Ego Network Analysis I

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MGT 780 Social Network Analysis
definition

• Full network

• Ego network (aka personal network, first-order zone, 1-neighborhood, etc.)
  – Ego (the respondent)
  – Alters (actors ego has ties with)
  – Ties among the alters
A compromise

- Combine the perspective of network analysis with the data of mainstream social science.
EGO NET RESEARCH DESIGN AND DATA COLLECTION
sampling

• Same as ordinary social science studies
• Random/probability samples
sources

• Every full network contains every node’s ego network
• (Ideally random) sample of nodes
  – Each sampled node called an “ego”
• Each is asked for set of contacts called “alters”
• Ego also asked (usually) about ties among alters
• Connections between ego’s or between alters of different egos are not recorded
  – Each ego is a world in itself
Survey data collection

• Each ego (“index person”) is asked for set of contacts called “alters”
  – Don’t need real or complete names
• Ego asked about the attributes of each alter
• Ego asked about various dimensions of their relationship to each alter
• Ego also asked (usually) about ties among alters
• Connections between egos or between alters of different egos are not obtained
  – Each ego is a world in itself
Name generator

• Series of open-ended questions asking about the people in a person’s life
  – Don’t need real or complete names
  – (variant is a position generator, which asks about the types of people in resp’s life)

• End result is a list of unique names that is compiled into a roster
Name interpreter

• For each alter generated by the name generator ask two sets of questions:
  – Attributes of each alter – age, sex, social class, etc.
  – Nature of the relationship with alter
    • Friends? Coworkers? Kin? How long known? Frequency of communication?
    • These questions can be same as in name generator. Difference is that the resp is reacting to roster of names, eliminating recall issues
Ego net structure

• (optional) Ask ego to indicate the ties among their alters
  – Typically a reduced set of ties, such as whether they know each other or how often they communicate with each other
ANALYZING EGO NET DATA
Network size

• Same as degree
• Could be asked more simply, but less accurately, by ‘how many friends have you got?’
• Well-correlated with lots of outcomes
Strength

• Average/median/maximum strength of tie with others
• How well connected to people in your neighborhood, department, etc.
• Strength of weak ties theory
Reciprocity

• Extent to which, when ego sends tie to alter, alter responds in kind
• Status differences?
• Cultural differences in meaning of social relations?
Composition

• How many of X kind of alters are in ego’s network neighborhood
  – Frequency or proportion of women among ego’s friends
  – Number of gay people among ego’s kin
Heterogeneity

• Given attribute X, and relation Y how diverse is ego’s personal network?
  – Friends mostly white? Does ego talk regularly with people from different walks of life?
  – How much variance in age in ego’s friends?

• Categorical versus continuous attributes
  – For continuous vars, just use standard deviation
Categorical Heterogeneity

• Given attribute X, and relation Y how diverse is ego’s personal network?
  – Friends mostly white? Does ego talk regularly with people from different walks of life?

• Herfindahl, Hirschman, Blau heterogeneity measure
  \[ H = 1 - \sum_k p_k^2 \]
  – \( p_k \) gives proportion of alters that fall into category k

• IQV – normalization of H so that it can achieve max value of 1
  \[ IQV = \frac{1 - \sum_k p_k^2}{1 - \frac{1}{k}} \]
Egonet Homophily

• Concept
  – To what extent an ego’s alters are like ego on a given attribute

• Approach
  – Construct relational contingency table for each node

• Measures
  – Pct homophilous (%H) = 0.67
  – E-I index = -0.333
  – PBSC = 0.24
“Quality”

- Average/median/max of ego’s alters’ attributes
- E.g.,
  - How wealthy are ego’s friends?
  - How prestigious?
- Lin social resource theory / social capital
  - You are as good as your network
Structural holes

• Burt ‘92
• A theory of individual social capital
  – Predicting promotion speed
• Not based on the attributes of ego’s alters, but on the structure of the ego network
Structural Holes

• Basic idea
  – Lack of ties among alters may benefit ego

• Benefits
  – Autonomy
  – Control
  – Information
Autonomy

Guy in Bar
Control Benefits of Structural Holes

White House Diary Data, Carter Presidency

Year 1

Year 4

Data courtesy of Michael Link
Information Benefits

• (Assume a fixed relational energy budget)

• Direct connection to outsiders means earlier, more actionable knowledge

• Bridging position provides control of information, agenda

• Value from
  – Bringing across ready-made solutions
  – Analogizing from others’ situations
  – Synthesizing others’ thinking
Information & Success

Data warehousing, systems architecture

Cultural interventions, relationship building

Information flow within virtual group

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Changes Made

• Cross-staffed new internal projects
  – white papers, database development

• Established cross-selling sales goals
  – managers accountable for selling projects with both kinds of expertise

• New communication vehicles
  – project tracking db; weekly email update

• Personnel changes
9 Months Later

Note: Different EV – same initials.


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Measures of Structural Holes

- Burt’s effective size
- Burt’s constraint
Effective Size

\[ m_{jq} = j's \text{ interaction with } q \text{ divided by } j's \text{ strongest relation with anyone} \]

\[ p_{iq} = \text{ proportion of } i's \text{ energy invested in relation with } q \]

\[ ES_i = \sum_j \left[ 1 - \sum_q p_{iq} m_{jq} \right], \quad q \neq i, j \]

\[ ES_i = \sum_j 1 - \sum_j \sum_q p_{iq} m_{jq}, \quad q \neq i, j \]

- Effective size is network size (N) minus redundancy in network

Figure 1. Adapted from Burt (1995:56)
Effective Size in 1/0 Data

- \( M_{jq} = j\)'s interaction with q divided by j’’s strongest tie with anyone
  - So this is always 1 if j has tie to q and 0 otherwise
- \( P_{iq} = \) proportion of i’s energy invested in relationship with q
  - So this is a constant 1/N where N is ego’s network size

\[
ES_i = \sum_j \left[ 1 - \sum_q p_{iq} m_{jq} \right], \quad q \neq i, j
\]

\[
ES_i = \sum_j \left[ 1 - \frac{1}{n} \sum_q m_{jq} \right], \quad q \neq i, j
\]

\[
ES_i = \sum_j 1 - \sum_j \frac{1}{n} \sum_q m_{jq}, \quad q \neq i, j
\]

\[
ES_i = n - \frac{1}{n} \sum_j \sum_q m_{jq}, \quad q \neq i, j
\]
Effective Size

Node "G" is EGO

<table>
<thead>
<tr>
<th>Redundancy with EGO's other Alternates:</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/6</td>
<td>2/6</td>
<td>0/6</td>
<td>1/6</td>
<td>1/6</td>
<td>1/6</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Effective Size of G = Number of G’s Alternates – Sum of Redundancy of G’s alters

= 6 – 1.33 = 4.67
Constraint

M_{jq} = j’s interaction with q divided by j’s strongest relationship with anyone
  So this is always 1 if j has tie to q and 0 otherwise

P_{iq} = proportion of i’s energy invested in relationship with q
  So this is a constant 1/N where N is network size

\[ c_{ij} = p_{ij} + \sum_{q} p_{iq} m_{qj}, \quad q \neq i, j \]

- Alter j constrains i to the extent that
  - i has invested in j
  - i has invested in people (q) who have invested heavily in j. That is, i’s investment in q leads back to j.
- Even if i withdraws from j, everyone else in i’s network is still invested in j
Sized by Constraint
Controlling for size

• Should one control for degree when using measures of structural holes?
Limitations of burt measures

• What if ego is not the only broker between alter 1 and alter 2
Ego betweenness

• The number of points that ego gets for being between two others is inverse function of the number of other members of ego’s neighborhood that are also between two others
  – G is between E and B, but so is A. So G only gets a half a point of brokerage

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Figure 1. Adapted from Burt (1995:56)
Do actors need to be aware of structural holes to benefit from them?

• For information benefits, no
  – Although it might help to recognize that your group 1 friends have solutions that group 2 doesn’t

• For control benefits, more so
Ajay’s Sample

- College Sorority
- N = 137
- 75% response rate
### Ego Network Structure and Perceived Ego Network Structure Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Means (Std. Dev.)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Density</td>
<td>.36 (.27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Bridging</td>
<td>.46 (.21)</td>
<td>-.77***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Eigenvector</td>
<td>17.96 (8.11)</td>
<td>-.34***</td>
<td>.71**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4. Perceived Density</td>
<td>3.81 (.70)</td>
<td>.10</td>
<td>.10</td>
<td>.26*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Perceived Bridging</td>
<td>3.09 (.98)</td>
<td>-.23**</td>
<td>.27**</td>
<td>.20*</td>
<td>-.02</td>
<td></td>
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<tr>
<td>6. Perceived Eigenvector</td>
<td>2.21 (.59)</td>
<td>-.04</td>
<td>.15</td>
<td>.30**</td>
<td>.16</td>
<td>.07</td>
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</tbody>
</table>
Observations

- Different measures of objective (inter-subjective, to be more precise) ego network structure are modestly correlated. But different measures of perceived ego network structure are not.

- Greater variance in measures of objective ego network structure than in measures of perceived ego network structure.

- In analyses not reported here: subjective measures of network structure are significant predictors of member satisfaction with how the organization is run; objective measures are not.

- Potentially sobering implications for validity of how ego network data are often collected (i.e., based solely on ego’s reports)
Brokerage as process

- So far we have identified brokerage with a particular network shape
- But brokerage can also occur when the brokered are already connected
  - Catalyst to do something
- Marriage and real estate brokers both exist to create a tie of some kind