Predictive policing and the role of analysis:
A framework for effective resource targeting

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From tackling street drinking in Wolverhampton (UK) …
… to predicting crime in Wellington (New Zealand)

Analysis forums identified up to 45% of burglary could be predicted. Prevention Managers Masterclasses focused on how it could be prevented.
From hotspot policing (Rhyl, Wales) to pacification (Rio, Brazil) …
Outline

• The role of analysis in policing
  – Contemporary policing: intelligence-led policing, problem-oriented policing, and evidence-based policing
  – The analytical function

• The Crime Prediction Framework
  – The *future*: immediate, near and distant
  – Aligning predictions to service responses
  – Data and analysis techniques for predicting crime must be sensitive to the spatial-temporal patterns of crime

• Introduce a methodical framework for predicting crime and how this should then inform how you go about responding to crime
  – Emphasising the value of an analytical approach
What is intelligence-led policing?

• Using intelligence to inform police decision-making
  – Rather than a purely responsive police strategy
    Example: tackling problem of repeat offenders (using intelligence) rather than responding to offenders

• Systematic analysis (intelligence products) to identify patterns
  – People: offenders and victims
  – Places: locations, buildings, facilities

• Involves information sharing and collaborative work with partner agencies
The UK intelligence production process

12 month intelligence development cycle

Plan/Control Strategy

**Strategic Assessment** → Action against strategic priorities with new issues being considered if escalated from Tactical Assessments → **Strategic Assessment**

**Tactical Assessments:** monitoring performance, identifying emerging issues, tasking/co-ordinating actions

**Target Profiles:** intel on individuals or groups

**Problem Profiles:** analysis that adds new intel by understanding and explaining the problems it considers

Spencer Chainey
UCL Jill Dando Institute of Crime Science
What is problem-oriented policing?

• Understanding the problem, dealing with its causes, rather than just reacting to individual events
• Being *crime specific* – breaking the problem apart
• Influencing decision-making with good analysis
• Recognising the importance of the immediate situation, temptations and opportunities in determining offending behaviour and vulnerability
• Thinking through how a given response will work
  – Measuring response impact
Problem-oriented policing
Tackling alcohol related violence in Cardiff
What is evidence-based policing?

- To determine *what works*
  - **Generate evidence**: conduct empirical research that involves robust evaluations of police activity
  - **Use evidence**: use of robust scientific evidence on the outcomes of police work to guide police activity

Specific crime problems (e.g., burglary)
Improving practices (e.g., hotspot policing)
Improving programmes (e.g., Neighbourhood Watch)
Improving policies (e.g., offender rehabilitation)

Targeted foot patrols reduced violent crime by 23%
Evidence-based policing ...

But to apply *what works*, need to know:

1. How it works (conceived, implemented, and sustained)
   - Sheds light on why it worked for them, and may not work for you!

2. What’s our problem?
   - Understand your problem (i.e., good analysis)
     • Translate ‘what works’ to your context
     • Understand what is likely to work (particularly if there is limited evidence-base)

Philadelphia Foot Patrol Experiment

• Patrols: 5 days a week, 16 hours per day, over 22 weeks, 15-20 mins per hour spent in hotspots during problem
• Officer boredom (standing still, not much to do …)
• Violence returned to previous levels within 3 months
The relationship between ILP, EBP, and POP

**Intelligence-led Policing**

- Helps inform decision-making

**Problem-oriented Policing**

- Scanning Analysis Response Assessment
- Understand the problem
- The outcome
- Helps inform what works

**Evidence-based Policing**

- Part of SA should involve research into what works
- Assessment of response informs what works
The role of analysis … (1 of 3)

• What is going on? What is likely to happen in the future? Involves a set of systematic processes that aim to identify and interpret patterns and correlations between crime data and other relevant information sources.

• What can we do to tackle it? For the purpose of supporting decision-making that informs and prioritises the design and allocation of police activity and crime prevention responses.
The role of analysis … (2 of 3)

Also …

• Supporting the **best use of limited resources** available for tackling crime and improving public safety

• Providing an **objective** means of identifying and understanding crime problems

• Taking advantage of the volumes of **information** that are collected by the police and other agencies
The role of analysis … (3 of 3)

• Crime analysis endeavours to provide the “right information … to the right people at the right time” (Fletcher, 2000)

• “Analysts should not simply provide management with statistics and colourful charts but a real understanding of criminal activity and the direction in tackling it” UK Criminal Intelligence Strategy Group

The role of the analyst
Each role overlaps and complements the others

• Reviewing performance and outcomes
  – Performance reports, evaluations
  – Live performance meeting e.g. CompStat

• Informing operational police tactics
  – E.g. targeting of police patrols

• Informing crime prevention initiatives
  – E.g. Problem solving analysis

• Supporting an investigation
  – E.g. serial crime investigation, cell phone analysis

• Products and techniques: target profile analysis, problem profile, network analysis (i.e. offender associations) …
Reviewing performance/directing new actions
Transport for London/British Transport Police CompStat – the analysts role
The role of analysis

Intelligence:
Analysis of information:
- crime records
- calls for service
- patrols (incl stop/search)
- covert surveillance
- offender interviews
- informants
- site visits
- public engagement
- socio-demo data
- partner data ...

Intelligence product: fundamental component to intel-led policing, facilitating decision-making framework

Response opportunities:
- Investigation/detection
- Deterrence
- Disruption and diversion
- Treatment and support
- Victimisation/risk/harm reduction
- Reassurance
- Public confidence
- Community engagement

Hotspot policing, Operation Ceasefire (tackling gangs), CCTV, Neighbourhood Watch, Scared Straight, CPTED (crime prevention through environmental design), restorative justice, and predictive policing all types of interventions and strategies.

Ratcliffe’s 3i Model

Criminal Environment

Analysis Unit

Decision-Maker

Interpret

Impact

influence

who what when where why how
Good policing and effective crime reduction
Involves three types of service response …

1. Immediate, operational response: for example, targeting of police resources on the next patrol shift
Good policing and effective crime reduction involves three types of service response …

2. Medium-term, situational response: for example, working with other local agencies to address opportunities for committing crime.

Tackling violent crime associated with night-time economy in Northampton

Reducing motorbike theft in London
Good policing and effective crime reduction
Involves three types of service response …

3. Long-term, strategic response: for example, addressing endemic causes through regeneration schemes and changes in policy

Before: chaotic, insecure storage, high theft

Marylebone Station

After: organised storage, more secure, low theft
Predictive policing is not a short cut for good policing and effective crime reduction.
A year of crime in Newcastle (October 2013 to September 2014, n = 24,259)

• How many of these crimes could have been predicted?
• How would they have been prevented?
A day of crime in Newcastle, England (1 October 2013) (n = 85)

- How many of these crimes could have been predicted?
- How would they have been prevented?
Spatial crime prediction – the research
Seven year research study into spatial prediction of crime

• Rigorous statistical methods for measuring prediction performance
  – Accuracy concentration curves (ROC curves)
  – Crime Prediction Index (area under the curve)
• Prediction performance of hotspot analysis techniques
  – Spatial ellipses, choropleth mapping, kernel density estimation and the Gi* statistic
• Temporal stability of hotspots
• Extent to which recent crime informs future crime
• Extent to which spatial regression analysis can inform predictions of crime
• Within the context of 20 years of practical experience of policing and public safety
An analogy: weather forecasting

• Forecasting the next few days
  – Data: recent weather best predictor of the immediate future
  – Forecasting technique that draws on current known patterns of weather e.g., movement of weather fronts, rainfall radar, movement of high pressure systems
An analogy: weather forecasting

• Forecasting the next week/month
  – Data: recent and seasonal trends
  – Forecasting technique: models that combine recent weather patterns with upper atmosphere weather movements, and seasonal patterns
An analogy: weather forecasting

- Forecasting the next few years
  - Data: climate trends, cyclical events (e.g., El Nino), sea temperature, greenhouse gases
  - Forecasting technique: models that examine the relationship between variables that influence changes in climate
Predictive mapping techniques and data

• Shows where … but weaker in informing when, and why, and what to do when there?
• **Data:** little consideration given to different influence that different data has on predicting crime
• **Interpretation - explaining why:** if spatial predictions of crime are to be made with confidence, the prediction must be based on clear theoretical principles
  – Which in turn informs the type of response
    Analysis provides the interpretation
    Computer generated output only offers description
• **The future:** lack of consideration given to what is meant by *the future* – the next few hours, days, weeks …?
Predictions aligned to service responses

<table>
<thead>
<tr>
<th>Police/Law Enforcement</th>
<th>Crime prevention initiatives</th>
<th>Strategies and changes in policy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immediate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appears random</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Near</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotspots</td>
<td></td>
<td></td>
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<tr>
<td><strong>Distant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent hotspots</td>
<td></td>
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</tbody>
</table>

Hotspots appear random, forming hotspots in the near future, and leading to persistent hotspots in the distant future.
Predicting the immediate future
The Crime Prediction Framework

Patterns that predict:
- Repeats and near repeats

Theory that explains the prediction:
- Foraging
- Boost

Responses: Law enforcement

Past | Now | Future
Predicting the immediate future
Identifying immediate risk using repeat and near repeat patterns

• Repeat victimisation:
  Heightened risk (and temporal decay of this risk) after an initial victimisation
  - Newcastle (UK): 15% of all burglaries (2010)
  - South Auckland (NZ) 10% of all burglaries (2014)

• Near repeat victimisation:
  Heightened risk within short space/time of originator incident
  Within 7 days and 200m of originator incident:
  - Newcastle: 23% of all burglaries (2010)
  - South Auckland: 15% of all burglaries (2014)
Immediate future
Patterns that predict: repeats and near repeats

Prediction accuracy

Accuracy concentration curve
(the more vertical the curve the better the prediction)

Crime Prediction Index
(1 is a perfect prediction)

- RV and NRV patterns most accurate for predicting immediate future
- Additional data can harm accuracy of the prediction
Police responses for predicting the immediate future
(Source: Chainey, 2012; Fielding and Jones, 2012)

• Countering the predicted heightened risk
  – Crime prevention officer
    • Visits burgled properties within 24 hours
  – Neighbourhood Police:
    • Visit neighbouring properties; as much face-to-face contact with residents as possible:
      Inform – Reassure – Advise
  – Visits (in high visibility uniform) to coincide with times when there have been burglaries

• Detection opportunities
  – Same offender; stop and search; prolific offender supervision; targeted forensic opportunities
Predicting the near future
The Crime Prediction Framework

Patterns that predict:
- Hotspot analysis
- Repeats and near repeats

Theory that explains the prediction:
- Foraging
- Boost
- Generators/attractors
- Flag

Responses:
- Law enforcement
- Crime prevention

Past | Now | Future
--- | --- | ---
Hotspot analysis | Repeats and near repeats | Patterns that predict:
Immediate | Near | Theory that explains the prediction:
Near future
Patterns that predict: hotspot analysis

Prediction accuracy

Accuracy concentration curve
(the more vertical the curve the better the prediction)

Crime Prediction Index
(1 is a perfect prediction)

<table>
<thead>
<tr>
<th>Crime type</th>
<th>CPI Gi* 95% significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burglary dwelling</td>
<td>0.960</td>
</tr>
<tr>
<td>Theft from the person</td>
<td>0.997</td>
</tr>
<tr>
<td>Assault with injury</td>
<td>0.995</td>
</tr>
</tbody>
</table>

E.g., based on 3 months of crime data to predict crime in next month

Hotspots most accurate at predicting the near future (Gi* better than KDE)
Predicting the near future

- Where crime concentrates one month – Likely to concentrate in same location the next month!

Example: Newcastle, England

<table>
<thead>
<tr>
<th>Crime type</th>
<th>Crimes committed in April 2010</th>
<th>Number of crimes in hotspots</th>
<th>Percentage of crimes in hotspots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burglary dwelling</td>
<td>130</td>
<td>21</td>
<td>16%</td>
</tr>
<tr>
<td>Theft from the person</td>
<td>60</td>
<td>41</td>
<td>68%</td>
</tr>
<tr>
<td>Theft from vehicle</td>
<td>190</td>
<td>48</td>
<td>25%</td>
</tr>
<tr>
<td>Assault with injury</td>
<td>154</td>
<td>68</td>
<td>44%</td>
</tr>
</tbody>
</table>
Predicting the distant future
The Crime Prediction Framework

Responses:
- Law enforcement
- Crime prevention
- Strategy/policy

Immediate | Near | Distant

Patterns that predict:
- Spatial regression
- Hotspot analysis
- Repeats and near repeats

Theory that explains the prediction:
- Foraging
- Boost
- Generators/attractors
- Flag
- Risk factors
Distant future
Patterns that predict: spatial regression

• Identifying those variables that are statistically related to distribution of crime
  – Geographically Weighted Regression – identifies spatially varying relationships

• Coefficients can be used to help predict how change in explanatory variable is likely to influence change in crime

• Example: domestic burglary in Newcastle, UK
  – Significant variables: burglary offenders, student population, Asian population
Distant future

Patterns that predict: spatial regression

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- Example: domestic burglary in Newcastle, UK
  - Significant variables: burglary offenders, student population, Asian population

- Example: violent assaults in Newcastle, UK
  - City centre: 10% increase in licensed premises could yield 9% increase in assaults (or vice-versa)
Summary
The Crime Prediction Framework

Predicting crime: where will crime occur in the future?

Different data, different techniques perform best for different time frames of the future.

Need to consider what we mean by the future.

Prediction performance of mapping techniques provides a benchmark against which other techniques can be compared.

Theory that explains the prediction:
- Foraging
- Boost
- Generators/attractors
- Flag
- Risk factors

Responses:
- Law enforcement
- Crime prevention
- Strategy/policy

Immediate
Near
Distant
Conclusions

- The bedrock of all types of contemporary policing is analysis
- Prediction is not only about where and when …
  - Need to explain why so you can determine what to do to counter the predicted activity (i.e., analysis is about understanding why)
- Policing is not only about tackling the immediate future
  - Policing approach that purely orients itself to the immediate future will undermine ability to shift/share responsibility to other agencies
  - Will undermine approaches for sustainably reducing crime
- Effective policing and crime prevention is based on good analysis
  - A push button approach to prediction will undermine the necessity for analysis
  - Analysis is required to effectively interpret crime problems, and influence decision-making on the responses to implement that have an impact on crime and improving public safety
Responding to and prevention crime?

or
Responding to and prevention illness?

or
Thank you

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