Fighting Crime in the Information Age
The Promise of Predictive Policing

William Bratton
Altegrity Security Consultants

John Morgan
National Institute of Justice

Sean Malinowski
Los Angeles Police Department

DRAFT[1]
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THE NEED FOR INNOVATION IN POLICING TODAY

Since the early 1990's, the homicide and property crime rates in New York City and Los Angeles have been reduced by well over 50%. Nationally, crime rates have declined by about 40%. Policing innovations like community policing and Compstat have contributed to this remarkable result, as have increased incarceration and demographic trends. Today, law enforcement has a new challenge: how can we continue to reduce crime, especially in our cities? We have reached the limits of the benefits we are likely to get from increased incarceration, especially given the heavy social and economic costs. Just as critically, the police professional is finding it more and more difficult to achieve additional crime reductions using the tools of the past fifteen years. Economic and social trends may create a gathering storm of crime, especially as the motivation to commit property crimes increases and law enforcement resources decrease.

In this environment, incremental crime reduction will rely on new innovations to quickly and effectively recognize and respond to crime patterns and trends. We also need to do a better job of identifying habitual offenders earlier in their criminal careers and intervening to promote desistance among them. Policing is a knowledge-based business, and smarter cops will be more effective cops. Technology can make us smarter in new ways, and we need to take advantage of that promise. Today, policing is being transformed by the introduction of a broad array of information technology, including data-enabled mobile devices, advanced information and sensor systems, databases, and forensic technologies. These technologies are changing police practice, often in unforeseen ways. It has always been expected that new technologies will make law enforcement safer and more efficient. Information age technologies are different, because they can make the officer smarter. The individual officer is getting better information about the individuals they encounter. The incident commander has improved situational awareness about resources, risks, and the local environment. The police chief can implement policies that reflect strategic knowledge about crime in their jurisdictions. Critically, the information can be used to forecast crime and permit intervention before it happens. The law enforcement professional can make and influence both tactical and strategic decisions based on foreknowledge about individuals, communities, economics, social trends, and much more. In short, we have entered an era of predictive policing.

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TECHNOLOGY AS A DRIVER OF INNOVATION

Over the last century, technology has driven and defined much of the innovation in society. Similarly, the impact of technology runs like a thread through the fabric of police practice. Through most of the 20th Century, police forces were governed by the "professional model" of policing, which was based on limiting corruption in departments, responding to incidents as quickly as possible, and conducting detailed investigations of major crimes. Police departments chose technologies that fit these needs, such as the police car equipped with a mobile radio that tied officers to central dispatch on a continuous basis. Fingerprints and other forensic technologies were developed to resolve crimes in a "scientific" manner that was considered beyond reproach.

In the latter part of the century, police patrol was fundamentally changed by the emergence of the handheld mobile radio, which enabled the officer to remain in contact with dispatch away from the police vehicle and thereby set the stage for the community policing revolution. Less lethal weapons, semi-automatic pistols, and lightweight body armor changed use-of-force and enabled officers to engage safely and more directly with suspects. In the last fifteen years, police forces have achieved major crime reductions through performance-based management based on systems like COMPSTAT, short for "computer statistics." COMPSTAT makes it possible to measure the performance of police managers and maintain accountability for the crime that occurs in their districts. The stunning success of performance-based management would not have been possible without the ability to record and track data in modern computer systems.

Police departments should adopt technologies that fit their strategic goals. Technology enables innovation, but it should not be the driver of strategy. For example, community engagement remains the critical foundation of any successful policing strategy. Today's technology can give police departments knowledge that enables community engagement and every other activity, including some that they may not have anticipated before.

Much of law enforcement's progress has been relied on seeing past the daily demands of dispatch and processing to see the big picture of crime in neighborhoods. Many years ago, the FBI's Uniform Crime Reports enabled police chiefs to look at crime numbers annually. Beginning in the 1990's, we could critically analyze crime data on a monthly, then weekly, then daily basis. Now, in the Los Angeles Police Department (LAPD), we have developed ways to get data several times a day for analysis and action, although we still face problems such as the access to useful analysis at the precinct level. The goal is to create easy-to-understand, actionable information for use by everyone in the department, especially the cops on the beat. LAPD is experimenting with alerts to patrol units based on their position. These alerts may relate to everything from outstanding warrants to last night's criminal activity. By streamlining mobile data entry and linking their information with the big picture in real time, patrol officers will be able to chase the radio less and focus their energies on critical problem-solving.

WHAT IS PREDICTIVE POLICING?

Innovative strategies like Compstat and community-oriented policing have revolutionized police practice in the last twenty years. Unlike previous generations of police managers, we have greater capability than ever before to use information to drive innovative strategies. We can consider a broader, deeper set of policing or criminal justice interventions because we can understand our environment better, even forecasting what is likely to happen in the future. The term, predictive policing, is therefore not meant to tie a police chief or anyone else to a particular strategy or cause us to abandon proven police techniques. Rather, police leaders need to be thinking about what's going to happen that may affect law enforcement and crime, what the implications are for their work, and how they may improve the future environment by acting today. The toolkit they may employ may involve any of the myriad strategies or interventions or innovations that are available to us.

What is critical is that police agencies develop and use good information and cutting-edge analysis to inform forward-thinking crime prevention. Predictive policing connects technology, management practices, real-time data analysis, problem-solving and information-led policing to lead to *results*—crime reduction, efficient police agencies, and modern and innovative policing. Just as Compstat and mapping technologies have enabled management accountability at the precinct level and below, advanced information tools now permit predictive policing and the proactive deployment of police resources to respond to crime trends as they occur or even before. Research suggests that changes in crime rates at the city level are driven by changes that are highly localized, perhaps even at the block or building level.[2] Good police chiefs have known this for many years. We can track crime at the block level and connect it to how police are managed through Compstat, or Comprehensive Computer Statistics, which incorporates intelligence, resource allocation, tactics, and follow-up.[3] Accountability is enforced typically at the precinct commander level, because that individual has tactical situational awareness, high levels of training and experience, and interaction with higher-level executives in a police department. In other words, the precinct commander intuitively knows which blocks or buildings are the problems in the local area and which police tactics will work best in those places. With this knowledge, the local commander can employ problem-oriented policing solutions tailored to the local community. Essentially, Compstat is an early information-age product, since it is dependent on real-time intelligence data and analysis about crime at the precinct level, something made possible by the advent of modern computer systems. A typical Compstat session will overlay geographic distributions of particular types of crime to inform tactical deployments in a precinct. However, what we call Compstat is itself undergoing radical change.[4] We now hear of police departments that identify a particular problem, like vehicle theft or drug activity, and decide that they want to "compstat it." They mean that they want to track the performance of their department against an outcome that is meaningful to their community and hold themselves accountable for the improvement of that outcome. Furthermore, this analysis should have a predictive element. Analysts can identify, track and correlate repeat or potential offenders, hot spots, victims and

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[2] Eck, John E. and David Weisburd. *Crime places in crime theory.* In Crime and Place, eds. John E. Eck and David Weisburd. Monsey, NY: Criminal Justice Press, 1995.

[3] V. E. Henry, *Compstat Paradigm: Management Accountability in Policing,* Business and the Public Sector, Looseleaf Law Publications, Inc., 2003.

[4] W. J. Bratton and S. W. Malinowski, *Police Performance Management in Practice: Taking COMPSTAT to the Next Level*, Policing, Vol. 2, No. 3, 2008, pp. 259-265.

witnesses, response times, patrol activity, and other variables. Advanced analysis can be based on intelligence gleaned from the community, incident reports, economic data such as housing foreclosures, and even weather reports. In this way, it is possible to predict where crime may increase next week or next month, thus enabling proactive deployment or other, fundamental crime prevention strategies. This is a major turning point for law enforcement and turns the old, reactive model of policing completely on its head. Now, we intend to be proactive, focusing on lead times and performance instead of response times and last year's crime rates. Further, we intend to use all of the tools at our disposal to anticipate criminal activity, including all elements from the city planning department and youth services to patrol and investigation, and everything in between.

PREDICTIVE POLICING AND OTHER POLICING MODELS

Policing in America has proven to be an extraordinary laboratory for experiments with innovative practices. There are those who have a tendency to apply labels to particular policing strategies, and that has led to a proliferation of so-called policing paradigms. The list includes problem-oriented policing, community-oriented policing, performance-based policing, evidence-based policing and professional model policing, as well as many others. Some models are related to predictive policing. In the 1980's, Jean-Paul Brodeur coined the term, "high policing" to refer to policing that involves domestic intelligence gathering or national-security-related activities.[5] In the United States, high policing is the responsibility of the Federal Bureau of Investigation, Secret Service, and many regional drug intelligence activities. Because these efforts are tied now to state and local policing through fusion centers and other activities, so we may expect that predictive analysis will play a big role in how police work together to respond to terrorism , organized crime, and similar threats. Intelligence-led policing has become a popular term since the terrorist attacks of September 11, 2001. Advocates of intelligence-led policing have established terrorism-focused fusion centers and information sharing standards.[6] More broadly, information-led policing encompasses the use of many forms of information by police, including mobile data terminals in police cars and sensor systems (e.g., gunshot detection systems).[7] Information-led policing and intelligence-led policing strategies each anticipate close connections between information analysts and law enforcement operations, which is a necessary part of predictive policing. Evidence-based policing encourages partnerships between police and researchers, but many evidence-based policing programs fail because departments don't have the information to inform interventions or track results. Thus, a predictive policing environment will provide fertile ground for evidence-based approaches to achieve broader success. Problem-oriented approaches are directly tied to predictive methods, because predictive methods permit the early identification of crime problems and development of critical solutions.

Often, one is left with the unfortunate impression that a police chief must choose a particular model to the exclusion of all others. So, the failure of a department may then be attributed to the poor decision of a police chief about the model of policing employed or inadequate execution of the model. In fact, no single model should be employed in any department in the

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[5] J. P. Brodeur, *High Policing and Low Policing, Remarks about the Policing of Political Activities*, Social Problems, Vol. 30, No. 5, 5 June 1983, pp. 507-520.

[6] David Carter and Jeremy Carter, *Intelligence-Led Policing: Conceptual and Functional Considerations for Public Policy*, Criminal Justice Policy Review, 2008.

[7] See http://www.it.ojp.gov/, the Global Justice Information Sharing program web site.

complex environment of real policing. Each department faces unique challenges that must be overcome for any improvement to occur. Also, no department could completely employ any individual strategy or intervention in its purest form, nor should it.

ELEMENTS OF PREDICTIVE POLICING

We suggest that predictive policing, while just a label like any other, is an important way to think about policing innovation and management. Predictive policing enables other strategies but is not a substitute for them. Nonetheless, there are specific elements of a successful predictive policing environment that can be recognized, regardless of the other methods that are employed.

- *Integrated information and operations*: Large police departments maintain dozens of databases. It is unusual to see these computer systems linked together to enable effective analysis. It is even more unlikely that other information sources, such as gunshot detection systems or dispatch systems, are linked into police analytical or fusion centers. Finally, police departments do not link their operations and information systems to other parts of the justice system or social services system. Thus, poor information sharing prevents good analysis and investigation. Even more troubling, poor information sharing can undermine efforts to intervene with individuals or neighborhoods to stop the cycle of violence. The best way to see the future and act appropriately is to have a complete picture of the current situation. Police must integrate their information and activities to enable situational awareness.
- *Seeing the Big Picture*: Few crimes are isolated incidents. Most crime is part of a larger pattern of criminal activity and social issues. This means that police need to be able to see these patterns in communities. Police need to use predictive intelligence to get out of the trap of day-to-day crisis control. Day-to-day activities dominate the time and energy of the police, despite reforms of the last thirty years. Response times to 911 calls and case clearance rates are used to measure performance, but these measures can be traps that prevent the police from acting effectively. Most of the emerging strategies of the last twenty years have been attempts to get law enforcement to broaden police work to see the big picture. For these interventions to work, it is necessary to build police organizations to use information to see the big picture patterns of what is going on around them.
- *Cutting-edge analysis and technology*: Police departments are information-rich but anlaysis-poor. Tomorrow's forward-thinking department must rely on good information that has been fully analyzed and disseminated. Good information comes from police reports, intelligence, sensors (e.g., license plate readers), forensic technology, and integrated information from multiple sources. To be useful, the information must be analyzed by police analysts with the proper tools and turned into usable products for the front-line officer. Predictive analysis may include tools that link people or activities, statistical techniques, geospatial tools, or visualization of complex interrelationships. With the advent of fusion centers, we now take for granted that we should use police intelligence to deal with terrorism. We should also use these kinds of resources to deal with domestic violence or identity theft, re-entry of parolees into communities, and other crime problems.
- *Linkage to performance*: Any modern police department should track police performance constantly. Predictive policing extends this concept to performance

targets and forecasting of crime trends. Thus, police departments can track performance against *expected* outcomes, as opposed to *past* outcomes. Although it is difficult to accurately predict crime trends, police departments can use the rich data at their disposal to make reasonable forecasts to move resources and adapt strategies. Even with minor improvements in such methods, police will be able to intercept bad trends before they become major threats to public safety.

- *Adaptability to changing conditions*: Police need to be trained, educated, and organized to be able to respond to the situational awareness that predictive policing can provide. It does no good to know that a particular set of individuals are likely to commit or be victims of homicide if the police and the criminal justice system are not equipped to intervene. Police need to recognize when they can use the many different strategies that may be used in different situations and be able to employ whichever is going to fit effectively. To do this, police departments must be able to attract a talented and educated work force, train them continuously, and enforce professional standards in keeping with national standards. This philosophy must extend all the way to the patrol officer, who must be able to execute difficult tasks based on highly sophisticated and targeted information analysis.

All of these elements are hallmarks of what we call "predictive policing." Of course, any of them can be associated with other ideas. We suggest that predictive policing is a useful construct that encompasses key activities and attitudes that are needed to do policing in the 21st Century. Further, we suggest that police do not implement these elements very effectively now. But we can achieve impressive gains in public safety and neighborhood development if we can effectively implement predictive policing.

POLICE IN THE INFORMATION AGE

In the business community, forecasting informs sales, inventory, marketing, research, and finances. Statisticians are projected (by statisticians of course) to be one of the fastest-growing occupations in the next ten years.[8] Every business from credit card companies to casinos use statistical forecasting to measure risk and invest their limited resources. For example, airlines and baseball teams maximize their revenue by adjusting ticket prices based on expected demand from their customers. In commerce, increased efficiency and a sense of urgency drive profits up. In crime fighting, we propose that more efficient and timely deployment of police resources drives crime down. Working more efficiently by leveraging predictive analytics frees up police officers to perform their primary function—catching bad guys. If we can use the information we already have to catch an individual after the second crime of an emerging crime spree, we may prevent the five or six other crimes he was going to commit had he been allowed to continue. Timely enforcement is in some ways more powerful than more punitive measures. We know, for example, that drug probationers will comply with drug treatment and be more likely to desist from illicit drug use if they are held accountable in a system that provides minor punishments but does so in a timely way, such as within hours of a violation.[9] In the same way, we propose that a predictive policing environment will improve the timeliness, suretyCERTAINTY and tempo of law enforcement and thus contribute to public safety without the need for increasingly punitive corrections

[8] New York Times, 8/6/2009.

[9] HOPE evaluation.

policies.

In some ways, police have a more complex task than other information-based professionals, because law enforcement must confront the most intractable social problems in our communities. Predictive tools should give us early warning about problems earlier in their evolution or perhaps even before they arise. In problem-oriented policing, we can use predictive analysis to prioritize neighborhoods, individuals, groups, and even strategies. We can predict criminal behavior from repeat offenders or help guide social services to at-risk youth. On a more strategic level, we can provide a forecast of the "crime temperature" for a city or even at the block level to guide deployment and other interventions. Like weather predictions, we know that the accuracy of these forecasts will vary. Nonetheless, weather forecasts allow us to plan our daily lives and account for potential disasters in a reasonable way. In the policing world, we can improve performance by measuring everything from crime reduction versus last year or last month to overtime, sick and injured on-duty time usage, morale, community satisfaction, misconduct, excessive force, officer safety, employee wellness, and a host of other measures. Regional Compstat measures and collaborative goal-setting and fulfillment among government agencies will become the new standard. An increasing ability to forecast potential performance problems in time to set up appropriate interventions will become the key to success in managing our response to crime and other problems in society. Computer technology will also likely be used to not only identify possible issues earlier, but also to recommend evidence-based interventions based on decision-support programs and functions that are self-healing and self-correcting. In this context, organizations must move to create an atmosphere and an ethos that encourages managers to make decisions based more on evidence than intuition.

EARLY EXAMPLES OF PREDICTIVE POLICING

LAPD and other departments are already implementing predictive policing in various forms. Like Richmond, LAPD is using advanced statistical analysis tools to drive deployments and operations, using business analytics as a model.[10] Also, LAPD's Gang and Narcotics Division and Criminal Gang Homicide Group are collecting spreadsheet-level data about shootings and gang activity. By focusing on projections and probabilities, they are denying violent gang members opportunities to commit violence and are saving lives. They leverage institutional knowledge, expertise and known facts about the variables, players, events and relationships to disrupt patterns of violence and retaliation assaults. Investigators have mapped out gang boundaries, key personnel and flashpoint events, like the gang anniversaries or "hood days." By pre-deploying police resources where and when violence is most likely to occur, gang units are thwarting the ability of violent gangs to quickly conduct retaliatory shootings. Ultimately, we want to link these data to all of the other gang, criminal and other information LAPD holds and provide the latest analytical horsepower to the data at the city's central crime center. We also want to use this information to tie the gang division's work with overall LAPD strategies and resources in community engagement and deployment. Arrests serve a role in prevention by taking the most violent and prolific offenders off the playing field, but they are no longer the sole focus. Nonetheless, we know that relatively few bad actors are responsible for the majority of crime and violence. This is especially true in gang circles where gang members are expected to "put their work in." So LAPD also uses analytics to assist us with

[10] C. Beck and C. McCue, Police Chief magazine, forthcoming.

investigations, quickly narrowing the field of inquiry to the most likely players using the facts of the case and supporting historical data.

As we stated in describing the elements of predictive policing, two critical factors in making this work are cutting edge technology and its integration with police operations. The Gang Homicide Group deserves access to the same kind of top-flight analysis we would give to a terrorism investigation. And they will made much more effective if their work is focused on key individuals and effective activities. We must enable close connections among information, analysis and operations, because these activities are not nearly as effective in isolation from one another.

The use of prediction to prevent crime does not stop at the door to the police station or with crime data. Some communities are now using these ideas at the city planning department, because it is possible to predict long-term crime patterns in a city based on new development or redevelopment. A police chief can use these tools to understand how the creation of additional housing or retail may increase the demand for patrol or 9-1-1 response or cause increases in crime. Crime is an economic problem too, so city leaders need to understand that they should invest in police resources at the same time they are encouraging economic development. A city manager can use predictive tools to modify plans to minimize the impact of crime, provide appropriate police resources, and maximize the long-term benefit to the city for economic development. In some cities, the recent mortgage crisis has transformed some new neighborhoods into crime-ridden blocks with high vacancy rates. If police and planners can predict the long-term crime consequences of development, then proactive crime prevention and response strategies can be used before these neighborhoods become problematic.[11] The community policing era has been characterized in large measure by the "broken windows" theory, which held that maintaining order on the street could limit general criminal activity and improve citizen confidence in neighborhoods.[12] In one of its manifestations, the predictive policing era may be characterized by idea of "gleaming windows," i.e., strategic planning to develop and redevelop good neighborhoods in ways that prevent disorder.

Many police innovators are using predictive techniques in many forms already. Chief Tom Casady in Nebraska is using geospatial tools to drive city planning and law enforcement operations.[13] Jeff Jonas has created non-obvious relationship analysis tools that are emerging in law enforcement use. Richard Berk's use of "random forest" statistical techniques to identify high-risk homicide perpetrators and victims.[14] Peter Bellmio teaches police executives about making strategic information connections to enable better response to child abduction cases. And there are many others, acolytes of a quiet revolution in policing.[15]

Crime prevention in the information age has several dimensions. Technology multiplies the

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[11] R. W. Greene, *GIS in Public Policy, Using Geographic Information for More Effective Government*, ESRI, Inc., 2000; and Chief Tom Casady (of Lincoln, Nebraska), whose blog details the use of geospatial information by Lincoln,

[12] James Q. Wilson and George L. Kelling. *BROKEN WINDOWS: The police and neighborhood safety*, Atlantic, March, 1982.

[13] See http://lpd304.blogspot.com/.

[14] Berk, R.A., Sherman, L., Barnes, G., Kurtz, E., and L. Ahlman, (2009). *Forecasting Murder within a Population of Probationers and Parolees: A High Stakes Application of Statistical Learning*. Journal of the Royal Statistical Society (Series A) 172, part 1: 191-211.

[15] NCMEC police chief training guide.

strategies available to law enforcement to prevent or displace crime. Properly used, these strategies are targeted to specific problems or individuals that the police know are a potential problem. In other words, they are a part of the strategic thinking that grows out of predictive policing. Let's look at three categories of such strategies: sensor systems, information sharing, and forensic identification. In each case, these technologies challenge us to rethink our assumptions about policing.

DEVELOPING SITUATIONAL AWARENESS

As noted above, predictive policing requires the *development* and use of information. Police agencies should not be passive receivers of whatever information is available. Rather, police need to understand what types of information are critical to improving their performance and develop strategies to go out and get that information. Predictive analysis and forward-thinking cannot be based on theories of what is happening in a city. Real situational awareness must be based on real data. The data comes from human sources and technology, such as license plate readers or other sensors. Police are very adept at human intelligence, and many departments collect databases of crime, incident, or suspicious activity reports, the challenge being to assimilate that information to get at the big picture.

Police departments are now deploying sensors of many types without a clear idea of the strategic importance of their information needs. These sensors include any technology that provides data about a place, person or object. The military and intelligence communities are very familiar with the use of sensors to track friends and foes or protect facilities. They use everything from tiny sensors to detect weapons of mass destruction to satellite sensors to direct air and navy assets and track threats. In law enforcement, we are beginning to understand the power of sensors to improve our situational awareness and do our job better. We have already alluded to the influence of police patrol on crime. Automated vehicle locator systems on police cars can provide a real-time view to police dispatch and improve tactical response. Personal locator sensors on first responders can help the incident commander deploy resources and ensure the safety of public safety personnel. Similar technologies on offenders, such as active GPS tracking systems, can monitor parolees and probationers in the field, prevent re-offending, and, for the non-violent offender, provide an effective alternative to incarceration. Camera systems have been used for red-light enforcement for over a decade in the United States. These systems have now been developed to the point at which they can be used to read license plates from police vehicles or roadside locations.[16]

In a predictive policing environment, we could use sensors locate stolen vehicles, do virtual police “pursuit” without high-speed chases, find vehicles linked to active crimes (such as in Amber Alert situations), and even find suspects in other crimes (through linkages between vehicle registration and wanted persons). In LAPD, we plan to link the data about the location of a police car to warrant and intelligence databases. Then, we can alert the patrol officer that a nearby home or business is a likely address for a key wanted suspect and give the officer a complete history, with picture, of the individual. Since all crime occurs in a time and place, tracking systems that locate individuals or assets in time and place should be central to any police deployment strategy.

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[16] S. Simon, *Denying the Road to Criminals*, Law Enforcement Technology, Vol. 31, No. 10, October 2004, pp. 170-5.

Video surveillance systems are another technology being used by police or private security everywhere these days. Used in transit systems, video surveillance is an effective tool for controlling theft and disorder. It is relevant to counter-terrorism, as well, although it has not proven to be an effective way to prevent a terrorist attack. Video surveillance has been used in public spaces, most notably in the United Kingdom, where an individual is likely to be photographed dozens of times during the normal course of their day. Unfortunately, these systems tend only to displace crime and use vast amounts of personnel time to monitor the video feeds. In the predictive policing model, any surveillance is integrated with other technologies and strategies to create public safety outcomes. That means that we extend video systems to include higher-resolution imaging of key locations to provide identification of individuals that is acceptable in court. It includes the use of smart video systems that recognize aberrant behavior in a location and alert those who are monitoring the system. We deployed this type of technology in Los Angeles on a limited basis with great success. Some credit the LAPD's ability to take back the once drug- and gang-ravaged MacArthur Park in part to the use of smart video systems utilizing software to recognize and alert police to certain types of behavior associated with assault, robbery and drug sales. When appropriate, we also can augment video with gunshot or concealed weapons detectors or facial recognition technology, and—of critical importance—tie these in with information systems, dispatch and risk analysis systems. Gunshot detection systems have become much more accurate, but police still may waste a lot of time chasing these signals and finding nothing at the scene unless the system is connected to other information available to police and combined into a real-time analysis framework. The main problem is that the system is not connected to all the other information available to police and not combined with real-time analysis. We seek to combine clean data with advanced analysis and pattern recognition to inform focused, risk-based decisions by law enforcement officers. Then, the technology will serve police instead of the other way around.

SMART DECISION-MAKING THROUGH PREDICTIVE ANALYSIS

Police can monitor a place to deter criminal activity. Again, this is an extension of the "broken windows" idea. We can make our cities safer by limiting social disorder through confident policing of low-level criminal offenses. Now, we can take that a step further by securing public places with sensors that deny the street to an identified criminal.[17] By targeting police activities to critical places, individuals and activities, we hope that predictive policing methods will improve the effectiveness of police while being less intrusive overall. In the interest of showing a police presence and improving public spaces, we have greatly increased the number of stops and arrests. Taken to its extreme, this leads to the old police "dragnet" of a neighborhood. Such tactics, while effective in the narrow sense, can detract from the long-term objective of a safe and just society. Predictive analytics may contribute to a different solution. Good information and analysis gives police the ability to target their operations much more on specific individuals or areas that really contribute to crime. We can maintain or even accelerate the pace and power of police operations while lowering the impact on the law-abiding citizens.

In some respects, criminal justice is an information-based industry. The development and

[17] Chris Miles citation

analysis of information forms the basis for policing, prosecution, and intervention strategies. Police executives focus on information flows to determine how to make themselves and their agencies more effective and efficient. In the era of predictive policing, the ability to use information effectively will be a critical asset for any successful chief. Especially with respect to terrorism, police chiefs believe information sharing and intelligence analysis must be improved, but the same issues apply to all criminal activity.

A child abduction is the most disturbing and serious crime faced by a police department.[18] It affects the entire community. To respond effectively, what does a police chief need to do? First, law enforcement must find out whether the case is a runaway, abduction by a non-custodial parent, a stranger abduction, or some other possibility. Then, the best ways to track down the child and identify the abductor must be established and put into place. Depending on the situation, any of hundreds of resources may be called upon by the police to resolve the case. Each action requires information that the responding police officer may not have. Some information, such as sex offender databases, will be available relatively easily. Other information may come from schools, social service agencies, transportation authorities, commercial databases, neighboring jurisdictions, or even from a sensor like a video surveillance system. Of course, the best information will come from human intelligence, e.g., interviews with witnesses. No police agency has seamless access to all of these resources, sometimes because of legal or bureaucratic barriers and sometimes because of technical or fiscal constraints. Very few police agencies have the ability to pull the information together and analyze it in real time to get useful answers to guide an investigation. Even fewer have the policies and procedures in place to use integrated information in such a proactive way. When a child abduction happens, minutes and seconds count, and it is too late to be trying to knock down barriers to information needed by law enforcement. Instead, the police chief must ensure that those information flows happen every day and inform every police interaction at every incident. In this way, the most serious incidents can be dealt with effectively, whether they be terrorist or other criminal activity, or even major natural disasters like Hurricane Katrina.[19]

In the military, the field commander uses information to establish situational awareness. The commander uses information to place resources where they will be most effective at solving or preventing problems, thus securing the battlefield. We do not have adequate tools for such situational awareness in law enforcement today. There are many reasons for this. Community policing was resisted because it was feared that police interaction with the public could lead to corruption. In a similar way, information sharing is resisted because of fears that it would compromise privacy or security. We cannot expect that national policy will change dramatically to permit a vast expansion of police authority to access individual information, but that is not necessary to enable effective predictive policing. Rather, police professionals must define in each case what information is important to protecting the public and dealing with offenders. Properly cast, we must argue that the offender's best interest is served by effective policing. Think of the missing child case. The vast majority of those cases involve troubled youth who have had many interactions with law enforcement and public

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[18] See, for example, *Missing and Exploited Children CEO Course*, National Center for Missing and Exploited Children, for information and training tools designed to improve proactive information sharing and coordination concerning runaway, parent and stranger abduction, and other missing children cases.

[19] Ben Ermini, *Communications: Hurricanes Katrina and Rita Missing Persons Hotline: Harnessing Technology to Reunite Families*, Police Chief, Vol. 73, No. 3, March 2006.

services. We fail both society and that young individual when we fail to have a full awareness of that person's situation so we can take appropriate action to prevent future criminal activity. With full information, police and other criminal justice professionals can be confident about intervention and resources and actions. This attitude is at the heart of the future of predictive policing. We can do a much better job of predicting future offending by an individual. Therefore, we have an obligation to ensure that information flows and analysis permit confident policing focused on those individuals.

POLICE ANALYTICS

Of course, we cannot lose sight of the fact that police must solve crime and enforce the law. A comparison with the federal intelligence agencies is instructive. The Director of National Intelligence has enormous resources to protect national security, including electronic surveillance, open-source intelligence, and incredibly sophisticated analysis. Unfortunately, human intelligence can be quite limited for some key problems, particularly with regard to terrorism. Police have the opposite problem. State and local law enforcement agencies have human intelligence that would be the envy of any federal intelligence agency. This intelligence is gathered by patrol officers, investigators, community policing units, and others. Unfortunately, we don't have access to the analytical resources available to the intelligence community. Fusion centers and drug intelligence centers have attempted to fill this void, but they are generally separated from most of the hard and soft information gathered during routine police work. Usually, the most effective data fusion and analysis is done by the individual officer based on the limited information available to him or her and their intuition and knowledge of their area of responsibility. There will never be a substitute for that kind of work. Nonetheless, advanced intelligence can provide information the individual officer simply can't produce.[20] We have already described strategic uses, such as organizational accountability and city planning. On a tactical level, the benefits are just as great. Existing law enforcement information sources can be used to discover non-obvious relationships among offenders or gangs, fuse sensor information with incidents, drive patrol deployments on a daily or even hourly basis, find stolen goods, identify suspects, prioritize leads, and just plain solve crimes.[21] In the United States, this approach is needed more than in other countries, because of the diffuse nature of our public safety community. When over 18,000 independent police agencies must work together, while criminals cross jurisdictional boundaries easily, information sharing and analysis must be constant and intense.

Predictive policing requires an attitude of information sharing right down to the individual officer. We have seen a major improvement in the last twenty years in the education and professionalism of law enforcement executives. That trend has also affected the rank and file. Going forward, police recruitment must focus on people with advanced skills to use information technology and interact with their colleagues and the public in an informed way. Every chief wants a special operations unit filled with highly-trained, physically fit men and women who can engage any person in a use of force when needed. In the same way, every agency needs patrol and investigations officers who collect, process, and act on information in a sophisticated, cooperative way that reflects that we live in an information age. It is possible that recruitment will be easier when young people of this sort are more attracted to

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[20] Malcolm Sparrow paper for Harvard policing session, "Heron City"

[21] See the Jeff Jonas blog, which covers his non-obvious relationship analysis work and other predictive analysis issues, at http://jeffjonas.typepad.com/.

policing.

PREDICTION USING FORENSIC TECHNOLOGIES

One cohort of such individuals are already creating a new kind of police work inside forensic units. The so-called “CSI Effect” has become a trite byword among many in the criminal justice field to represent unreasonable jury expectations demanding sophisticated forensic evidence in every case. Of course, in many cases, such evidence is not available. Juries are not demanding this evidence just because of television shows. In fact, they realize that scientific evidence is inherently more powerful and objective than traditional police investigation techniques. Many false convictions have now come to light as a result of incorrect eyewitness identification, reliance on outdated forensic techniques, and poor investigation and prosecution. DNA technology has not only cleared many of these wrongly convicted individuals, but it has also identified thousands of violent offenders. So, police can place an individual at a crime scene even if the only living witness is the criminal himself.

As an investigative breakthrough, such an advance has been greatly underestimated. Its power as a crime prevention tool is why forensic science is an integral part of the new predictive policing era. First, we can now link one individual to many crime scenes and even indict them as a John Doe based on their DNA profile, even when we don't know their name. We can improve burglary clearance rates dramatically using this technology, linking multiple burglaries to a single individual. In turn, we now know that most cold hits on murders and sexual assaults are from offenders with a previous history of only a burglary conviction, so catching a burglar will prevent the offender from committing even more serious crimes. Linking these methods to Compstat (as in New York City) and other accountability measures can make forensic results a key part of successful policing. We can expect other forensic methods to catch up to DNA in sophistication in coming years. New fingerprint methods, ballistic identification, and digital evidence are just a few examples. Since criminals live in the information age too, the exploitation of digital evidence is one of the cornerstones of effective policing in the new era. We suggest that forensic technology should be used as a predictive analysis tool, i.e., that we no longer apply forensics at the back end of individual cases to “prove” that a suspect is guilty. Rather, we should use these technologies to solve cases on the front end and establish patterns of criminal activity that can be linked to other information. Forensic information can add to our situational awareness, just like other sources of information like incidents or sensors.

Interestingly, the profile of the forensic scientist has already transformed a great deal as a result of the DNA revolution. New practitioners tend to be more highly educated and their education reflects deep technical and scientific knowledge. They are much more likely to be female, still a rarity in most police departments. Silently, they have become the first practitioners of the predictive policing model. They solve crime using advanced information analysis to identify individual criminals. They link multiple crimes together across jurisdictional boundaries using interoperable databases. They constantly improve their practice through the adoption of new technology and techniques. In short, they are great examples of information age, predictive policing.

PREDICTIVE POLICING AND THE POLICE PROFESSIONAL

To be successful, we must find ways to adapt that model to a variety of policing disciplines. Innovative attitudes and policies must extend from the officer to the sergeant to the chief and beyond. That is especially so because today's technology may not work in tomorrow's world, so the police must constantly adapt. We must have access to the latest technology, whether it is adapted from other fields, such as the military or commercial sectors, or developed especially for law enforcement purposes. Further, we must have the ability to evaluate technology and police practice to choose the most effective tools on an ongoing basis. There is little investment in that kind of research and evaluation for law enforcement right now, especially compared to other fields facing similar challenges, such as public health.

In the predictive policing era, we must have a much more robust resource to drive innovation and help cutting-edge police leaders experiment with new tools and methods. The police chief and the public may reasonably ask the extent to which these technologies offer useful alternatives to current practice, i.e., just how innovative are these tools in real practice? This question encompasses several considerations. First, what is the criminal justice benefit of a particular technology? Many tools, like other criminal justice practices, are of extremely limited utility or may even detract from good practice. Police leaders must often make decisions about the adoption of innovative practices without good information about effectiveness or appropriate policies for use. Less-lethal technologies provide an excellent case study opportunity in this regard. A conducted energy device may save a life when used as an alternative to lethal force. When used against a passively resisting individual, any less lethal weapon may unnecessarily raise the risk of death or injury while short-circuiting the use of more nuanced policing methods. So, even a well-engineered and “safe” tool may detract from the effectiveness of the police officer.

Also, the community may ask whether the benefit to effective law enforcement is achieved at a cost to the safety and civil rights of the public. Intelligence and surveillance tools have raised the most visible concerns as a result of their application to counter-terrorism efforts. Some of the most powerful tools available to law enforcement raise these concerns, such as advanced forensic technologies, closed-circuit television systems linked to facial recognition databases, and license plate recognition systems used for red-light, speeding enforcement or stolen vehicle detection. There are a variety of technologies that can be used to prevent crime by denying easy access to public spaces by criminals. All of these systems can be used in ways that could infringe on the privacy of the public-at-large, and the central consideration in their use is whether the criminal justice benefit is compelling enough to justify that intrusion. To some extent, the successful adoption of any law enforcement technology is dependent on the effective demonstration and communication of the public safety benefit to the community. Further, for the most intrusive technologies, it is necessary to deploy them in such a way to minimize the intrusion necessary to achieve the desired impact. DNA technology is a powerful criminal justice tool, but its use in practice was greatly enabled by the development of short-tandem-repeat markers that do not reveal race, medical conditions or other information about an individual. These markers provide law enforcement with the ability to identify an individual from biological evidence but do not invade the privacy of anyone whose DNA is analyzed any more than necessary to achieve that result. Advocates for certain intelligence methods and interrogation tactics have failed to demonstrate that their methods are the least intrusive way to achieve the impact they seek. In many cases, in fact, it is

impossible to demonstrate any impact at all. In this regard, these methods are not much different from criminal justice practices outside the technological realm, such as boot camps and stringent crack cocaine sentencing guidelines that have failed to demonstrate a positive impact while raising cost and civil liberty concerns.

USING PREDICTIVE POLICING TO SERVE AND PROTECT

Although we have made impressive gains against crime over the last decade-and-a-half, we still face unacceptable levels in our country. Crime and social disorder continue to threaten the civil life of many of our cities and neighborhoods. We must not believe that we can rest on the successes of community policing and "broken windows" policing. The challenges of crime in a free society in the information age make the job harder every day. Criminals use new methods and technologies. Police must adapt to this new environment and take advantage of new methods and technologies. We now can work smarter than we thought possible even ten or twenty years ago. We can use powerful tools to deploy our resources to prevent crime and identify offenders. We can play a central role in making communities safer and more vibrant. We can use our new tools to direct our resources to helping those at risk. We can help each police officer tailor decisions to the demands of each situation. In the end, we will measure our success not just by crime reduction. If we truly succeed, we will also witness an improvement in the human side of policing. Predictive policing can help us understand our communities better and make us better partners to the people we serve and protect.