

Lecture 6: Network dynamics

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Three rules of epidemics

- What tips an infection?
 - Small changes in connections between neighborhoods?
 - External forces upsetting stable system equilibria?
 - Changes in individuals' behavior and situation?

Law of the Few

- How does having a few exceptionally well-connected people affect tipping point?
- **80\20 rule:** a minority of the population is responsible for the majority of the activity
 - Hundreds of sexual partners, business associates, friends
 - Heidi Roizen and Lois Weisberg



Stickiness Factor

- If attributes be spread over network ties, what gives it an impact and makes the attribute spread?
- Stickiness, catchiness, virality, memorable
 - Memes: self-replicating ideas



Power of Context

- How do we alter our behavior based upon a particular situation?
- Subconscious sensitivity to group size & neighbors' behavior
 - Genovese attack and 38 witnesses: no police called
 - Latane & Darley's bystander effect
 - Christakis & Fowler: obesity, happiness, loneliness as contagions



Changes on networks

- We've only considered static networks to date
 - Snapshots of Facebook, web, social groups
 - "Cross sectional data"
- How did these networks grow? How can networks change?
 - Nodes & edges can be added & removed
 - Attributes of nodes & edges can change
- Examples?



Data

- *Dynamics* implies changes in time or age
- Longitudinal data necessary to measure changes over time and make strong causal claims
 - Repeated measurements of the same network
- Collection problems:
 - **Left censoring**: important changes happened before data collection
 - **Right censoring**: data collection does not last long enough to capture important changes
 - Omitting important actors, over-recall & measurement inconsistencies, panel conditioning & attrition, missing data, etc.



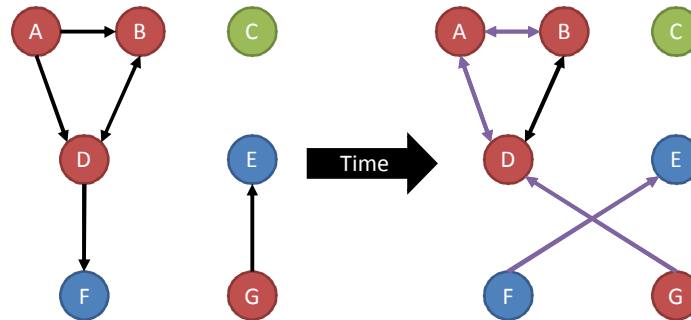
Selection vs. Influence

- Selection: Immutable characteristics
 - Race, ethnicity, gender, etc.
 - **Simple** process: Attributes remain fixed and influence how connections are formed
 - Homophily
- Influence: alterable characteristics
 - Interests, activities, infectiousness, etc.
 - **Complex** process: Feedback and interactions between ego's attributes, network structure, alters' attributes
 - Diffusion and coevolution



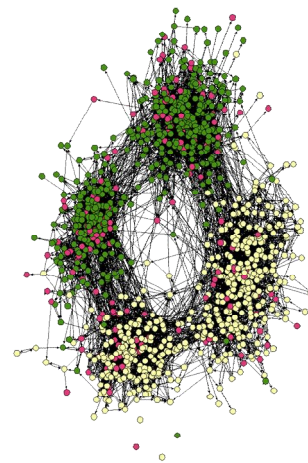
Homophily

- Existing attributes drive creation & destruction of connections
- “Birds of a feather flock together”



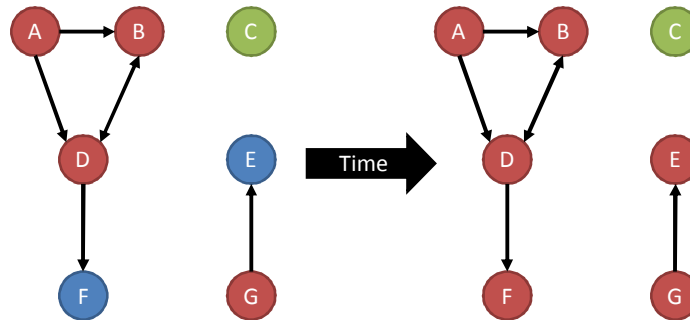
Measuring homophily

- Ex: Friendship network of boys and girls
- No homophily
 - Random mixing: equal or non-significant differences in likelihood of boy-girl friendship ties as girl-girl or boy-boy
- Homophily: same loving
 - Boy-girl ties significantly *less* likely than boy-boy\girl-girl
- Heterophily: different loving
 - Boy-girl ties significantly *more* likely than boy-boy\girl-girl ties



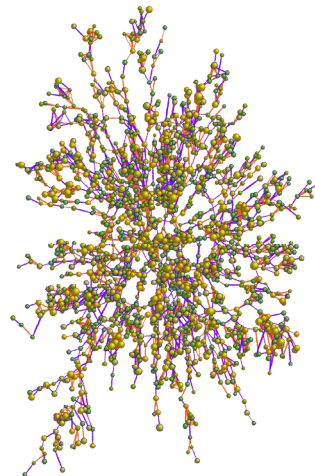
Diffusion

- Existing connections drive creation & destruction of attributes



Obesity contagion

- Are people forming or dissolving friendship ties based on obesity status?
- Are people forming or dissolving friendship ties based on attributes correlated with obesity status?
- Are people's obesity statuses influenced by their friends' obesity statuses?



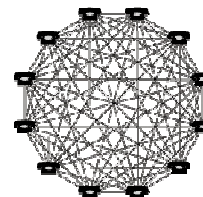
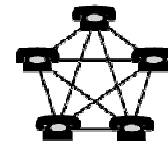
Information cascades

- Contagion by imitation
 - **Rational:** crowded bar vs. empty bar
 - **Conformity:** group size of Milgram's sky-starers
- Informational effects
 - Choices made by others provide indirect information about what they know
- Direct-benefit effects
 - Copying others' decisions has direct payoffs: network effects
- Implications for viral marketing, political campaigning, managerial decision-making?



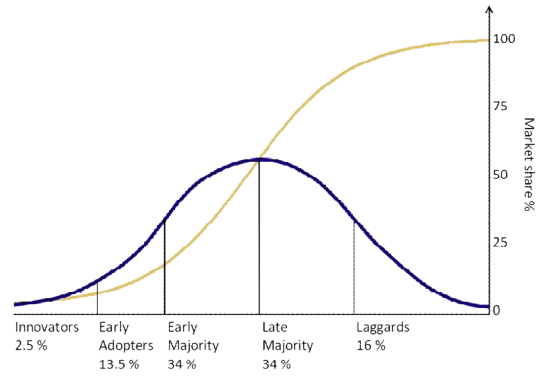
Network effects

- Value of a good or service is proportional to the number of other people who use it
 - Telephones, fax machines, Facebook
 - Collective action problem
- Commons problem = inverse network effects
 - Highways, fisheries, children



Diffusion & adoption of innovation

- Everett Rogers' adoption process
 - Knowledge
 - Persuasion
 - Decision
 - Implementation
 - Confirmation



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