The weakest link?
An update on linkage analysis of serious sexual assaults

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Case linkage analysis
aka comparative case analysis
aka signature analysis
etc.

• Why is effective ‘case linking’ important?
  • Counteracting ‘linkage blindness’
  • Increasing evidence
  • Developing efficient investigative strategies
  • Similar fact evidence

• What is the most effective method?
  • A number of ‘independent’ offence characteristics or
  • Or grouping offence characteristics according to underlying behavioural themes?
Overview

1. Linking process & practice
2. Underlying assumptions
3. Problems
4. Empirical evidence
   1. Dimensional behavioural linking approach
   2. Multivariate behavioural linking approach
5. Linkage accuracy comparison study
6. Outlook
1. Linking process & practice


<table>
<thead>
<tr>
<th>Offence</th>
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<th>Offence</th>
<th>Offence</th>
<th>Offence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Venue</td>
<td>Indoors</td>
<td>Masked</td>
<td>Knife</td>
<td>Gloves</td>
<td>Masturb.</td>
<td>VagPen.</td>
<td>Takes/rings</td>
</tr>
<tr>
<td>Request &amp; read documentation</td>
<td>Construct list of behaviours for index offence</td>
<td>Search for similar cases</td>
<td>Construct lists of behaviours for other potentially similar offences</td>
<td>Identify similar and dissimilar behaviours</td>
<td>Weight similarities and differences</td>
<td>Write a report for prosecutor/police</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Totaal | 12 | 35 | 44 | 21 | 31 | 44 | 41 |
%       | 24 | 70 | 88 | 42 | 62 | 88 | 82 |
2. Underlying Assumptions

• **Consistency (Behavioural stability assumption)**
  – An offender behaves relatively consistent within a series of offences.

• **Uniqueness (Behavioural distinctiveness assumption)**
  – An offender will show a relatively unique combination of offence behaviour that differentiates him from others.

• Stranger sex offenders exhibit some consistency across offences (e.g., Bennell et al., 2009; Bootsma & van den Eshof, 2006; Grubin et al., 2001; Grubin et al., 1997; Lundrigan, et al. 2010; Mokros & Alison, 2002; Santtila et al., 2005; Woodhams & Labuschagne, 2011; Woodhams et al., 2007; Yokota et al., 2007).

• Linking serial sexual crimes enjoys therefore empirical support.

<table>
<thead>
<tr>
<th>Consistent</th>
<th>Unique</th>
<th>Not unique</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geographic behaviour</td>
<td>Precautions</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
<td>Crime scene risk</td>
</tr>
<tr>
<td></td>
<td>Age group victim</td>
<td>Specific sex behaviour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(anal penetration)</td>
</tr>
<tr>
<td>Not consistent</td>
<td>Compensating behaviour</td>
<td>Degree of sexual &amp; intimate behaviour</td>
</tr>
<tr>
<td></td>
<td>Weapon use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Violence – anger</td>
<td></td>
</tr>
</tbody>
</table>

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3. Problems...

• Despite some evidence for consistency, there’s need for a clear theoretical framework in research & practice
• Changes in M.O. can be due to (Woodhams & Labuschagne, 2011):
  – Situational dynamics (victim resistance, location(s), time)
  – Learning processes
  – Evolving fantasy element...
• Research primarily based on solved samples (Bennell & Canter, 2002)
• Uncertainty on including high and low occurring characteristics...
• ...and which offences of a series should be included to (Woodhams & Labuschagne, 2011)
• Ignoring the value of non-occurring characteristics (Salo, 2008)
• Comparable statistical approaches (Bennell et al., 2009)?
3. Problems (cont.): To scale or not to scale?

**Multivariate behavioural linking**
- Pragmatic approach
- Using all available information
+ Comparison of a larger no. of characteristics
- “one size fits all approach”
  (see following presentation from Woodhams et al.)

**Dimensional behavioural linking**
- Theory assumed approach
- Using groups of characteristics that share a common/latent theme
+ Allows for more intra-series differentiation (e.g., binding and gagging belong to the same theme)
+ Bigger picture approach
- Susceptible to more interpretation errors
4. Empirical Evidence

Dimensional behavioural linking

• Grubin et al. (2001): largest ViCLAS study ever
• 4 behavioural domains & 4 types per domain
  – Control (victim choice, approach, etc.)
  – Escape (precautions)
  – Sex (sex. behaviour)
  – Style (verbal behaviour)

• 79 of 81 series were correctly linked
• Control (68%) > Escape (52%) > Sex (50%) > Style (46%)
• Only 14-26% consistency within 4 domains
• Consistency dependent on situation & victim recollection abilities

256 ≠ types!
4. Empirical Evidence (cont.)

Multivariate behavioural linking

• 27 single behaviours yielding an AUC = .75 (Bennell et al., 2009)

• 111 offence characteristics: AUC = .77-.88
  Woodhams & Labuschagne (2011); see next presentation
5. Linkage accuracy comparison study
(Winter, Lemeire, Meganck, Geboers, Rossi, & Mokros, in prep.)

Rationale

• Previous studies compared Mokken based scaling vs. Bayesian Analysis in Italian serial homicides ($N = 116$) (Santtila et al., 2008 & Salo, 2008):
  – Mokken based scaling predict. accuracy: 63%
  – Bayesian based predict. accuracy: 83%

• To investigate which approach is more accurate in linking serious sexual offences.
5. Linkage accuracy comparison study
(Winter, Lemeire, Meganck, Geboers, Rossi, & Mokros, in prep.)

Method
• Sample of solved cases provided by SCAS ($N = 209$):
  – Serial sexual offences ($n = 90$) committed by 30 offenders
  – One-off rapes ($n = 79$)
  – Attempted rapes ($n = 50$)
• 2 coders, good IRR ($K = .78$)
• Significant differences betw. serial & non-serial offences
• 7 derived Mokken Scales with acceptable-strong scale properties
• DFA (LOOCV) linkage prediction based on the Mokken scales sum scores
• Naive Bayesian linkage prediction (LOOCV) with 47 variables entered simultaneously

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Results

• Predictive accuracy of the Bayesian analysis:
  – Top 1: 36%
  – Top 5: 57%
  – But including one-off’s and attempts: 13%

• Predictive accuracy of the Mokken derived scales:
  – Top 1: 29% (59%)
  – But including one-off’s and attempts: 9%
5. Linkage accuracy comparison study
(Winter, Lemeire, Meganck, Geboers, Rossi, & Mokros, in prep.)

<table>
<thead>
<tr>
<th>Behavioural scale</th>
<th>Percentage correct links LOCV</th>
</tr>
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<tbody>
<tr>
<td>Location: Indoor</td>
<td>12.2%</td>
</tr>
<tr>
<td>+ Location: Outdoor</td>
<td>15.6%</td>
</tr>
<tr>
<td>+ Controlling behaviour</td>
<td>27.8%</td>
</tr>
<tr>
<td>+ Expressive violence</td>
<td>30.1%</td>
</tr>
<tr>
<td>+ Forced sexual acts</td>
<td>30%</td>
</tr>
<tr>
<td>+ Compensating behaviour</td>
<td>26.7%</td>
</tr>
<tr>
<td>+ Degrading behaviour</td>
<td>28.9%</td>
</tr>
</tbody>
</table>
5. Linkage accuracy comparison study
(Winter, Lemeire, Meganck, Geboers, Rossi, & Mokros, in prep.)

Figure 1. ROC-curve comparison of dimensional behaviour linking \((\text{AUC} = .74)\) and single behaviour linking \((\text{AUC} = .84)\) when looking at serial cases only \((n = 90)\).

Figure 2. ROC-curve comparison of dimensional behaviour linking \((\text{AUC} = .80)\) and single behaviour linking \((\text{AUC} = .89)\) when looking at serial cases and one-off offences \((n = 219)\).
6. Discussion & outlook

• Relative consistent offender behaviour
  – Geographical & controlling characteristics remain most valid predictors
• Different approaches offer similar, very accurate results
• Direct hit (error free) accuracy is limited in ‘real’-life circumstances
  – But cannot be expected (Woodhams & Labuschagne, 2011)
  – See following presentation for unsolved-solved linkage comparisons
• Final linking decision are made by qualified analysts, but statistical approaches can offer support
• Larger replication samples needed & sample overlap with Grubin et al. studies (1997; 2001)
Thank you for your attention!

Questions?

- Sunglasses on?
  - Yes
  - No
- Remove sunglasses
- Put on sunglasses

Slides?

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