

5_Network+Effects+II

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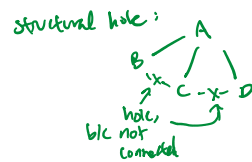


Advanced Network Analysis 5. Network Effects II: Positions and Structure

Weihua An



Network Positions



- ▶ Structural holes
- ▶ Structural equivalence
 - Division into groups via **hierarchical clustering**
 - Division into core and peripheral groups through **blockmodeling**

Structural Holes

- ▶ Structural holes measures an actor's brokerage power in a network. A broker is an actor with ties to others who are otherwise disconnected.
 - Traditional measure: betweenness centrality
- ▶ Types of brokers (Gould and Fernandez 1989)
 - Coordinator: $A \rightarrow A \rightarrow A$ (all nodes belong to the same group)
 - Gatekeeper: $B \rightarrow A \rightarrow A$ (source belongs to different group) *connect outside to inside*
 - Representative: $A \rightarrow A \rightarrow B$ (recipient belongs to different group) *connect inside to outside*
 - Consultant: $B \rightarrow A \rightarrow B$ (broker belongs to different group) *connect two outside*
 - Liaison: $B \rightarrow A \rightarrow C$ (all nodes belong to different groups) *connect from diff. departments*
- ▶ Mechanisms
 - Awareness of new information (Burt 2004)
 - Access to new resources (Podolny 2001; Hillmann and Alven 2011)
- ▶ Critiques
 - Competition for brokerage (Buskens et al. 2008)
 - Role/identity conflicts (Krackhardt 1999)
 - Status concerns (Podolny 1993)
 - Social undesirability of arbitrage

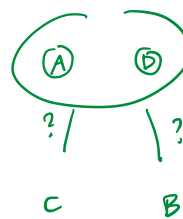
Structural Equivalence

- ▶ Two nodes are structurally equivalent if they are connected to others in the similar manner (Wasserman and Faust 1994).
 - Euclidean distance: difference in the ties of two actors *e.g. look at 2 rows*
 - Correlation: correlation in the social ties of two actors
 - ▶ Mechanisms
 - Similar information and risk exposure
 - Serve as a reference frame
 - ▶ Structural cohesion vs. structural equivalence
 - Coleman et al. (1957) found social contagion explained the diffusion of a new drug in physicians' prescriptions.
 - Burt (1987) showed that structurally equivalent alters of previous adopters adopted faster than friends/colleagues of previous adopters.
- # friends you have* → *# structurally equivalent friends you have*
- row equivalent: position you take is also important*

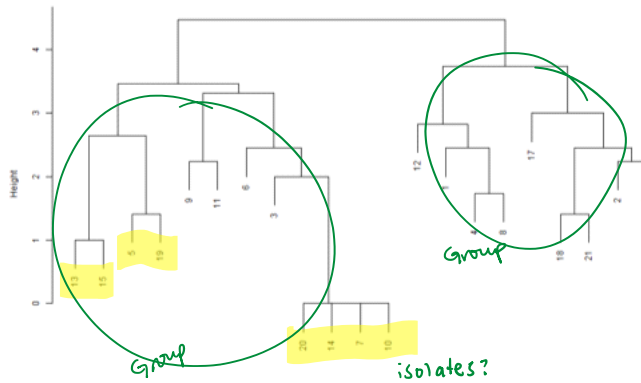
Hierarchical Clustering

Based on structural equivalence, a network can be divided into groups.

- ▶ The two most similar nodes are grouped.
- ▶ Recompute structural equivalence. There are three ways to measure the distance between the group node and other nodes.
 - Single-link: smallest distance between the group-node and others
 - Complete-link: largest distance between the group-node and others
 - Average: average distance between the group-node and others
- ▶ Repeat until finishing the division.



Hierarchical Clustering of the Manager Friendship Network

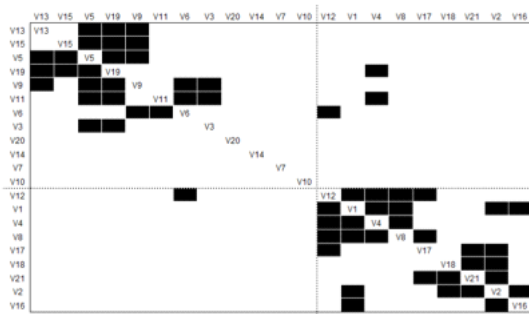


Blockmodeling

Blockmodeling aims to divide a (big) network into a smaller one composed of blocks/groups (White et al. 1976).

- ▶ One approach of conducting blockmodeling is to use the dendrogram generated by the hierarchical clustering method to divide actors into blocks. So actors within each block are structurally similar to one another.
- ▶ Create a density table that shows proportions of connections within and across blocks.
- ▶ A generalized approach of blockmodeling would be to do a blocking by optimizing a certain goodness of fit (e.g., maximizing connections in central groups while minimizing connections in peripheral groups).

Blockmodeling the Manager Friendship Network



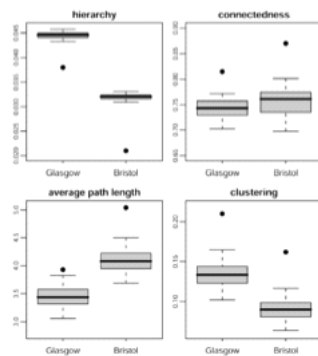
	Density of the Reduced Blocks	
	Block 1	Block 2
Block 1	0.42	0.01
Block 2	0.03	0.20

how many ties
Block 1 sends to
Block 2

Block 1 is the core,
Block 2 is the periphery

Structural Effects

- Measures of network structure
 - Cohesion: Density, transitivity, and mean geodistance
 - Hierarchy: Centralization and reciprocity
 - Clustering: (1) Transitivity coefficient. (2) The clustering coefficient of an actor is the density in its local network. The overall clustering coefficient is the mean of the clustering coefficients of all the actors.
- How to test whether the observed network has a significant structural feature?
 - Compare the observed network with randomized networks.



Baldassarri et al. (2007) show that as compared to random networks with the same degree distributions, civic networks display "polycentric" features.

- Less hierarchical
- More connective
- Longer average path length
- Higher level of clustering

Structural Effects

How networks with different structures affect outcomes/processes?

- Bonding vs. bridging
 - Morgan and Sorensen (1999) show that the most effective public schools had horizon-expanding networks while the most effective Catholic schools are characterized by norm-enforcing networks.
- Diffusion
 - A network with a more dispersed degree distribution (i.e., with high-degree nodes) facilitates simple diffusion (Barrat et al. 2008)
 - Local clustering (homophily) facilitates complex diffusion that requires reinforcement from multiple contacts (Centola 2010) or a critical mass of early adopters (Choi et al. 2010; Rogers 2003).
- Path-dependence
 - Hidalgo et al. (2007) shows the core of the product space is formed by metal products, machinery, and chemical products. There is a path dependence in the evolution of product space because of comparative advantage and sunk cost. State-sponsored industrialization helps achieve long jumps in product space.

*Branching like a tree
only takes 1 or 2 steps
to reach center*