Improving the explanatory content of analysis products using hypothesis testing

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International Crime and Intelligence Analysis Conference
25-26 February 2016, Manchester (UK)
Overview

• Analysis/intelligence products
• The role of analysis
• Using hypothesis testing to move from the descriptive to the explanatory
  – Problem profile structure
  – Examples: robbery, mobile phone theft, domestic burglary
• Practical considerations
• Resources
The UK intelligence production process

12 month intelligence development cycle

Plan/Control Strategy

SA: Action against strategic priorities with new issues being considered if escalated from Tactical Assessments

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

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UCL Jill Dando Institute of Crime Science

SA: Strategic assessment: identifying priorities for strategic action
What should a good analysis product/report look like?
What should a good analysis product look like?
A survey of police managers and analysts

• Concise
• Clear
• Well structured
• Explain why the problem exists
• Be interesting
• Use good quality data

• Should include recommendations
• Well presented, with good use of graphs, maps and pictures
• Provides more than just statistics
• Draws from the evidence-base
What are the main reasons that prevent the production of good analysis products?
What are the main reasons that prevent the production of good analysis products?
A survey of police managers and analysts

- Poor terms of reference on what is required
- Lack of time to do good analysis
- Managers want the analysis to justify what they plan to do, rather than the analysis informing what they do
- Managers do not know what analysts can do
- Poor quality data
- Data not available
- Lack of feedback on the analysis produced
- IT systems are poor
- Managers do not really know what they want!
The intelligence-led production process
And the role of analysts and decision-makers

General, descriptive intelligence profiles, with very little that explain specifically why the problem exists; fail to help identify what is likely to have an impact.

How can we change this and improve the analytical function?

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

Ratcliffe’s 3i Model

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

Intelligence product: fundamental component to intel-led policing, facilitating decision-making framework
Improving the explanatory content of intelligence analysis using hypothesis testing (the scientific method)

- Hypothesis: a true (or false) statement that provides a plausible reason to explain the problem
  - Testing it results in coming to some conclusions
What’s a hypothesis?
Improving the explanatory content of analysis products using hypothesis testing

• Frame direction and content of analysis using hypothesis testing

Hypothesis:
– A true (or false) statement that provides a plausible reason to explain the problem - results in coming to some conclusions
– Identifies the data that are required and analysis to conduct
– Helps identify key intelligence gaps

• Focus is on examining **Why**

– Using whichever WWWWH (4Ws1H) are most suitable for the hypotheses that are being tested
Improving the explanatory content of analysis products using hypothesis testing

• Injecting scientific method into SA of SARA

• Key stakeholders of the problem should be the ones who come up with hypotheses
  – Helps improve commissioning/dialog on what is required

• Makes it easier to identify how to respond
  – Hypothesis testing helps explain why there is a problem
  – Identify the tactics and strategies that counter these explanations

Hypothesis testing in action at New Zealand Police
Injecting hypothesis testing into Scanning-Analysis
Reducing gang-related drug crime in Phillipstown, New Zealand
Injecting hypothesis testing into Scanning-Analysis
Reducing gang-related drug crime in Phillipstown, New Zealand

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_1$ Active burglars with local knowledge are targeting Phillipstown</td>
<td></td>
</tr>
<tr>
<td>$H_2$ High rates of unemployment are increasing motivation to offend</td>
<td></td>
</tr>
<tr>
<td>$H_3$ Status quo</td>
<td></td>
</tr>
<tr>
<td>$H_4$ Local drug use/supply is increasing motivation to offend</td>
<td></td>
</tr>
<tr>
<td>$H_5$ Null</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence</th>
<th>$H_1$</th>
<th>$H_2$</th>
<th>$H_3$</th>
<th>$H_4$</th>
<th>$H_5$</th>
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<tbody>
<tr>
<td>Crime increasing</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
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<tr>
<td>Multiple Drug Dealing Hubs</td>
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<td>✓</td>
<td></td>
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<td>✓</td>
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<tr>
<td>Gang Presence</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Large offence base</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Chronic Disorder offences</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Frequent gang violence</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequent family violence</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Incorporating hypothesis testing into analysis

Analysis report structure

• Overview – clearly defining the problem and setting the scene
  – Key features about the problem e.g., scale of the problem, trends, who’s involved?
    Share overview with stakeholders, getting them to propose hypotheses

• Reasons for the problem
  – Hypotheses (3-5 max – unlikely you’ll have capacity to do more)

• Analysis
  – Each section based on testing each hypothesis

• Conclusions/interpretation
  – Drawing together the results from the analysis
  – Explaining why the problem exists
  – Recognising that the problem is made of several different, unique qualities
Examples of hypotheses: street robbery in Town A

1. The periodic increases in robbery are due to a large number of offences being committed by a small number of offenders

2. Increases in robbery are an extension of bullying and imposition of power rather than for financial again

3. The robbery increase is a reflection of an increase in community tensions between ethnic groups. This has resulted in an increase of groups of one ethnicity targeting lone or small groups of persons of a different ethnicity (e.g. white group on lone Asian male, Asian group on two white males)

4. Increases in robbery have been caused by an increase in offences against taxi-drivers
3.4. *Hypothesis 4: Increases in robbery have been caused by an increase in offences against taxi-drivers*

Over the last year, only 2% of robbery victims stated their occupation as a taxi-driver. Figure 19 shows the level of robbery victimisation against taxi-drivers compared to the trend in robbery between January 2011 to March 2012. This indicates that victimisation against taxi-drivers is not behind the recent increases in robbery.

![Graph showing change in victimisation against taxi-drivers compared to all robbery](image)

**Figure 19.** Change in victimisation against taxi-drivers compared to the total robbery trend.

**Summary and interpretation**
- Increases in robbery have been not been caused by an increase in offences against taxi-drivers
Example: mobile phone theft in Birmingham

Hypotheses (1 of 2)

1. The increase in mobile phone theft has been driven by the theft of high value smartphones rather than other types

2. Young women (18-25), most of whom are students, have increasingly become victims of mobile phone thefts, particularly on Friday and Saturday nights

3. The increase in mobile phone thefts is being driven by organised criminality rather than offenders operating on their own

4. A small number of licensed premises are responsible for the increase in mobile phone thefts during hours associated with the night-time economy
A small number of licensed premises are responsible for the increase in mobile phone thefts during hours associated with the night-time economy (NTE)

- 396 licensed premises in Birmingham
- Seven licensed premises were responsible for 50% of all mobile phone theft and ¾ of entire increase
- Response design implications?

<table>
<thead>
<tr>
<th>A</th>
<th>Proportion of mobile phone thefts 2011 (listed with volume)</th>
<th>Rank: thefts in 2011 per 100 capacity</th>
<th>Change OctDec2010 to OctDec2011 (listed with volume change)</th>
<th>OctDec2010 to OctDec2011: % of increase attributable to LP</th>
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<tbody>
<tr>
<td>A</td>
<td>14% (135)</td>
<td>1</td>
<td>200% (32)</td>
<td>19%</td>
</tr>
<tr>
<td>B</td>
<td>12% (114)</td>
<td>5</td>
<td>156% (28)</td>
<td>16%</td>
</tr>
<tr>
<td>C</td>
<td>6% (58)</td>
<td>13</td>
<td>450% (18)</td>
<td>10%</td>
</tr>
<tr>
<td>G</td>
<td>3.5% (33)</td>
<td>12</td>
<td>457% (14)</td>
<td>8%</td>
</tr>
<tr>
<td>E</td>
<td>4.5% (43)</td>
<td>2</td>
<td>700% (14)</td>
<td>8%</td>
</tr>
<tr>
<td>I</td>
<td>2% (21)</td>
<td>4</td>
<td>1100% (11)</td>
<td>6%</td>
</tr>
<tr>
<td>D</td>
<td>5% (44)</td>
<td>3</td>
<td>500% (10)</td>
<td>6%</td>
</tr>
</tbody>
</table>
Example: Explaining the burglary increase in Oldham

Overview: domestic burglary in Oldham

• Nov 2010 - February 2011
  – 18% increase (91 more burglaries)

• Increase concentrated
  – Q2 Oldham East: 65%
Example: Explaining the burglary increase in Oldham

Overview: domestic burglary in Oldham

- Emerging problem areas (Using Dispersion Calculator)
  - 12 out of 462 areas (grid cells) were mainly responsible for the increase

Why do you think we have had this increase in burglary in Oldham?
Example: Explaining the burglary increase in Oldham

• **Hypothesis 1 (More Offenders):** The increase in burglary is attributable to an increase in burglary offenders living in these areas as a direct result of an increase in prison releases.

• **Hypothesis 2 (Less Effective Cocooning):** The increase in burglary is attributable to a decrease in the effectiveness of “cocooning” in these areas, leading to a higher level of repeat and near-repeat victimisation.

• **Hypothesis 3 (Targeting Jewellery):** The increase in burglary has been driven by an increase in gold jewellery thefts, particularly in Asian (Indian) neighbourhoods.

• **Hypothesis 4 (Darker Evenings):** The increase in burglary is attributable to an increased opportunity for burglars to offend in the early evening due to the extended hours of darkness over the winter.
Explaining the burglary increase in Oldham

**Hypothesis 1 (More Offenders):** The increase in burglary is attributable to an increase in burglary offenders living in these areas as a direct result of an increase in prison releases

- **Prison releases**
  - Increased by 52%. However:
    - Intensive supervision of ex-offenders via Spotlight (IOM)
    - Only one of these prisoner releases was linked to a BDW that was committed between Nov10-Feb11
    - Only 5 offences were linked to 4 offenders who had been released from prison between Jul-Oct 2010

- If recent prison releases were considered to be responsible for the recent increase in burglary
  - Expected many more linked to burglaries that were committed during the Nov 2010 – Feb 2011 period
Explaining the burglary increase in Oldham

Hypothesis 2 (Less effective cocooning): The increase in burglary is attributable to a decrease in the effectiveness of “cocooning” in these areas, leading to a higher level of repeat and near-repeat victimisation.

- **Repeat victimisation:**
  - Jul-Oct 2010: 3.1% of burglaries were repeats
  - Nov10-Feb11: 1.2%

- **Near repeat victimisation:**
  **Jul-Oct 2010:**
  - 7% of burglaries were near repeats
  - Evidence of near repeats within 2 days, between 200m to 300m from an initial burglary
  **Nov 2010-Feb 2011:**
  - 9%
  - Evidence of near repeats within 2 days, and within 200 metres around an initial event

- If near repeats were reduced to levels in Jul-Oct10, this alone could contribute towards 4% reduction in burglaries (1 in 5 additional burglaries were near repeats)

**Near repeats by police beat area**

<table>
<thead>
<tr>
<th>N'hood</th>
<th>Beat</th>
<th>Beat Name</th>
<th>Jul-Oct 2010</th>
<th>Nov10-Feb11</th>
<th>Diff</th>
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<tbody>
<tr>
<td>Q1</td>
<td>Q1E6</td>
<td>Coldhurst</td>
<td>2</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Q1F5</td>
<td>Werneth</td>
<td></td>
<td>0</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Q1G5</td>
<td>Medlock Vale</td>
<td></td>
<td>4</td>
<td>0</td>
<td>-4</td>
</tr>
<tr>
<td>Q1H5</td>
<td>Alexandra</td>
<td></td>
<td>10</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Q2</td>
<td>Q2J1</td>
<td>Oldham town centre</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q2J5</td>
<td>St Marys</td>
<td></td>
<td>2</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Q2K5</td>
<td>Waterhead</td>
<td></td>
<td>10</td>
<td>9</td>
<td>-1</td>
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<tr>
<td>Q2L5</td>
<td>St James</td>
<td></td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Q3</td>
<td>Q3Q5</td>
<td>Failsworth West</td>
<td>0</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Q3R5</td>
<td>Failsworth East</td>
<td></td>
<td>2</td>
<td>0</td>
<td>-2</td>
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<tr>
<td>Q3S5</td>
<td>Hollinwood</td>
<td></td>
<td>2</td>
<td>7</td>
<td>5</td>
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<tr>
<td>Q4</td>
<td>Q4T5</td>
<td>Royton North</td>
<td>4</td>
<td>0</td>
<td>-4</td>
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<tr>
<td>Q4U5</td>
<td>Royton South</td>
<td></td>
<td>2</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>Q4V5</td>
<td>Shaw</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Q4W5</td>
<td>Crompton</td>
<td></td>
<td>0</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Q5</td>
<td>Q5M5</td>
<td>Chaderton North</td>
<td>6</td>
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<tr>
<td>Q5N5</td>
<td>Chaderton Central</td>
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<td>13</td>
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<tr>
<td>Q5P5</td>
<td>Chaderton South</td>
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<td>Q6</td>
<td>Q6X5</td>
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<tr>
<td>Q6Y5</td>
<td>Saddleworth North</td>
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<td>0</td>
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<tr>
<td>Q6Z5</td>
<td>Saddleworth West and Lees</td>
<td></td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
Explaining the burglary increase in Oldham

Hypothesis 3 (Targeting jewellery): The increase in burglary has been driven by an increase in gold jewellery thefts, particularly in Asian (Indian) neighbourhoods.

- Jul-Oct 2010: 58 burglaries where jewellery was stolen (11% of all burglaries)
- Nov 2010-Feb 2011: 71 burglaries where jewellery was stolen (12%)
- Jewellery remains popular item to steal; difficult to distinguish ‘gold’
- Increase in burglaries where jewellery was taken accounts for 5% of the total increase in burglary
- Targeting of Asians: no evidence to support this
- No hotspots of burglary for jewellery

Summary and interpretation:
- Jewellery continues to be common target, can’t determine gold from other jewellery, overall increase is small
- No evidence to suggest any particular ethnic group or geographic area
  - Rather, areas where there has been increase in jewellery burglaries are areas which have experienced an increase in burglary generally
Explaining the burglary increase in Oldham

Hypothesis 4 (Darker evenings): The increase in burglary is attributable to an increased opportunity for burglars to offend in the early evening due to the extended hours of darkness over the winter.

Time of day 15:00 – 20:59:

- Burglary increased 98% in Nov 2010–Feb 2011 compared to the same period in Jul – Oct 2010
  - Increase is equivalent to approx 100 more burglaries
  - Equates to 18% increase in burglary in Oldham
- Other hours of day: remained comparable to summer period
- Pattern has been evident in each of the previous 3 years
Did the analysis make a difference?

Police and partnership response (October 2011)

Prevention focus (the introduction of super-cocooning!)

Reduce seasonal vulnerability; minimise near repeats

- Visit neighbouring properties; as much face-to-face contact with residents as possible:
  - Inform – Reassure – Advise
    (start with those within 100m)

“I’m not sure whether you are aware, but there was a burglary a few doors up yesterday.
The chances of you being burgled are very low.

There are a couple of things you can do to help us out”

- Report suspicious behaviour
- Offer seasonally-sensitive, tailored crime prevention advice
Did the analysis make a difference?

• Nov 2010 – Feb 2011: 606
• Nov 2011 – Feb 2012: 457
• Reduction of 25%
• Specific reductions in near repeat victimisation
• Unanticipated benefit: Increase in public confidence
Practical considerations

• Approach does not provide all the answers!
  – Explains several of the main causes
  – Myth busting
  – Identifies key intelligence gaps
  – Analysis product richer in explanatory substance

• Encouraging key stakeholders/decision-makers to suggest hypotheses improves commissioning
  – Actually results in some dialog!
  – Better involves them in interpretation of analysis results

• Involving number of different agencies leads to richer range of hypotheses
Some examples hypothesis testing has been applied to

<table>
<thead>
<tr>
<th>Burglary</th>
<th>Youth disorder</th>
</tr>
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<tbody>
<tr>
<td>Problematic street drinking</td>
<td>Theft of vehicles</td>
</tr>
<tr>
<td>Alcohol-related violence</td>
<td>Sexual assaults</td>
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<tr>
<td>Theft from vehicles</td>
<td>Street drug dealing</td>
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<td>Youth cannabis use</td>
<td>Domestic violence</td>
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<tr>
<td>Street parking</td>
<td>Robberies in Post Offices</td>
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<td>Street robbery</td>
<td>Knife crime</td>
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<td>Criminal damage</td>
<td>Mobile phone theft</td>
</tr>
<tr>
<td>Bicycle theft</td>
<td>Metal theft</td>
</tr>
<tr>
<td>Illegal dumping of waste</td>
<td>Psychoactive substances</td>
</tr>
<tr>
<td>Cycling accidents</td>
<td>Organised criminal groups</td>
</tr>
<tr>
<td>Illegal flower sellers</td>
<td>Child sexual exploitation</td>
</tr>
<tr>
<td>Email-based fraud</td>
<td>Illegal importation of puppies</td>
</tr>
</tbody>
</table>
Summary: the role of the analyst

• Helping to interpret the criminal environment by providing a thorough understanding of the problem
  – Determining why the problem exists
  – Being objective in the intelligence created (critical assessment)
  – Identify intelligence sources other than recorded crime data
  – Identify intelligence gaps
• The analysis stage should also involve drawing from the evidence-base

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
Summary: the role of the decision-maker

- Ensure the product is fit for purpose
  - Clearly commission what is required
  - Converse rather than task ...
  - Identify a group of key stakeholders
  - Pose hypotheses
  - Set a realistic timeframe
  - Provide critical feedback

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
Resources


Free access from the publications section of profile page: http://www.ucl.ac.uk/scs/people/profiles/spencer-chainey

**JDiBrief:** Hypothesis testing crime analysis

www.jdibrief.com

**Short courses:**

Hypothesis testing crime analysis, 17 May 2016

http://www.ucl.ac.uk/scs/cpd-events

Bespoke course: Problem solving, analysis and implementing evidence-based responses

Contact me for details s.chainey@ucl.ac.uk
The value of using a hypothesis testing approach to improve the explanatory quality of analysis products

• Need to move on from producing descriptive, general material, that says very little, and usually what is already known!

• Hypothesis testing approach naturally leads to coming to some explanatory conclusions
  – Does not explain everything, but tests what are initially seen to be the main reasons

• Improves the commissioning process and the translation of analysis to response

• Class 5C: ACIA class: Analysis of competing hypotheses Owain Gower, Sussex Police

• 6B Seminar stream: The value of hypothesis testing in analysing organised crime Matt Ashby, College of Business Law and Social Sciences, Nottingham Trent University

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