Behind Rossmo’s assumptions: further hypotheses to make geographic profiling more operational

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This is the price for 1 DNA test in Belgium.

Cost of a DNA investigation: $300 \times \text{Nb of Suspects}$

Reducing the number of suspects saves a large amount of money and time.

$\Rightarrow$ Need for methods such as geographical profiling.
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Rossmo defines the following assumptions to apply GP

Link between crimes must be accurate and complete

The offender must be local (not too long journey)

He should not change his anchor point

Crimes must be committed by a single offender
From solved series in Belgium, we observed

- **Link**
  
  Systematic comparison of modus operandi only for violent crimes

- **Local offender**
  
  Distances can be about 10 km or more and few consistency between offenders

- **Change of anchor point**
  
  A lot of series with multiple residences or influence of past residence
Before applying GP methodologies, we should be able to estimate if those assumptions are met.
Will GP be effective or not?
To answer to this question, I decided to combine theoretical and operational approaches

A literature review to identify the assumptions in GP and criteria favouring their meeting

The study of what is behind those assumptions in terms of research methodology with an unsolved series as illustration
A better understanding of the spatio-temporal context of the crime should improve GP effectiveness
Behind Rossmo’s assumptions:
further hypotheses to make GP profiling more operational

Rossmo’s assumptions: description, ante-evaluation and applicability

Case study: development of another spatial hypothesis for the offender’s behaviour
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Case study: development of another spatial hypothesis for the offender’s behaviour
I. Link The degree of certainty for the link between crimes depends on

<table>
<thead>
<tr>
<th>Crime type</th>
<th>DNA or ballistic traces</th>
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<tbody>
<tr>
<td>Offender’s properties</td>
<td>Consistency in modus operandi</td>
</tr>
<tr>
<td>Spatio-temporal aspects</td>
<td>Proximity in time and space of crimes</td>
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</table>
I. Link - The highest level of certainty is reached by DNA matching

3 facts present the same DNA profile
I. Link - Closeness in time and space is often the only way to link events to a series

In this case, two subpatterns are linked to the "DNA sites"
II. A local offender supposes first short distances to crime influenced by

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Place attractiveness varies with spatial scale and time

According to Branthingham, a distance decay is only observed for neutral places in terms of criminality.

Attractiveness can be analysed from inter-city scale to neighbourhood one.

Opening hours of shops, bars influence place attractiveness.
II. Local Offender - Attractors can be point primitive
II. Local Offender - Attractors can be segment primitive
II. Local Offender - Attractors can be area primitive
II. A local offender is often associated with a uniform distribution of crimes around an anchor point

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<th>Spatio-temporal aspects</th>
<th>Spatial organisation of the city</th>
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<td>Grid network vs disorganised network</td>
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<td>New vs old cities</td>
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<td>Orientation of physical barriers</td>
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From the observations, classical methodologies appear to be inappropriated for the series

Influence of the road network on the journeys-to-crime

Only one neutral place from which a distance decay could be applied

A crime distribution around two entities
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Case study: development of another spatial hypothesis for the offender's behaviour
A new spatial hypothesis was proposed to explain the pattern

A distance decay for the only place with less a-priori attractiveness

A minimisation of variance for the others journeys in line with observation of offender’s spatial consistency
A corridor is highlighted by minimizing the variance for the length of JTC (threshold of 10%)
From the neutral place, a linear distance decay function is applied.
The combination of both surfaces
restricts the search area
The offender’s residence was located near the highest probability
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Rossmo’s assumptions can be estimated with crime elements among others spatio-temporal properties.

Offender’s spatial consistency is another spatial hypothesis that could be applied to places presenting the same level of attractiveness.
Geographical profiling can really save time and money

Only a good comprehension of the spatio-temporal aspects of crimes allow to reduce the pool of suspects.

Still a lot to do to improve this comprehension!
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