Predictive Policing: What It Is, What It Isn’t, and Where It Can Be Useful

John S. Hollywood, Susan C. Smith, Carter Price, Brian McInnis, Walt Perry

NLECTC Information and Geospatial Technologies Center of Excellence
RAND Corporation, Arlington, VA

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Bottom Line Up Front

- **What it is:** using computer models, supported by prior crime and environmental data, to anticipate risks of crime and inform actions to prevent crime.

- **What it isn’t:** Minority Report, a crystal ball, ESP, a revolution that will change everything, etc.
  - If you are doing crime mapping you are already doing a basic form of predictive policing.

- **Where it can be useful:** to find smarter ways to deploy resources and find and fix problems leading to crime
  - Does require a commitment to “taking actions to prevent crime”
Outline

1. Introducing predictive policing
2. Methods to make predictions revealed
3. Problems with predictions
4. Taking action on predictions
5. Review
The Big Picture

• Universities and technology companies
  – Developing computer programs based on private sector models of forecasting consumer behavior

• Police agencies
  – Use computer analysis of information (crimes, environment, intelligence)
  – “Predict” and prevent crime

• The idea
  – Improve situational awareness (tactically /strategically) to create strategies to police more efficiently and effectively
How Does It Work In Real Life?

• With situational awareness and anticipation of human behavior, police can identify and develop strategies to prevent criminal activity
  – By repeat offenders
  – On repeat victims
  – By locations or types of targets

• Police use their limited resources
  – To work proactively
  – Using effective strategies to prevent the activity
  – BUT - The effectiveness of the strategies must be measureable
    • Reduced crime
    • Higher arrest rates for serious/stranger offenses
    • Broader social and justice outcomes and impacts
Predictive Policing Process

- Data collection
- Analysis
- Police operations
- Criminal response

Altered Environment → Data → Prediction → Intervention
A Private Sector Example

- **Predictive analytics** is used by businesses to determine sales strategies
  - Example: Wal-Mart analyzes weather patterns to determine what it stocks in stores
  - They overstocks duct tape, bottled water and strawberry Pop-Tarts before major weather events
  - The Pop-Tarts* represent a “non-obvious relationship”

- There are many of these relationships in law enforcement that can be explored with predictive policing

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*For example: Olivia Katrandjian, “Hurricane Irene: Pop-Tarts Top List of Hurricane Purchases”, abcnews.com, August 27, 2011*
What Kinds of Questions Might We Answer?

Where

Larger areas

Linked crime series

Related crimes

Most activity in this quadrant

Crime hot spots

Immediate crime threats

Problem locations

Crime rates for neighborhoods & precincts

Who

Persons linked to crime scenes

Likely perpetrators

Most likely offenders

Most likely violent conflicts

Preemptive (Future)

Farther future

Larger groups

Impacts of changes to neighborhoods

Investigative (Past)

Farther past

Larger areas
Who Is Interested In It?

- **Researchers** – Have the background and expertise to design predictive model
- **Civil Rights Activists** – Have concerns of these techniques intruding on the rights of citizens, especially the poor and minorities
- **Practitioners (Analysts)** – Have a professional interest on how this can make their work better / more useful
- **Police Chiefs** – Eager to find new techniques to reduce crime
- **The U.S. Government** – New forum for funding, research, literature, and evaluation
- **The Private Sector** – Sees potential for funding of research grants, consulting and software development
What the U.S. Government Says

• **First Predictive Policing Symposium**
  – Held in Los Angeles, November, 2009
    • Sponsored by NIJ and BJA
    • By Invitations Only (100+/-)
      – Police Chiefs, Researchers, Government, Analysts
    • Explored Policy Implications, Privacy Issues and Technical Elements

• **Second Predictive Policing Symposium**
  – Held in Providence, RI, June, 2010
    • Sponsored by NIJ and BJA
    • By Invitations Only (150+/-)
      – Police Chiefs, Researchers, Government, Analysts
      – Agencies with grants to implement/evaluate provided progress reports

A Theoretical Motivation (1)

• "The naysayers want you to believe that humans are too complex and too random — that this sort of math can't be done," said Jeff Brantingham, a UCLA anthropologist who is helping to supervise the university's predictive policing project [for LAPD, NIJ funded]. "But humans are not nearly as random as we think," he said. "In a sense, crime is just a physical process, and if you can explain how offenders move and how they mix with their victims, you can understand an incredible amount."

• Above supported by Routine Activities Theory, Rational Choice, Crime Pattern Theory** and the brand new Blended Theory, which is new as of this presentation

** For descriptions, see, for example, Ronald Clarke and Marcus Felson (eds.), Routine Activity and Rational Choice, New Brunswick, NJ: Transaction Publishers, 2003
A Theoretical Motivation (2) – A —Bladed Theory”

• Criminals and victims follow common life patterns; where those patterns overlap can lead to crimes
  – Geographic and temporal features influence the where and when of those patterns
• Criminals make —rational” decisions using factors such as area & target suitability, risk of getting caught, etc.
• Can ID many of these patterns and factors; can steer criminals’ decisions through interventions
• Best fits —stranger offenses” like robberies, burglaries, and thefts – less so vice and relationship violence
Methods Revealed: A Quick Guide to Ways to Finding High-Risk Locations

Predictions based on prior crimes: *Hot spot methods*

- Add crimes just committed: *Near repeat methods*
- Add other crimes, disorder, suspicious activity, environmental factors, etc.: *Regression and data mining methods*
- Add proximity to crime attractors and diverters: *Risk terrain modeling*
- Add changes over time: *Spatiotemporal methods*

Can combine these methods, as well

Understanding the *mathematics* of these methods usually requires specialized knowledge. Understanding the *ideas behind them* do not.
Hot Spot Analyses / Crime Mapping

Elliptical Methods

- Find oval-shaped areas with the greatest numbers of crimes

Kernel Density Estimation

- "Averages out" crimes; flags areas with the greatest crime density

Implicit *prediction* – areas recently seeing high crime will have high crime in the future

Near Repeat Methods

• **Key assumption of hot spot methods**: areas recently seeing higher levels of crime will see higher crime in the future

• Take the same idea and shrink it to micro-place and micro-time levels
  – If there’s just been a crime, the risk of crime is increased for a short distance away, for a short time
  – Strong effects for burglaries – less for other types of crime

• Examples include self-exciting point process methods* used by Santa Cruz and Los Angeles (which have seen heavy media coverage) and the NIJ-funded *Near Repeat Calculator**

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Regression and Other Data Mining Methods

- Hot spot and near repeat methods estimate future crimes based on recent histories for that single type of crime
  - \([\text{Future crime}] \sim f[\text{past crime}]\)
- Regression and other data mining methods estimate future crimes based on recent crime histories plus many other factors that might help explain crime
  - \([\text{Future crime}] \sim f[\text{past crime, past other types of crime, past reports of disorder, past suspicious activity, demographics, economics, weather, etc.}]\)
Regression Example (from Forthcoming NIJ-Sponsored Research)

• Map shows robbery risk predictions from a regression model
  – Robbery risk as a function of prior crimes plus disorderly and suspicious activity calls

• Found corridors and landmarks associated with greater risk
—Risk Terrain Modeling” Family of Methods

• Identify types of locations associated with higher crime and predict future crime risk based on nearness to those locations

• **Example:** Find that robberies occur near —main streets” and —bars”; color areas near —main streets” and “bars” as higher-risk

Source: Paul Joyal, NSI, —Recent History of Policing” Presentation to the NIJ Technology Working Group on Modeling and Simulation, Arlington, VA, April 2011
Using Time: Temporal and Spatiotemporal Methods

- **Insight:** crime patterns can change over time
  - Day/night cycles
  - Weekend vs. weekday
  - Paydays, sporting events, concerts
  - Time of year
- Can create simple models to account for these changes
  - *Example:* to predict where crime will be on paydays, look at where crime has been on paydays historically
- Other methods predict changes in crime levels given recent trends ("time series analyses")
More Methods: From Hot Places to Hot People

- **Geographic profiling** uses crime positions to identify the anchor sites for serial criminals
  - Assumes we have linked crimes – are models for doing this based on statistical similarity
  - Can then overlay with lists of addresses / anchor points of prior offenders
  - GPS tracking may take this to another level – “who was near this crime scene?”

- **Models to assess risk of reoffending**: can identify persons coming out of jails and prisons who are most likely to reoffend in various ways using regression and other data mining models
So, What Are Some Pitfalls?

- Consider this example...

  - Goal is to be as accurate as possible in predicting purse snatchings
  - E.g., have 99%+ of future purse snatchings (green triangles), land in ―hot spots‖ (red and yellow areas)

What Output is Actionable? Do We Need to Trade Off “Accuracy” and Usefulness?

Note the large proportion of DC colored as “red”

Is the Data Complete and Correct?

Why aren’t there any purse snatchings on the National Mall or Capitol Hill?

Do We Understand the Causes?

Predicting Purse Snatchings in the Summer of 2008

Why is this area highlighted?

Predicted Events

What About Civil and Privacy Rights?

- Supreme Court has ruled that standards for what constitutes reasonable suspicion are relaxed in ―high crime areas‖ (e.g., hot spots)
  - What constitutes a high crime area is a completely open question
- Issue minor in comparison to civil and privacy rights issues raised by identifying ―hot people‖
  - What do we do with a prediction of re-offending that, while much better than chance (~80% accurate), is still far from definitive?
—The arrests were routine. Two women were taken into custody after they were discovered peering into cars in a downtown parking garage in Santa Cruz, Calif. One woman was found to have outstanding warrants; the other was carrying illegal drugs.

But the presence of the police officers in the garage that Friday afternoon in July was anything but ordinary: *They were directed to the parking structure by a computer program that had predicted that car burglaries were especially likely there that day.* (emphasis added)

The program is part of an unusual experiment by the Santa Cruz Police Department in predictive policing — deploying officers in places where crimes are likely to occur in the future.”

Reality of Predictions

• Recall that Santa Cruz’s model includes a ―Near Repeat‖ component — the computer sent the officers there because there had recently been crimes there
  – Very useful, but much less exciting

• A typical prediction might be that a given area will see an average of 0.2 robberies per month
  – Obviously, will not actually see 0.2 robberies
  – Instead, will see long stretches of no robberies interspersed with spikes, with the spikes coming largely at random

*He who lives by the crystal ball soon learns to eat ground glass.*
- Edgar R. Fiedler
Taking Action on Predictions

• Most of the focus on predictive policing tends to be on the predictions

• Much less has been written on the policing – the specific interventions done to act on the predictions

• Three levels of interventions—
  – Generic: putting more resources into areas (and times) at increased risk
  – Crime-specific: assigning those resources to carry out interventions tailored to combating the expected types of crime
  – Problem-specific: Identifying specific problems generating crime risk and fixing them

_Hypothesis:_ Crime- and problem-specific interventions require more analysis, but will be better targeted and hence more effective
Examples have included foot patrols, vehicle patrols (marked / unmarked), and checkpoints.

There appear to be “Goldilocks” conditions on getting best results from the special deployments:

- Size of patrol needs be balanced. Too large – effect diluted; too small – units are overly constrained.
- Time-wise, “Koper curve”* suggests being in one area for 13-15 minutes has the maximum deterrent effect.

Increased contacts and field reports during deployments have been reported to be useful:

- Focus is on getting information about criminal activity in the area and describing how to report suspicious activity.

Crime-Specific Interventions

• Analysts now generate recommendations to assign resources to an area to carry out specified interventions to combat those types of crimes seeing increased risk
  – A significant change to business practices for crime analysis

• Interventions can be selected from problem-oriented policing guides
  – Center for Problem-Oriented Policing’s web site at http://www.popcenter.org/
  – Also see the Office of Justice Programs' summaries of interventions and evaluations at http://www.crimesolutions.gov/
Problem-Specific Interventions

- What to do to take action on hot spots is highly dependent on the specific crime problems.
- Analysts can dive into the data supporting predictive policing forecasts to determine what the specific problems are.
- Can do this by looking at maps, overhead photos, and narrative descriptions of hot spots and the crimes within them, looking for common themes.
Two Examples*

• Clerkenwell, England – identified hotspots for "vehicle theft"
  – After examining photos from crime sites, determined the big problem was stealing scooters and motorcycles from racks outside a few establishments

• Chula Vista, CA – identified hot spots for store robberies
  – "Hot spots” were fairly spread out, so additional site characteristics were considered
  – Found that the big problem was targeting of a specific chain of convenience stores

Solving Specific Problems (Cont’d)

• If forecasts can be associated with specific problems, departments can tailor specific strategies

• Examples—
  – Working with specific sites identified as high-risk to improve their security measures
  – Working with neighborhood groups on neighborhood watch / reporting efforts
  – Working with city agencies and neighborhood groups to prevent, or at least maintain, foreclosures

Documentation for these interventions is a shortfall – if you can describe a promising intervention for acting on predictions in detail, we would like to hear from you
Review

• *Predictive policing* is using computer models, supported by prior crime and environmental data, to *anticipate risks of crime* and *inform actions to prevent crime*
  – For the “predictions”, numerous models and applications have been developed
  – However, the part in italics is often overlooked
• Very promising – but it is not *Minority Report* or a crystal ball
  – Be wary of pitfalls – data correctness, forecasting accuracy v. utility, meaning, etc.
  – For those already doing crime mapping and analysis, predictive policing is an incremental improvement
• *Key need*: best approaches to act on the predictions
Questions?

Contact:

• John Hollywood, johnsh@rand.org
• Susan Smith, ssmith@rand.org