behavioral Sciences Section, Orillia, Ontario, Canada. It will be available in the near future from the British National Crime Faculty, Bramshill, United Kingdom.

Concerned about the mapping and prediction of serial crimes, Geggie (1998) reported on the work of Officer Timothy Meicher of the Los Angeles Police Department. The case related to robberies involving a perpetrator who rode a motorcycle and snatched purses from elderly victims in shopping center parking lots—hence the title "the Los Angeles Motorcycle Bandit." Employing basic statistical concepts—mean and standard deviation—Meicher produced a map with boundaries indicating two probability levels for the next bandit strike, one at 68 percent and the other at 95 percent (figure 6.2). Meicher then collaborated with Geggie to automate the process of producing the probability map. Their model was subsequently distributed both inside and outside the Los Angeles Police Department.

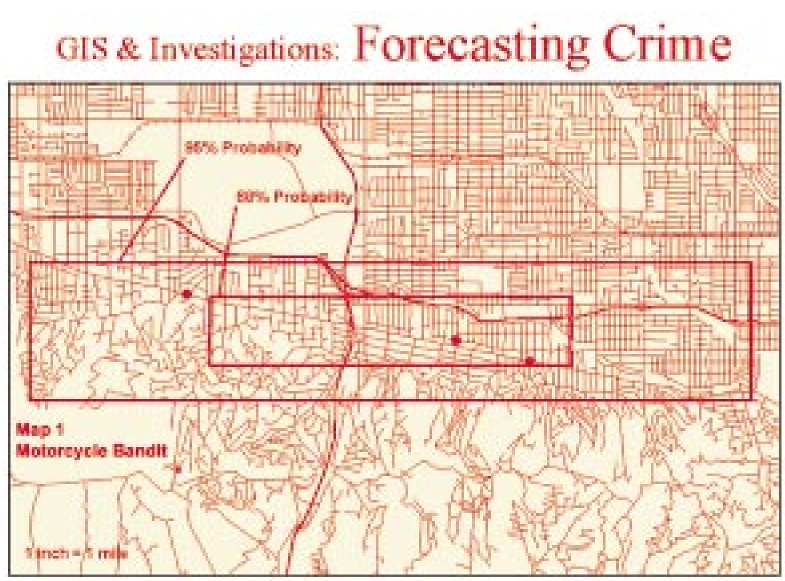

Figure 6.2

A map showing probability boundaries in the Los Angeles, California, Motorcycle Bandit case.

Source: Geggie, 1998. Reproduced by permission.

High-resolution GIS

We often lose sight of the fact that GIS can be useful on any geographic scale, from global (small scale) to small (large scale), such as a room. Most crime analysis is conducted on what could be labeled medium scale, typically representing a city or neighborhoods within a city. Rengert, Mattson, and Henderson (1998) have reported on GIS applied to individual buildings or other small areas, such as street segments, terming this approach high-resolution GIS. The four panels of figure 6.3 contain several views representative of this approach. In the upper left panel, a "plan" view shows the footprint of a highrise building on the Temple University campus in Philadelphia. Crime incidents have been compressed so that they are all seen as if at one level. This compression enables law enforcement to determine whether incidents might be clustered around elevator shafts, for example, or restrooms, which tend to be at identical locations on each floor of a highrise. The upper right panel provides a perspective of the building with incident locations in their three-dimensional positions. At lower left, a technique for delineating clusters uses spheres to provide a sense of what might be called "highrise hot spots." Then at lower right, a cluster within a cluster defines the limits of the larger pattern of incidents and then focuses on the denser pattern within.

Forecasting: Complex statistical methods and crime mapping

In cooperation with the Pittsburgh Police Department, Olligschlaeger (1997) employed advanced statistical methods in an attempt to identify *emerging* drug markets, which

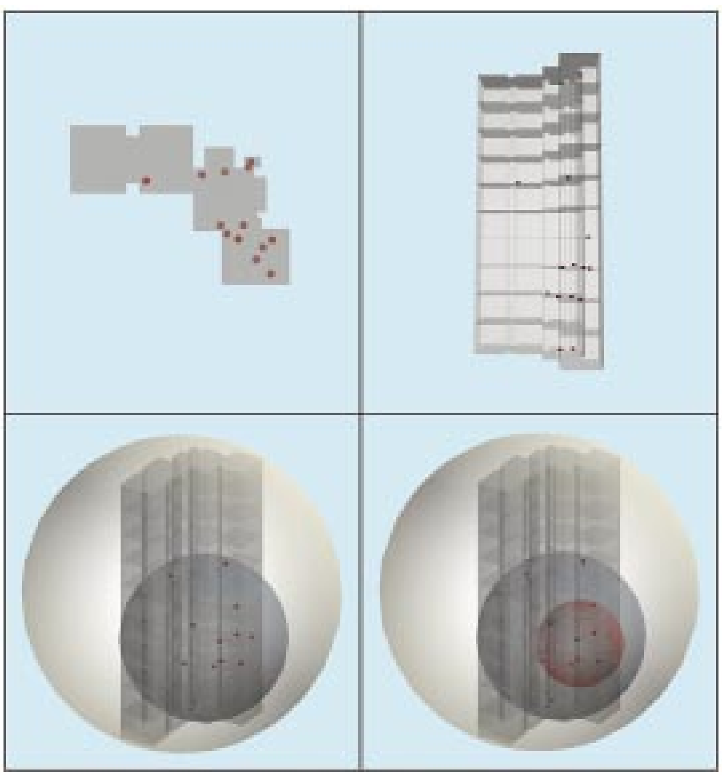

Figure 6.3

A map using high-resolution GIS to show crime in a highrise building.

Source: Rengert, Mattson, and Henderson, 1998. Reproduced by permission.

are relatively difficult to detect by conventional means. This is because they often are revealed only indirectly through the commission of other crimes, such as robberies or burglaries, and then only after a delay. Given the importance of drug markets as crime generators, early warning is useful. Three types of calls for service (CFS) were used to develop models: *weapon-related*, *robbery*, and *assault*. *Commercial land use* and *seasonality* were also included as model criteria based on evidence in the literature. A grid of cells measuring 2,150 square feet was then superimposed on the city, with the size of the cells determined by the need to have cells big enough to represent a reasonable number of CFS, but small enough to supply an adequate number to satisfy statistical modeling requirements. The grids were then used as the framework for choropleth maps.

Following rules based on gaming simulation, a statistical model estimated the consequences of the various types of CFS at certain levels. (For details of the model's architecture and specifications, see Olligschlaeger, 1997). Then forecasts from different methods were compared with actual patterns to provide a basis for evaluation.

Experience showed that a type of gaming simulation model known as the neural model did better than other types tested. A difficulty with the analysis—namely, the use of large quantities of computer resources—becomes less of a problem as the power of personal computer processors increases. Overall, the analysis suggested that advanced methods of the type tested—the neural model—could be useful tools in spatial forecasting.

Mapping change: From pins to grids

Also employing a grid mode of representation for Pittsburgh, Gorr used 750-foot cells approximating four city blocks. Based on a pin map, a grid map (figure 6.4)

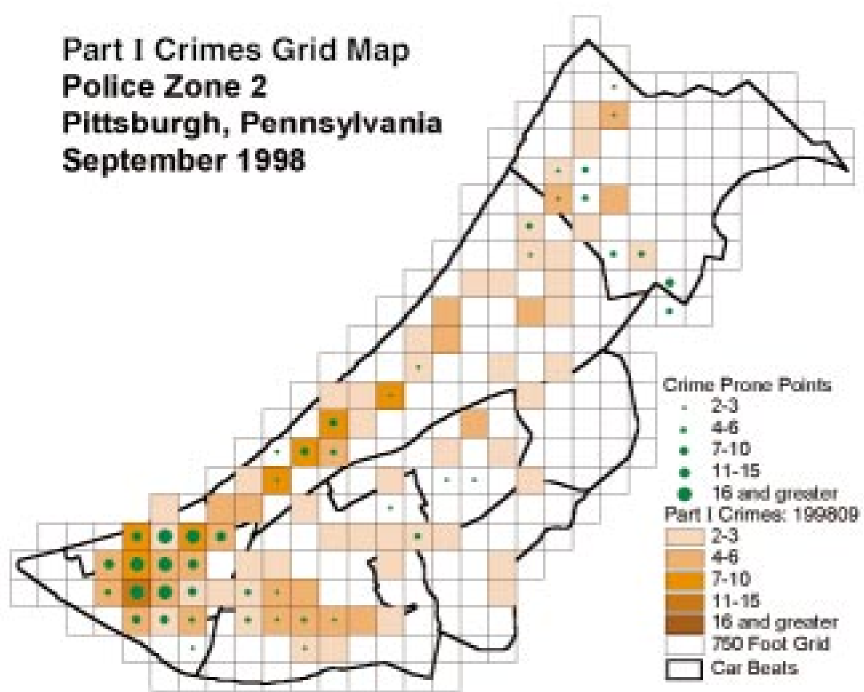

Figure 6.4

A map of grid cells. Reproduced by permission.

Source: Wilpen Gorr, Heinz School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, Pennsylvania. Reproduced by permission.

displays the Part I crimes from the pin map in each grid cell, suppressing cells with only one crime. The grids show the total demand for serious crime suppression, in combination with an indicator of crime-prone land uses. The latter indicator came from the PhoneDisc®[3] yellow pages and includes the total number of restaurants, fast-food stands, bars, drug stores, retail stores, pawn shops, jewelry stores, etc., by grid cell, suppressing cells with only one such establishment. This example shows how the reformulation of information and the introduction of a related layer (or layers) of data can provide new and more useful interpretations than the original data alone.

As shown in figure 6.5, this methodology was used to analyze change by converting the two pin maps into grids and then subtracting one from the other to get the measure of change. Grid cells have several advantages:

- They clearly show crime intensity in places with many overlapping point markers.
- Their data are in the form needed for time-series plots, bar charts, and statistical analyses, which are examples of crime space/time series, with one "slice" shown in figure 6.5.

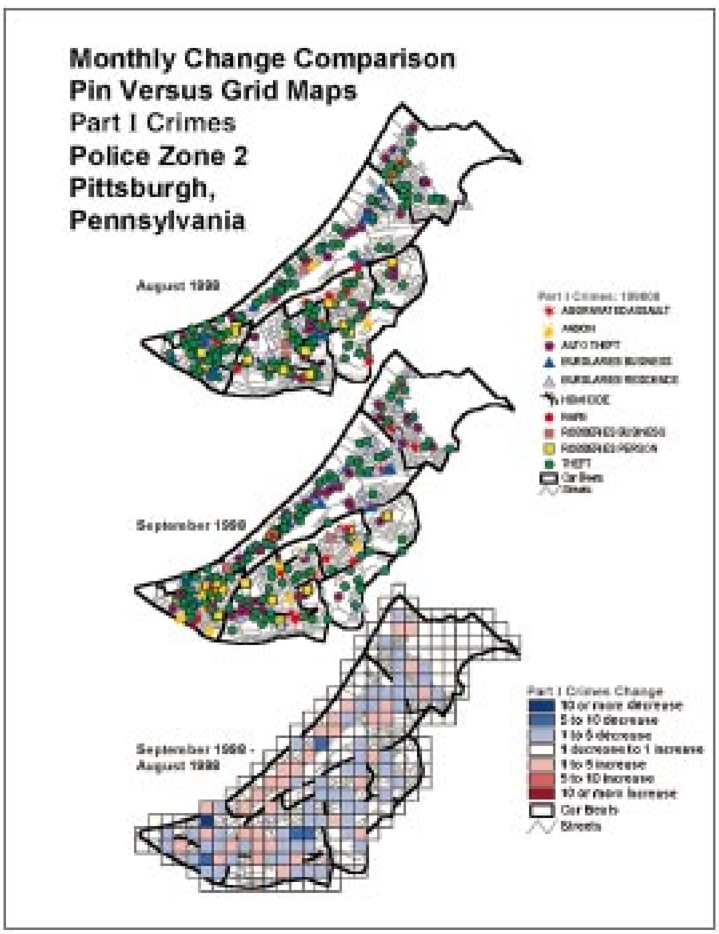

Figure 6.5

Two pin maps and a change map for August–September 1998, based on pin maps of Part I crimes for Pittsburgh Police Zone 2 (the equivalent to a precinct). The pin maps include streets and car beats for the zone, as well as downtown Pittsburgh, Pennsylvania, (the two beats on the left) and several neighborhoods.

Source: Wilpen Gorr, Heinz School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, Pennsylvania. Reproduced by permission.

- The grids can be used to produce change maps that are more legible than pin maps.

Making maps come to life[4]

Application of Virtual Reality Modeling Language (VRML) to crime data allows the user to change a viewpoint by rotating, translating, zooming in and out, and tilting maps, providing a dynamic way of viewing crime. The images shown in figures 6.6 and 6.7 are part of an animation that depicts different crime types reported to police for various time periods in Vancouver, British Columbia, Canada. In

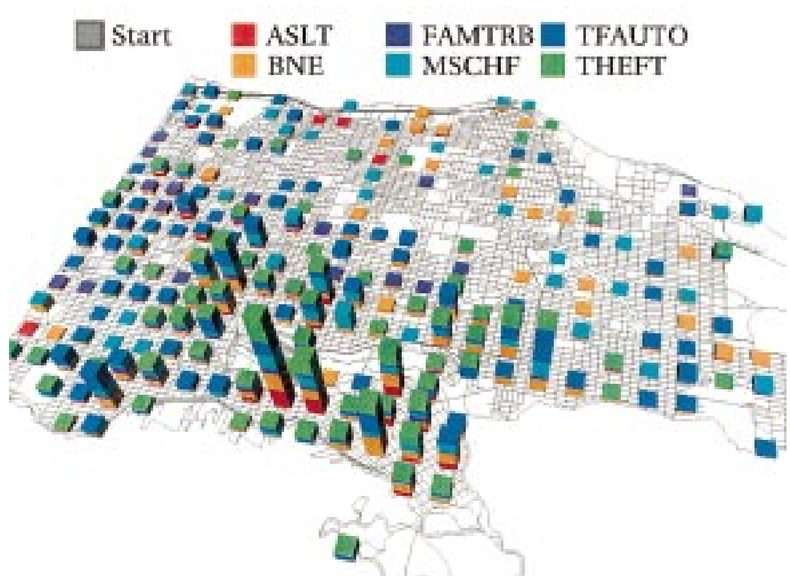

Figure 6.6

A rotated view of six types of crimes on a map of Vancouver, British Columbia, Canada. Different crime types are mapped to different colors and stacked in three dimensions.

Source: Lodha and Verma, 1999. Reproduced by permission.

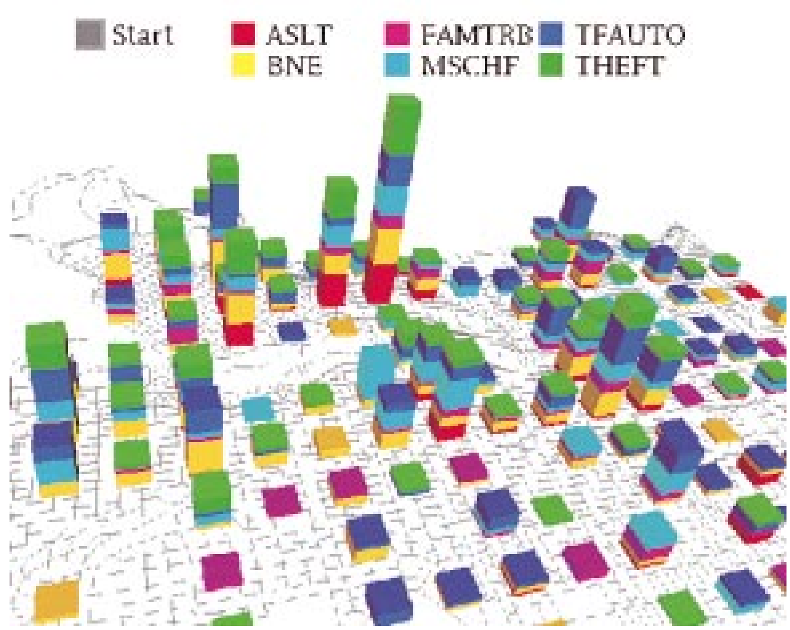

Figure 6.7

A zoomed-in view of six types of crimes on a map of Vancouver, British Columbia, Canada.

Source: Lodha and Verma, 1999. Reproduced by permission.

its original context, this animation could be activated by clicking the start button shown in the images. The process of creating the images involves first rasterizing the data, then developing a color code key for the crime types, and, finally, designing a system for displaying the crime—in this case, as a histogram.

In figures 6.6 and 6.7, six different types of crime are illustrated: assault (ASLT), breaking and entering (BNE), family trouble (FAMTRB), mischief (MSCHF), auto theft (TFAUTO), and theft (THEFT). The height of the stack is proportional to the total number of crimes in an area, so hot spots can be recognized as "highrises." The two figures display the same data—the same map—from different viewpoints after rotating and zooming in.

Another approach that is easy and yet quite effective as a means of visualizing change involves animating a two-dimensional map. In figure 6.8, calls for service in Mesa, Arizona, were mapped and (in the original) animated. This map uses isoline mapping (joining points of equal value—in this case, equal CFS counts[5]). The animation is a rapid-sequence display of a series of maps of successive arbitrary time intervals giving the visual impression of movement, much like an animated cartoon.

These applications illustrate how we can expect maps to become more dynamic, more maneuverable, in the years ahead. Not only is it likely that the flexibility of maps will improve, but a more user-friendly environment will likely evolve in parallel. The average analyst will simply not have time to do the programming that Lodha and Verma (1999) did to produce their maps, and tools of this sort will, of necessity, become easier to use.

Digital aerial photography in policing

As noted throughout this guide, police departments employ GIS technology in various applications, including criminal

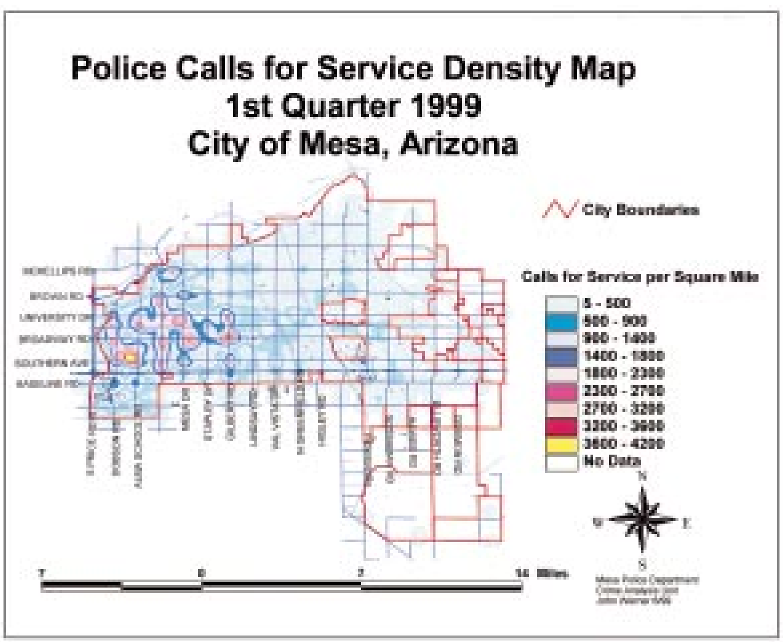

Figure 6.8

A map showing the density of police calls for service in the first quarter of 1999 in Mesa, Arizona.

Source: J. Werner and the Crime Analysis Unit, Mesa, Arizona, Police Department. Reproduced by permission.

intelligence and crime analysis, crime prevention, public information, and community policing. Typical GIS applications involve taking a georeferenced crime database, filtering the data as needed, and mapping it over a street database to put the crime data in its spatial context. Other data layers may be used, such as census tracts, ZIP Codes, or council districts, but the most frequent underlying context is city streets.

Digital street maps typically provide extremely limited contextual information. Streets are represented as single lines and sometimes color coded to indicate their type (e.g., freeway, arterial, collector). They can be labeled, if necessary, to enhance the level of detail, but the information provided by the street database is quite limited. In recent years it has become clear that the visualization of crime data needs to be improved to provide opportunities for better communication within and between the internal and external constituencies of police departments.

We can portray the general context of visualization along a continuum from complete abstraction, at one extreme, to reality at the other (figure 6.9). Most existing crime maps would be located left of center on the continuum. The crime mapping future will see increasing movement to the right, toward more realistic presentations.

Confidentiality and privacy considerations will probably set limits on how far to the right the process moves. Ultimately, these limits will be culturally conditioned, with more detail where public information and geographic precision are prized and less detail where values put more emphasis on privacy. This variation will be seen, and is already seen, from city to city, State to State, and nation to nation.

Increasingly, police departments are using large-scale (representative fraction 1:2,400) digital aerial orthophotos, also known as DOQ, for digital orthophoto quadrangles. The "ortho" part means

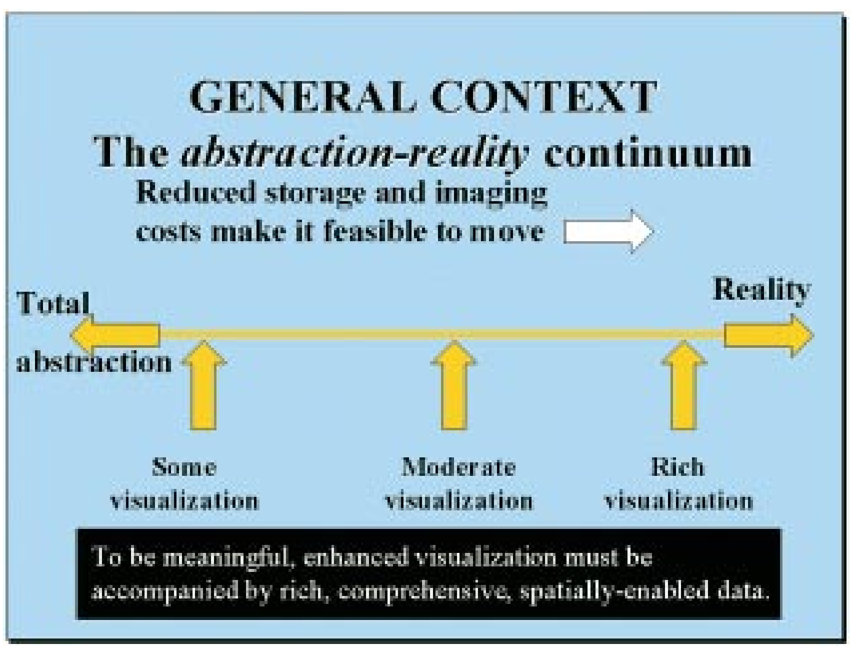

Figure 6.9

A diagram illustrating the abstraction-reality continuum.

Source: Keith Harries.

perpendicular to the Earth's surface, just as *ortho*dontics corrects teeth so that they are perpendicular to gums. Photos are produced in "tiles," or rectangles, such that each tile typically represents about a square mile (4,000 feet by 6,000 feet or 24 million square feet[6]). The tiles are rectified for errors due to edge distortion (which increases away from the camera lens), other distortions due to the attitude (or position) of the airplane, and terrain. The edges of the tiles must match perfectly. The raster images (see chapter 4) are registered to the center lines of the appropriate digital street-based maps so that geocoded crime data can be accurately portrayed in their "real" spatial context, permitting the identification of land uses, landmarks, and virtually any relevant landscape features.

Furthermore, other coverages are typically digitized and made available as part of the orthophoto package, including spot heights, building footprints, topography, street boundaries, water bodies, and open space. These can be quite useful with or without the associated orthophoto. The data within the photos and the associated digitized coverages are so rich that they could find applications in tactical team operations, for example, where land elevation, terrain, building heights, building footprints, fences, and water bodies can be used to plan where to place officers and determine what their sight lines will be.

While maps have progressed from two dimensions to three, so have aerial photos. Just as three-dimensional maps have limited specialized applications, the applications of three-dimensional photos are likewise limited at present, but potential uses are numerous and ultimately limited only by the user's imagination. As the example in figure 6.10 shows, images can be quite striking in their depth and realism and add to the crime analyst's arsenal of environmental data.

Potential applications of aerial photography are numerous. Any geocoded

Figure 6.10

A three-dimensional orthophoto cityscape.

Source: Orthophoto imagery and three-dimensional model courtesy of ASDI Technologies, Colorado Springs, Colorado. Reproduced by permission.

information can be superimposed on the photos, including census data, liquor license locations, drug-market data, injury locations, probationer addresses, housing and zoning code violations, and other data that may be relevant to the needs of community policing (see, for example, figure 4.4 in chapter 4). Eventually, we may see orthophotos supplanting "traditional" street-based maps in some, if not all, of the applications where such maps have typically been used.

Integration of orthophotos with conventional data is by no means the only possibility for enhanced visual display. For example, other raster images may be keyed to the orthophotos. One possibility explored in a pilot project[7] in Baltimore County, Maryland, was the development of an archive of ground-level digital photos intended to characterize neighborhoods and landmarks, precinct by precinct.

These ground-level images were linked to a land use map database, and symbols were placed on the land use map at all locations where a ground-level photo had been taken. In ArcView®, hot links were established between the symbols and the database; when the symbols were clicked on, the ground-level picture would pop up, as shown in figure 6.11 (for specific directions, see ESRI, Inc., 1997, chapter 16, "Creating Hot Links"). Yet another possibility is the use of virtual reality to enhance the visualization of scenes in a way that provides somewhat more flexibility than an analog videotape. A set of digital photos is taken in a circle using a special tripod, with the number of pictures calibrated to the focal length of the camera lens. Then a program is used to splice the pictures together at the edges. A viewer with pan and zoom capabilities enables re-creation of the 360-degree panorama. Free viewers are available for

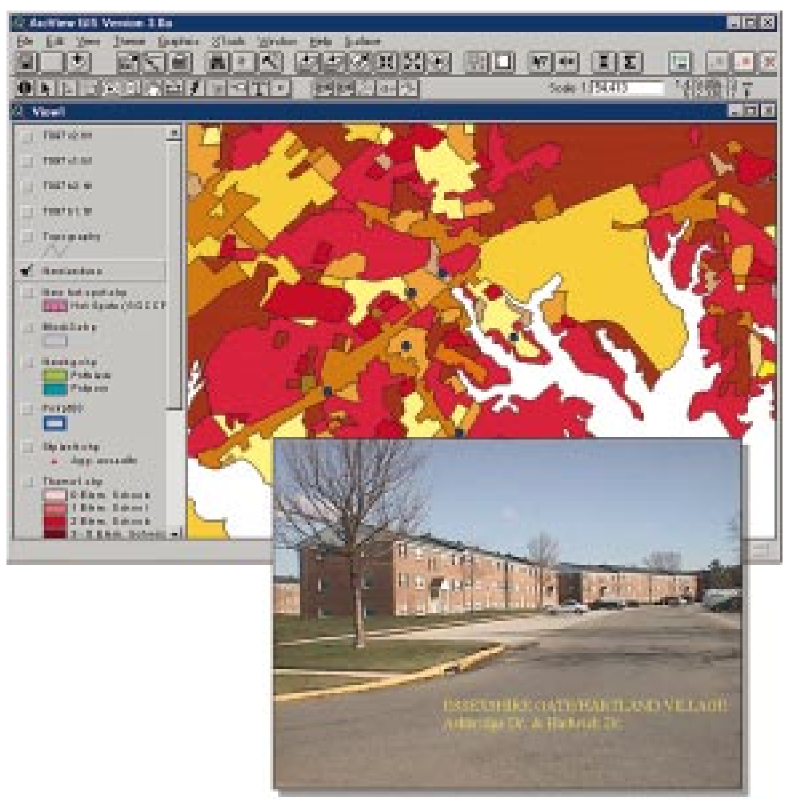

Figure 6.11

A ground-level photograph that pops up when linked to a land use map in ArcView®.

Source: Keith Harries.

Figure 6.12

A 360-degree panorama (top), and a selected part (bottom), of interest owing to the potential conflict between public housing and owner-occupied housing residents. A wall was built to separate the two "neighborhoods."

Source: Keith Harries and Thomas Rabenhorst.

downloading (see appendix). This technology could be used for training purposes, for documenting a crime scene that could serve as evidence in court, or for community meetings when a specific location may be the focal point of interest (figure 6.12).

The 360-degree view provides a sense of the local environment that may not be conveyed by either a ground-level still picture or an orthophoto. Virtual reality presentations could be linked to maps or orthos, too. To get a sense of what virtual reality is like, go the National Gallery of Art Web site (*http://www.nga.gov/home.htm*), where virtual reality tours are available (see appendix).

Until recently, the costs of storage and random access memory (RAM) limited the use of memory-intensive applications, such as the display of orthophotos. Each tile, with its associated coverages, requires about 30 megabytes of hard drive space. A city like Baltimore or Washington, D.C., each somewhat less than 100 square miles, would need more than 3 gigabytes (GB) dedicated to it. But with hard drives of 20+ GB readily available at modest cost, this limitation no longer poses a problem. Likewise, the relatively low cost of RAM permits the fast manipulation of large graphics files.

Anticipated applications of orthophotos in community policing include:

- Community residents being able to select their homes or apartment buildings and seeing how the locations of crime incidents or other illicit activities relate to their own locations even if they have no firsthand experience of the events.

- Officers more easily recognizing and contextualizing information, whether that information involves crime locations or various social or environmental problems.

- Police dispatchers (who are increasingly likely to be civilians relatively unfamiliar with the detailed community geography of the city) having the capability to enrich dispatching information with landmarks as reference points provided by photos that pop up on their computer screens. Dispatching technology could be enhanced dramatically if both dispatchers and officers in the field could simultaneously see orthophotographic images displaying the origins of calls.

- Crime prevention officers, analysts, commanders, and administrators being able to present more persuasive visual evidence of problems and communicate better with legislative bodies, community groups, and their professional colleagues.

- Planning being enhanced by realistic and accurate perceptions of the size and scope of proposed actions.

The integration of GIS and GPS

The integration of data and technologies will be pushed to the limit to extract as much value as possible. The possibilities are limited only by our imaginations. Whereas GIS offers a powerful toolbox, GPS, another technology with untapped potential in law enforcement, permits accurate location finding in field settings. Triangulating from 24 satellites (put in orbit at a cost of $12 billion by the U.S. Air Force), GPS, in its more advanced modes, can provide accuracy to one centimeter, or about half an inch. (For a tutorial explaining how GPS works, go to *http://www.trimble.com*.)

In reality, however, structural and environmental limitations, such as tall buildings, a forest canopy, or operations in mountainous terrain, and the ability of the Air Force to manipulate the accuracy available to civilians may mean an error of up to 100 meters. These problems can be overcome by using GPS base stations with established locations and manipulations that have come to be referred to as *differential positioning* GPS or DGPS. This is defined by *GPS World Magazine* as:

> A technique used to improve positioning or navigation accuracy by determining the positioning error at a known location and subsequently incorporating a corrective factor (by real-time transmission of corrections or by postprocessing) into the position calculations of another receiver operating in the same area and simultaneously tracking the same satellites.

The bottom line, however, is that users should generally be prepared for considerably lower resolution than some numbers quoted in promotional materials.

Another possibility for integrating technologies involves the combined use of GIS, GPS, and management information systems (MIS). This would allow close to real-time crime mapping, since the geocoding step would be eliminated (Sorensen, 1997). However, some operational questions need to be examined. For example, with how much certainty will incident locations be reported? A patrol officer may report “arrived” status prematurely, sending what in theory should be the incident location, but what in practice may be erroneous. On the other hand, GPS offers the possibility of accurately reporting places that have no meaningful street address. A shopping mall covering 100 acres may have a conventional street address that is meaningless in terms of conveying locational precision. With GPS, the precise spot of an auto theft in the parking lot could be pinpointed, providing potentially useful information for protecting areas of the parking lot that are prone to theft. Crime inside the mall building could be reported with greater precision, whether in stores or in public spaces, provided a reasonably close line-of-sight GPS reading could be obtained. This type of "precision mapping" is already being performed in Charlotte, North Carolina, where GPS is used to plot exactly where crimes occur, even for locations without street addresses.

An application of GPS that is in development is in the area of probation and parole—tracking probationers and parolees if the terms of their release require limitations on their mobility. Indeed, future crime mapping applications will go beyond crime mapping per se and into other components of the criminal justice system, including corrections. One can expect to see the manipulation of spatial information and the application of new tools and technologies evolving in the coming decade. While developments in other branches of criminal justice will likely parallel spatial analysis developments in policing, we also can expect to see the development of specialized methods adapted to particular needs.

Postscript: The future of GIS in policing

When asked, "Why bother to discuss the future of GIS?," Clarke (1997) responded with three reasons that might apply equally to crime mapping:

- The need to plan equipment purchases in the most efficient way, anticipating trends.
- The need to stay abreast of the new field spawned by GIS called *geographic information science.*
- The need to be prepared for cross-fertilization of different criminal justice fields using GIS.

Clarke suggested that we can classify speculation into two types:

- The forward extension of current trends.
- Pure speculation, with the likelihood that some ideas will become reality while others will fade away.

Clarke also noted that data will become more complete, more detailed, more timely, and more varied than ever before. This will be helpful to GIS as an "end user" of data—if the core data get richer, then possibilities for enhanced analysis also increase. But Clarke was referring to GIS in general. Can we have the same expectations for crime mapping?

Given that most crime data are already point defined (address-type), could they be improved in terms of spatial definition? Yes, at least marginally, through the use of GPS technology to remove address ambiguities, of which there are many. Whether locational data can be improved across the board may depend on the GPS protocols that develop, one police department at a time. Data quality will probably improve, and addresses will probably become more precise as more agencies use automated field reporting and integrated computer-assisted dispatching and records management systems.

More on GPS and policing

Equipping patrol units with GPS would mean that their locations could be known as often as each unit is "polled," or automatically asked to respond, perhaps every few minutes. This would be an excellent security device for officers, since their location could be determined at any time, and, if an officer were down or needed help, knowing his or her location would save valuable time.

But will GPS units typically be located in patrol cars? If so, some ambiguities in incident location will remain, since the car will not always be parked precisely where the incident takes place. If GPS units are hand held, or incorporated into officers' uniforms, accuracy may improve significantly. The caveat on GPS data, however, is that the physical environment may not permit a satellite reading owing to the presence of tall buildings or other obstacles. Such difficulties aside, the era of real-time access to spatially enabled crime data is rapidly approaching—a development that will force us to reconsider what we are doing and why and how we are doing it. This development is not without risks, such as the temptation to jump to premature conclusions on the basis of real-time, but possibly unconfirmed, information.

The Web: Already a force in the dissemination of police information

A development that may have the greatest impact on the manipulation of crime data may be the use of the Web for access to data that have already been geocoded and are in the public domain, such as census data, including census geography. A corollary development will likely be demands for local data on Web sites. Currently, police departments are split on this issue, with some routinely putting their less sensitive data on the Web, and others refraining from doing so. The power of the Web to facilitate data sharing will invite more open data dissemination protocols, but these will be offset to some extent by security and privacy concerns.

Public information revisited: How much public access to allow

A pervasive force at work in the background is the historical culture of policing that has generally frowned on easy public access to crime data. This reluctance is borne of several factors, including fear of misuse and misinterpretation; the indisputable need for confidentiality for some crimes, such as rape and juvenile offenses; fear of political reprisals when crime rates are increasing; and a reluctance to expend scarce resources on data dissemination. In the background was, and is, a certain degree of proprietorship regarding data and a somewhat natural reluctance to simply give information away, even though it might be in the public domain already, at least in theory. A subtext to this is the view that crime data should not be made available to the public if they do not have to be, since public disclosure only constitutes another potential source of problems.

On the other hand, undermining nondisclosure is the fact that many city and neighborhood newspapers routinely publish lists of local crimes, complete with addresses. The only missing link is the codification necessary to produce a citywide map. Criminal matters most often come before the courts and, in so doing, jump squarely into the public domain. In the long term, it is increasingly difficult to see how most crime data could be kept private, particularly data related to incidents for which there is no active investigative interest and no need to protect victims. Indeed, some departments that were secretive a decade ago are now beginning to put their data out on CD-ROMs or at least are talking about doing so. Others refuse to release data, even for legitimate apolitical research.

One certainty is that, in addition to technological and methodological innovations in crime mapping and in collateral fields that can be productively integrated into mapping methods, a debate about the disclosure and exposure of crime data will continue into the foreseeable future.

Multimedia and integration

Multimedia and integration are likely to be among the most prominent themes that evolve in the crime mapping arena over the next decade. Crime mappers will certainly take advantage of all the new technological advances, often using multimedia in ways that their developers might not have anticipated. Integration of various technologies, with data archiving (or warehousing) and data mining becoming more prominent, will be inevitable. Crime mapping may find itself merging into an enterprisewide GIS, as governments network access to data and standardize GIS platforms across entire jurisdictions to ensure compatibility and reduce costs. Change is certain. The only uncertainty is how the rate of change will vary from place to place.

Conclusion

Rapid change is the order of the day in crime mapping. It’s tempting to hold out and ride the next wave of innovation, skipping the present phase that is doomed to obsolescence as soon as the shrink-wrap comes off the software package or hardware box. This seems to have two advantages in the short term: minimizing costs and reducing the need for training. The problem with this approach is that the time is never right because another wave of innovation is always on its way.

Policing is undergoing a paradigm shift resembling the kind of change that Kuhn (1962) described three decades ago in his book *The Structure of Scientific Revolutions*. A paradigm shift is the idea that, from time to time, various realms of human endeavor experience dramatic—almost revolutionary—changes. Kuhn applied the term to changes in science, such as the transition in biology from thinking in terms of whole organisms to a molecular or genetic perspective. Although it is pretentious to put changes in crime mapping on the same level with major changes in natural science, it is realistic to use the notion of a paradigm shift to understand the nature of changes in the technology of policing.

It is easy to underestimate or overestimate the rate of change and the long-term impact of technological changes in policing—including crime mapping. While current and future advances promise to lend substantial support to law enforcement, we should remember that technologies such as crime mapping are only tools and, like other tools, their benefits to society depend on the human agents who wield them.

Summary

Chapter 6 has explained:

- What types of changes may be expected in crime mapping in the next decade.
- What geographic profiling is and how it can be useful.
- High-resolution GIS and how it can be applied.
- How complex statistical methods can be used in spatial forecasting.
- Why digital aerial photography is finding applications in crime mapping.
- How various kinds of data visualization can be productively integrated.
- How GIS and GPS can work together.
- How the World Wide Web may both increase and limit data access.
- Why we can expect continuing debate on public access to crime data and the results of crime analysis.
- What to expect in terms of applications of multimedia and integration technologies.

Notes

1. This interpretation and the accompanying map were provided by Det. Insp. D. Kim Rossmo of the Geographic Profiling Section, Vancouver Police Department, Vancouver, British Columbia, Canada.

2. According to a reviewer with profiling experience, however, profiling is an extremely specialized and expensive process demanding a skill level and financial commitment that few agencies can realistically afford, at least not with the currently available technology.

3. For more information on yellow pages and phone books on CD-ROM, see *http://www.phonedisc.com/*.

4. I am indebted to Dr. S.K. Lodha (University of California, Santa Cruz) and Dr. Armind Verma (Indiana University) for the maps and accompanying interpretation. The maps shown are from Lodha and Verma, 1999. Available online at *http://wcr.sonoma.edu/v1n2/lodha.html*.

5. See chapter 2 for additional explanation.

6. A square mile is 1,760 yards x 3 = 5,280 feet^2 or 27,878,400 square feet.

7. This pilot project was known as OPRA, for *O*rtho*p*hotographic *R*epresentation and *A*nalysis.