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Locating spatial analyses of crime: the crime analysis framework

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Locating Spatial Analyses of Crime: 
The Crime Analysis Framework

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Why Map & Analyse Crime Data?

- to identify the scale and distribution of crime and disorder
- to explore relationships between crime and the environment (physical & social)
- to target resources for crime prevention
- to evaluate the impact of crime prevention
- to inform police operations
- to apprehend offenders
- to profile the spatial behaviour of offenders.
- to predict the spatial and temporal distribution of offences
- to develop Early Warning Systems of emerging problems
- to communicate with and to engage communities
- to support bids for extra resources from government
The Crime Analysis Framework (Hirschfield, A., 2005)

Crime Centred Analysis (CCA)

Disaggregate

Aggregate

Crime Environment Analysis (CEA)

A

B

D

E
Crime Centred Analysis I

**Where** do crimes occur?
**When** do crimes occur?
**When** crimes occur, *where* do they occur?
**Where** crimes occur, *when* do they occur?

**How** do crimes occur (MO analysis)
**Do** areas with one crime problem have other crime problems?
**Where** are these areas?
**Which** and **how many** crimes do they have?
**How much** of the population is affected (prevalence)?
**How** concentrated is crime (socially, temporally, over space)?
Crime Centred Analysis II

To what extent are there repeat crimes?
What is the time interval between repeats?
Where are repeat crimes concentrated?
Who are the victims? Who are the offenders?

Do offenders live in the areas with the highest crime rates?
Do offence locations relate to those of previous offences?
Is the volume of crime decreasing or increasing?
Are crimes affecting the same areas or new areas?
Are crimes diffusing or concentrating?
Is there evidence of displacement or crime switch?
Crime Environment Analysis

Physical & Built Environment
- Land use
- Terrain
- Urban Design
- Communications

Social Environment
- Migration
- Ethnicity
- Deprivation
- Social cohesion

Policy Environment
- Target Hardening
- CCTV
- Alley-gates
- Street Wardens
- Home watch
- Other ABIs
Crime Environment Analysis II

What types of area have high crime?
Are they student areas or deprived estates?
Do they have particular types of housing /built environment?
Are they Policy Priority Areas?

What types of transport and communications do they have?
Are they accessible to offenders physically/ socially?
Do they have poor natural surveillance?
Do they have a large number of potential crime attractors?
Do they have crime prevention measures already?
Are they deployed in the right places at the right times?
How does the crime prevention relate to crime change?
Crime Centred Analysis (CCA)
Techniques for Aggregate CCAs

- Tabulation of crime counts and derivation of crime rates
- Identification of areas with significantly high and significantly low crime
- Calculation of the concentration of crime at area level
- Identification of crime mix and its variation across areas
## Distinguishing High and Low Crime Rates

<table>
<thead>
<tr>
<th>Ward</th>
<th>Households</th>
<th>Burglary</th>
<th>Theft of Vehicle</th>
<th>Theft From Vehicle</th>
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<td>2,366</td>
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<td>31.7</td>
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<td>56.6</td>
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<td>2,876</td>
<td><strong>47.2</strong></td>
<td>19.8</td>
<td>70.3</td>
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<td>Mean</td>
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<td>25.1</td>
<td>12.0</td>
<td>40.4</td>
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<tr>
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<td><strong>12.2</strong></td>
<td>5.2</td>
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</table>
### Malicious Ignition Dwelling Fires 1998/99

**Resource Targeting Table (RRT)**

<table>
<thead>
<tr>
<th>Ward Code &amp; Name</th>
<th>Cum %</th>
<th>Cum %</th>
<th>No. of</th>
<th>Cum %</th>
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<tbody>
<tr>
<td></td>
<td>Pop</td>
<td>Hhlds</td>
<td>Incidents98/99</td>
<td>Incidents98/99</td>
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<td>0.46</td>
<td>0.49</td>
<td>47</td>
<td>4.00</td>
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<tr>
<td>2 BNFE  Beswick and Clayton</td>
<td>0.94</td>
<td>0.98</td>
<td>39</td>
<td>7.33</td>
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<tr>
<td>3 BNFD  Benchill</td>
<td>1.45</td>
<td>1.46</td>
<td>37</td>
<td>10.48</td>
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<td>4 BNFM  Cheetham</td>
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<td>2.00</td>
<td>37</td>
<td>13.63</td>
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<tr>
<td>5 BNFY  Lightbowne</td>
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<td>2.55</td>
<td>36</td>
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<td>6 BNFZ  Longsight</td>
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<td>3.11</td>
<td>34</td>
<td>19.59</td>
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<tr>
<td>7 BRFJ  Langworthy</td>
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<td>3.57</td>
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<td>8 BRFC  Broughton</td>
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<td>4.00</td>
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<tr>
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<td>10 BNFF  Blackley</td>
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<td>4.94</td>
<td>25</td>
<td>29.64</td>
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<tr>
<td>11 BNFU  Harpurhey</td>
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<td>5.45</td>
<td>25</td>
<td>31.77</td>
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<td>12 BPFW  Werneth</td>
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<td>5.86</td>
<td>23</td>
<td>33.73</td>
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<tr>
<td>13 BRFK  Little Hulton</td>
<td>6.19</td>
<td>6.34</td>
<td>23</td>
<td>35.69</td>
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<tr>
<td>14 BNFB  Baguley</td>
<td>6.68</td>
<td>6.84</td>
<td>20</td>
<td>37.39</td>
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<tr>
<td>15 BQFD  Central and Falinge</td>
<td>7.11</td>
<td>7.28</td>
<td>20</td>
<td>39.10</td>
</tr>
<tr>
<td>16 BRFL  Ordsall</td>
<td>7.39</td>
<td>7.60</td>
<td>20</td>
<td>40.80</td>
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<tr>
<td>17 BPFR  St.Marys</td>
<td>7.88</td>
<td>8.05</td>
<td>18</td>
<td>42.33</td>
</tr>
<tr>
<td>18 BQFP  Middleton West</td>
<td>8.16</td>
<td>8.33</td>
<td>18</td>
<td>43.87</td>
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<tr>
<td>19 BNGA  Moss Side</td>
<td>8.68</td>
<td>8.88</td>
<td>17</td>
<td>45.32</td>
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<tr>
<td>20 BPFJ  Hollinwood</td>
<td>9.08</td>
<td>9.28</td>
<td>17</td>
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<td>21 BNFA  Ardwick</td>
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<td>9.69</td>
<td>15</td>
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<tr>
<td>22 BNGC  Newton Heath</td>
<td>10.00</td>
<td>10.23</td>
<td>15</td>
<td>49.32</td>
</tr>
</tbody>
</table>

← 25% of Incidents

← 50% of Incidents
CCA:
Crime Mix

Crime Mix: Barchester

Crime Mix: Ward 18

Crime Mix: Ward 14
<table>
<thead>
<tr>
<th>Ward</th>
<th>Burglary Prevalence</th>
<th>Burglary Concentration</th>
<th>Burglary Prominence</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>52.1 (1)</td>
<td>8.8 (2)</td>
<td>20.3 (1)</td>
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<tr>
<td>21</td>
<td>47.2 (2)</td>
<td>10.0 (1)</td>
<td>11.6 (14)</td>
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<tr>
<td>1</td>
<td>42.2 (3)</td>
<td>7.3 (4)</td>
<td>12.0 (12)</td>
</tr>
<tr>
<td>8</td>
<td>35.6 (4)</td>
<td>6.5 (7)</td>
<td>13.6 (8)</td>
</tr>
<tr>
<td>13</td>
<td>35.6 (5)</td>
<td>7.2 (5)</td>
<td>14.4 (7)</td>
</tr>
<tr>
<td>9</td>
<td>34.1 (6)</td>
<td>8.5 (3)</td>
<td>18.9 (3)</td>
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<td>7</td>
<td>33.1 (7)</td>
<td>6.6 (6)</td>
<td>12.2 (11)</td>
</tr>
<tr>
<td>15</td>
<td>26.5 (8)</td>
<td>5.2 (9)</td>
<td>10.7 (17)</td>
</tr>
<tr>
<td>2</td>
<td>25.9 (9)</td>
<td>4.2 (11)</td>
<td>16.3 (5)</td>
</tr>
<tr>
<td>20</td>
<td>25.1 (10)</td>
<td>4.6 (10)</td>
<td>7.6 (20)</td>
</tr>
<tr>
<td>19</td>
<td>24.6 (11)</td>
<td>5.2 (9)</td>
<td>11.3 (16)</td>
</tr>
<tr>
<td>14</td>
<td>21.2 (12)</td>
<td>2.3 (16)</td>
<td>19.0 (2)</td>
</tr>
</tbody>
</table>
CCA Mapping Techniques

Disaggregate Data Analyses

• Mapping the distribution of individual incidents (offence, victim, offender locations);

• Mapping the distribution of repeat incidents (multiple incidents, repeat victims, prolific offenders)

• Identifying clusters/‘hot spots’ from points

• Exploring space-time clustering
Criminal Damage to Bus Stops Wirral

(Newton 2004)

Points
Criminal Damage to Bus Stops Wirral

(Newton 2004)

Hot Spots
A day of crime in Harrow.

24 hour animation of street crime patterns, created using one year of crime data.

(Chainey, 2001)
Crime Environment Analysis (CEA)
Techniques for Aggregate CEAs

• Derivation of crime rates for areas ranked by deprivation level
• Derivation of crime rates for different types of residential neighbourhood
• Identification of overlap between high crime and high values on other social indicators (e.g. unemployment)
• Calculation of the concentration of crime by area type, social indicator
HIGHEST ARSON & HIGHEST DEPRIVATION

Highest 10% Deprivation

Highest 10% Arson
Mapping crime with deprivation

Residential burglary rate by deprivation level

ILC decile

<table>
<thead>
<tr>
<th>Decile</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>9</td>
</tr>
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</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

Crime rate

0  1  2  3  4  5  6  7  8  9  10

Deprivation decile

Residential burglary rate by deprivation level

0  10  20  30  40  50

Bar chart showing the relationship between deprivation decile and residential burglary rate.
Assault Rate: Merseyside

Deprivation Decile

Assaults per 10,000 Population

0  20  40  60  80  100  120

Deprivation Decile

1  2  3  4  5  6  7  8  9  10

Assault Rate
Assault Distance from Home: Merseyside

Deprivation Decile

Kilometres from Home to Place of Attack

Assault Distance from Home

Deprivation Decile

0 1 2 3 4 5 6 7 8 9 10
Disaggregate Data Analyses

• Mapping incidents on contextual backcloths (Geodemographics, land use maps, digital aerial photos)

• Mapping hot spots and spatial-temporal clusters in relation to the environment

• Identifying ‘hot spot’ demographics & land use

• Conducting specific site and RADIAL analyses
Offences in Oxton
Offenders in Oxton
High Definition GIS at Temple University

Crime Environment Analysis
(Disaggregate)

Prof. George Rengert (Temple)
Crime Environment Analysis (Disaggregate)

Spencer Chainey  (Jill Dando Institute, UCL, London)
Conclusion

• **Much** can be gained solely through CCAs
• **CEAs** add further insights by identifying factors that facilitate/inhibit crime (e.g. low/high social cohesion, good/poor natural surveillance)

**Both CCA and CEA require:**

• **Awareness** of sources of data on crime, disorder, land use and socio-demographic conditions
• **Expertise** in data manipulation and processing
• **Basic skills** in data analysis
• **Competence** in the use of GIS
• **An ability** to interpret the results from analysis