Strength of Weak Ties, Structural Holes, Closure and Small Worlds

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Strength of Weak Ties theory

- Granovetter 1973
- Overall idea
  - Weak ties are surprisingly valuable because they are more likely to be the source of novel information
  - Social outcomes such as hearing about job opportunities are a function of having weak ties.

1st Premise – g-Transitivity

- ## G-Transitivity
  - Within arenas, social networks tend to be g-transitive
    - If A and B have a strong tie, they are likely to have many acquaintances (weak ties) in common
    - Stronger the tie btw A and B, and the stronger the tie btw B and C, the greater the chance that A and C have at least a weak tie

Strong tie

B

Strong tie

C   Strong tie   A
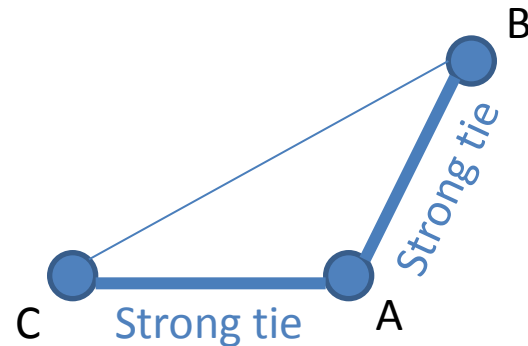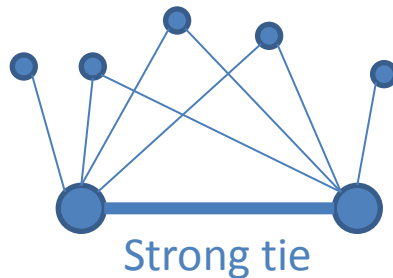
Reasons for g-transitivity

- Reasons for g-transitivity
  - Forces determining tie strength are themselves transitive
    - Spatio-temporal co-occurrence
    - Similarity
   - Congruence & the avoidance of cognitive dissonance
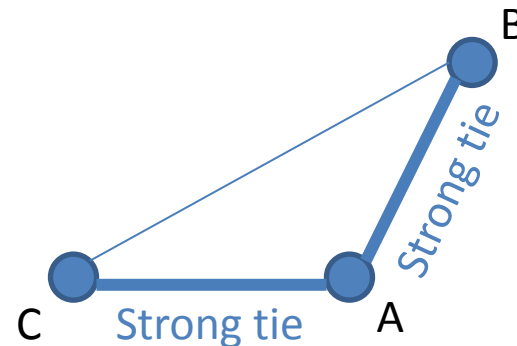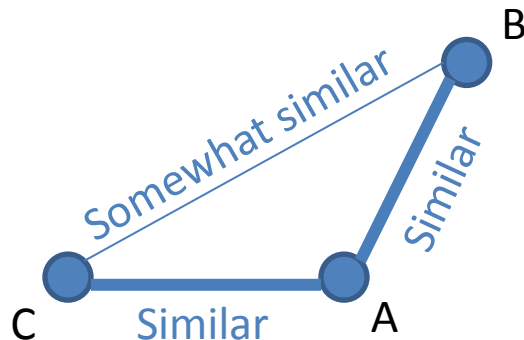
2ⁿᵈ Premise -- Bridging

- ## Bridges are more likely than other ties to be sources of novel, non-redundant information

- Bridging definition
  - A tie between X and Y is a bridge if removing the tie would mean the shortest path from X to Y were quite long
  - A tie is a local bridge of degree k if removing the tie leaves a shortest path of length k

VioletThink

Y

X

Local bridge of degree 5

C

A

B

GreenThink
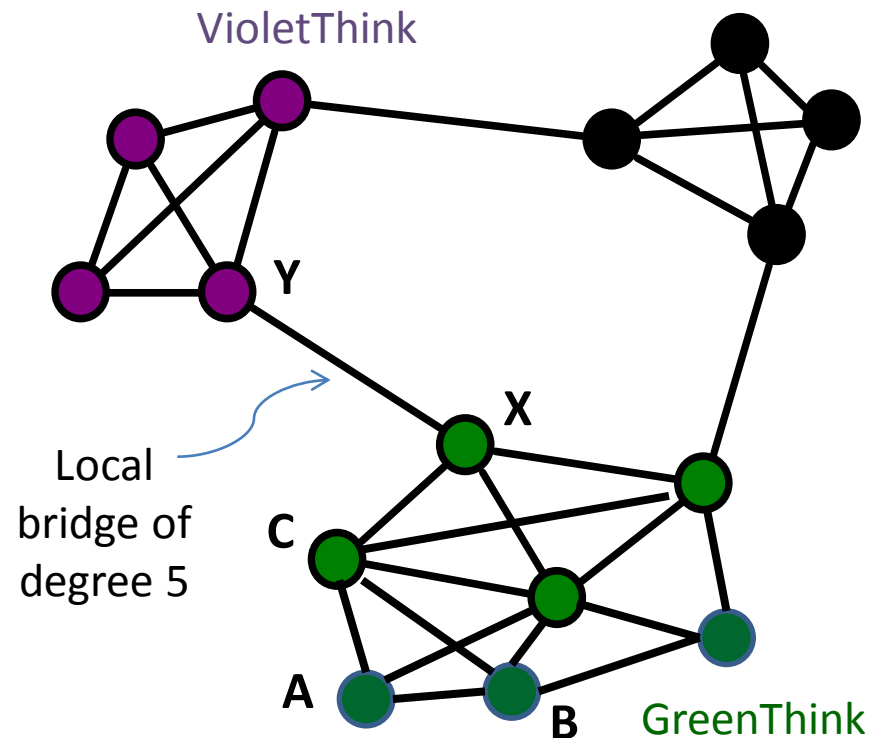
1ˢᵗ Inference

- Only weak ties can be bridges
  - To extent g-transitivity holds, weak ties more likely to be bridges

    - Suppose AB is a strong tie
    - G-transitivity implies other ties from A's friends to B, and vice versa
   - Therefore AB cannot be a bridge, since other paths connect A and B
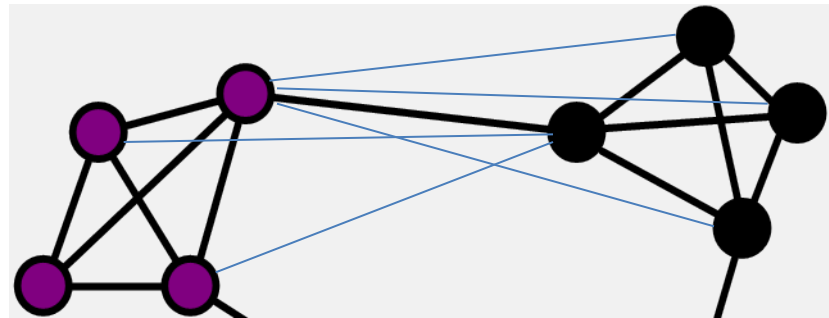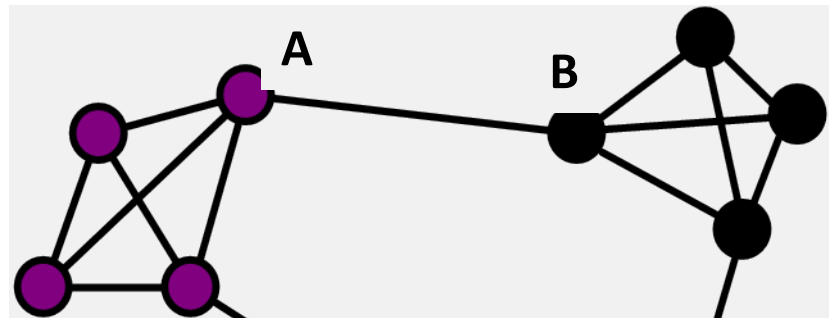
2nd Inference - Conclusion

- Weak ties are more likely to be sources of novel information
  - G-transitivity guarantees that only weak ties can be bridges
 - Bridges are the sources of novel information

Structural hole theory

- Burt 1992 theory of social capital
- Structural hole is lack of connection between two nodes that is bridged by a broker
- A has open network, many structural holes
- A has the more favorable ego network
  - Information benefits
  - autonomy

B

structural hole

A
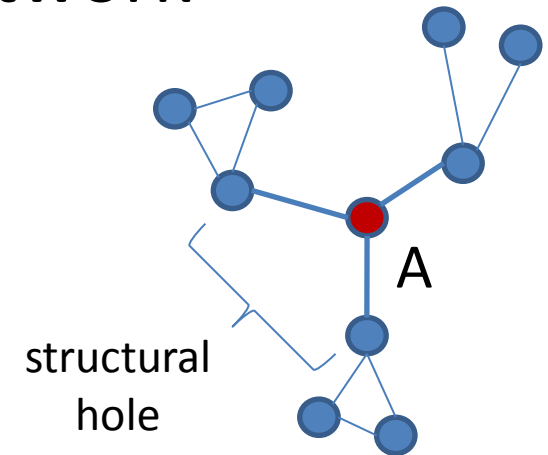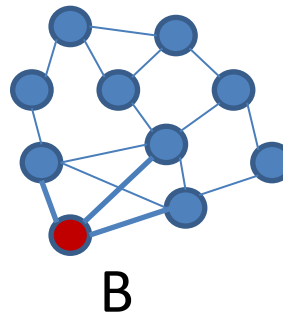
Structural holes and weak ties

- The "arms" of a structural hole are bridges
- Granovetter relatedes bridgeness to tie strength
  - Weak ties are not good in themselves
  - Strong ties create transitivity which creates a closed world with redundant ties
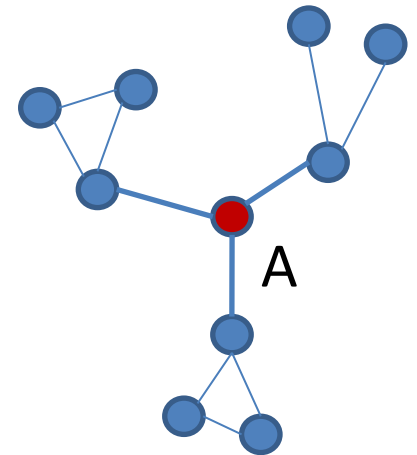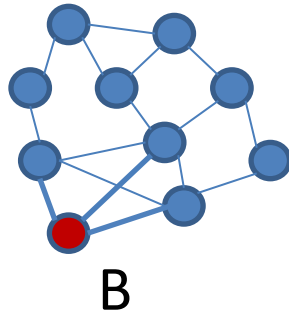
Small World Theory

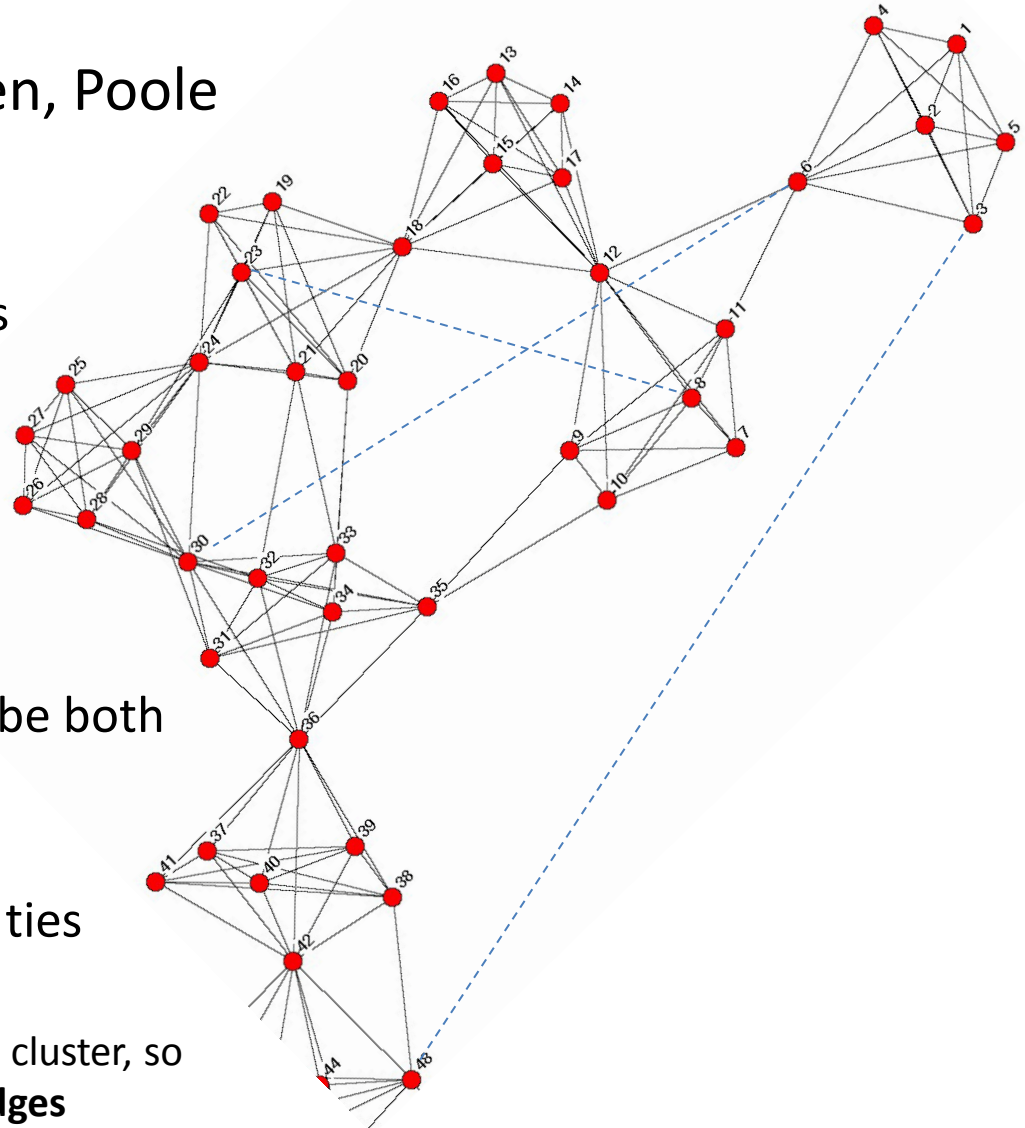- Rapoport, Horvath, Kochen, Poole (1950s)
  - Transitivity creates clumpy networks w/ long distances

- Milgram (1960s)
  - Human network has short distances

- Watts & Strogatz (1998)
  - How can human networks be both clumpy and have short distances?
  - Answer, just a few random ties will do it
    - Most nodes are outside your cluster, so **random ties are usually bridges**

The three theories
share a common universe

Core Model

- Model social systems as networks of nodes and ties
- **The ties act as pipes through which things flow (Atkins backcloth/traffic distinction)**
- Paths permit flows between non-adjacent nodes
- Long paths take longer to traverse
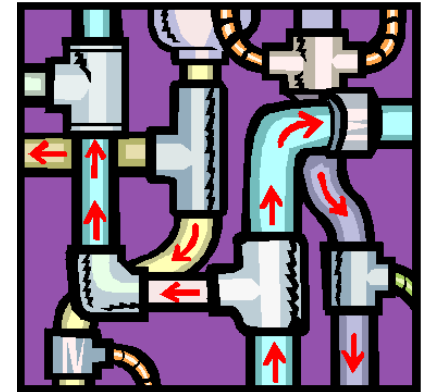
Transitivity-flow claim

- **A derivation or theorem from model relating structure to outcome**
- Clumpy (highly transitive) networks will have long distances relative to other networks with same density
- Transitivity slows flows

Common model + derivation underlies three theories

Core Flow Model

- Model social systems as networks with nodes and ties
- The ties act as pipes through which things flow
- Paths permit flows between non-adjacent nodes
- Long paths take longer to traverse

Transitivity Derivation

- A derivation or theorem from model relating structure to outcome
- Clumpy (highly transitive) networks will have long distances relative to other networks with same density
- Transitivity slows flows

Granovetter:
-Strong ties create transitivity

Granovetter:
-Weak ties are source of novel info

Burt:
- Structural holes provide info benefits leading to rewards

Small world
- Random rewiring shortens paths

Ornamenting
Each author "ornaments" model with different bits (e.g., weak ties, structural holes, random rewirings)

Resolving the Coleman-Burt dispute

- Burt: social capital consists of open networks
  - More non-redundant info coming in
  - Closed networks <u>constrain</u> egos
- Coleman: social capital consists of closed networks
  - Ties among parents, teachers & other adults ensure child does homework … succeeds in life
- But underlying principle is same: ties among alters constrain ego
  - In child's case, constraint is good for ego
  - In manager's case, constraint is bad for ego
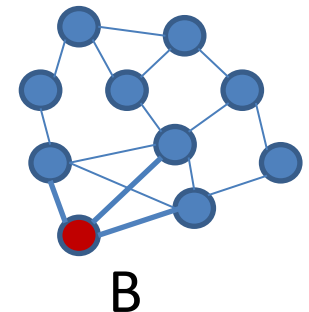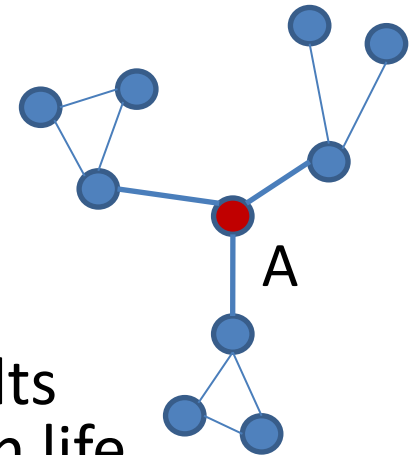
Deriving more theory from flow model

- Transitivity theorem is one of many that can be derived from the flow model
- *Structurally equivalent* nodes will have similar opportunities, constraints, outcomes
  - To extent nodes are structurally equivalent (i.e., connected to same others), they can be expected to have similar flow outcomes
    - Time until arrival
    - Frequency of reaching them

Nodes u and v are structurally equivalent if N(u) = N(v)
where N(u) is the graph theoretic neighborhood of u

Differentiating the flow model

- Can derive some propositions w/out specifying nature of flow
  - But for others (e.g., time until first arrival, frequency of flow to each node), need to specify characteristics of the flow process
- Characterizing how things flow
  - What kinds of trajectories are possible (or more probable)
    - Geodesics: shortest path between two nodes (CDE) PACKAGE
    - Paths: can't visit a node more than once (CDGE) VIRUS
    - Trails: can't use any edge more than once (CDBGDE) GOSSIP
    - Walks: unrestricted – can repeat edges (CDCDBGBE) $ BILLS
  - Transmission types
    - Replication (after transmission, both source and target have copy)
      - Serial (first send to one contact, then another)
      - Parallel (send to two contacts simultaneously, as in a broadcast)
    - Transfer (what flows can only be in one place at a time)