Multilevel network analysis and covert networks

Professor Garry Robins, University of Melbourne
Dr Johan Koskinen, University of Manchester
Dr Peng Wang, University of Melbourne
Associate Professor Petr Matous, University of Tokyo

Illicit Network Workshop, Adelaide, Dec 2014
Today’s agenda

1. Multilevel networks

2. Models for Multilevel networks

3. Empirical example
   - Farmers in Ethiopia

4. The application of multilevel network analysis to illicit networks
Illicit networks

Sageman (2004)
Russian-Italian Mafia Network (Varese, 2008)
Quebec Hell Angels Network (Morselli, 2008)
Multi-level networks
In social network research, we need to match the network representation with theoretical elements of a social system, else we risk misspecification.

Social systems are often:
- Multilevel
- Geospatially embedded
- Dynamic
- Involve multiple types of relations
- Involve actor attributes of various types.
A multi-level network structure

Wang, Robins, Pattison & Lazega (2013)
(following Iacobucci & Wasserman, 1990, Wasserman & Iacobucci, 1991)
Examples of multilevel networks
French cancer researchers

Bodin & Tengo (2012). Disentangling intangible social-ecological systems. *Global Environmental Change*
**Ethiopian farmers**

<table>
<thead>
<tr>
<th>Communication network of all 265 farmers</th>
<th>Nonentrepreneurs (A)</th>
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<tr>
<td><img src="image1.png" alt="Diagram 1" /></td>
<td><img src="image2.png" alt="Diagram 2" /></td>
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<th>Entrepreneurs (B)</th>
<th>Meso-level communication (X)</th>
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<td><img src="image3.png" alt="Diagram 3" /></td>
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Wang, Robins & Matous (2014)

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Exponential random graph models
Network self organization

Reciprocation

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Network self organization

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Network self organization

Multiple triangulation: (Denser regions)
Network self organization

High degree nodes
Multiple social processes

Tie
Reciprocity
Activity
Popularity
Triads
Brokerage

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ERGMs for Multilevel networks

Exponential random graph models for multilevel networks

Peng Wang\textsuperscript{a,}\textsuperscript{*}, Garry Robins\textsuperscript{a}, Philippa Pattison\textsuperscript{a}, Emmanuel Lazega\textsuperscript{b}

\textsuperscript{a} Melbourne School of Psychological Sciences, The University of Melbourne, Australia
\textsuperscript{b} IRIS SO-BIO, University of Paris-Dauphine, France

\begin{tabular}{l}
\textbf{ARTICLE INFO} \\
Keywords: Multilevel networks
\end{tabular}

\begin{tabular}{l}
\textbf{ABSTRACT} \\
Modern multilevel analysis, whereby outcomes of individuals within groups take into account group membership, has been increasingly used in social science. Theoretical developments (see Robins and \textsuperscript{b})
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ERGMs for multilevel networks

Affiliation based activity  Affiliation based closure or homophily

Cross-level entrainment  Cross-level structural equivalence

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Empirical examples

Farmers in Ethiopia
(Matous, Todo & Ishikawa, 2014; Wang, Robins & Matous, 2015)

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Unpaved roads

Households accessed by walking across fields

Matous, Todo & Ishikawa, 2014
Ethiopian farmers
(Wang, Robins & Matous, 2015)

Attributes:
• Network ties at both levels segmented by location in village and religion;
• Education homophily for entrepreneurs; whereas for non-entrepreneurs, higher education associated with more activity
• Richer entrepreneurs have more non-entrepreneurial clients

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Ethiopian farmers
(Wang, Robins & Matous, 2014)

Structurally:
- Entrepreneurs have different structural equivalence roles than non-entrepreneurs
- Entrepreneurs tend not to share non-entrepreneurial “clients”; except when they are connected themselves
- Popular entrepreneurs link with popular non-entrepreneurs
Conclusion

This relatively small village is influenced by classical demographic factors:

- **geospatial**, **religious** and **wealth** segmentation

But there are also self-organizing network processes that affect the flow of agricultural information.

- in particular, **closed advice structures** that restrict the flow of information between clique-like structures of entrepreneurial and client non-entrepreneurial farmers.

Without multilevel ERGMs, it would be difficult to uncover the structure of these social processes.
Application of multilevel network analysis to illicit networks

Koskinen, Stevenson, Edwards, Oliver, Broccatelli, Robins & Wang (2014)
Incomplete multilevel (and multiplex) networks in the covert domain

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Suffragettes 1908-1912

Personal ties (Pankhurst)
Events (Blathwayt)
Operations (Bristol)
Events and visits: Blathwayt’s Bath

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Eagle House in Bath
- owned by Blathwayt family
- important social focus for suffragettes

The Blathwayts
- invited suffragette prisoners & associates
- visits
- plant trees
- supportive hub for militants conducting covert acts

Reconstructed from Blathwayt diaries 1908-12.

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What are the implications of multilevel network analysis for criminal network studies?

- Criminal networks have typically been constructed as person to person.
- But multilevel network analysis opens additional ways to think about illicit networks
  - Person-person
  - Person-place
  - Person-operation
  - Operation-place
- All at the same time!
- With limited observation, it may be easier to observe person-place, than person-person.
- New methods are being developed to analyse multilevel networks

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“Doing Social Network Research: Network research design for social scientists”
To be published by Sage, January 2015

Fundamental network concepts and theories
Research questions and study design
Social systems and data structures
Network observation and measurement
Methods for data collection
Ethical issues for social network research
Network visualization
Methods for social network analysis
Drawing conclusions from social network results

Illicit Network Workshop,
Adelaide, Dec 2014
3-day course on SOCIAL NETWORK ANALYSIS AND NETWORK MODELS at Swinburne University, Melbourne

Wednesday 11th February – Friday 13th February 2015

Lecturers:
Dr Dean Lusher, Professor Garry Robins (University of Melbourne),
Dr Peng Wang & Dr Julia Brennecke

For all enquiries, contact:
Dr Dean Lusher
Faculty of Business and Law
Swinburne University
E: dlusher@swin.edu.au
Thank you!