Knowledge & Networks: A Research Agenda

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So, can we go now?

Knowledge is social.

(end of seminar?)

Recent research on knowledge

- Communities of Practice
  - Much knowledge is tacit
  - Knowledge embedded in practice & routines
  - Highly situated in contexts
  - Learned through participation: apprenticeship
- Transactional memory
  - Knowledge distributed across different heads
  - Exploiting organization's knowledge requires knowing who knows what

I interact, therefore I know

When people interact,
they share knowledge,
change knowledge,
create knowledge.

Ergo

What knowledge there is and who has it,
is affected by who interacts with whom

I see an opening for networks!

There are implications at two levels:

- Factors that determine who interacts with whom will affect what knowledge is created and who knows what
  - What determines who interacts with whom?

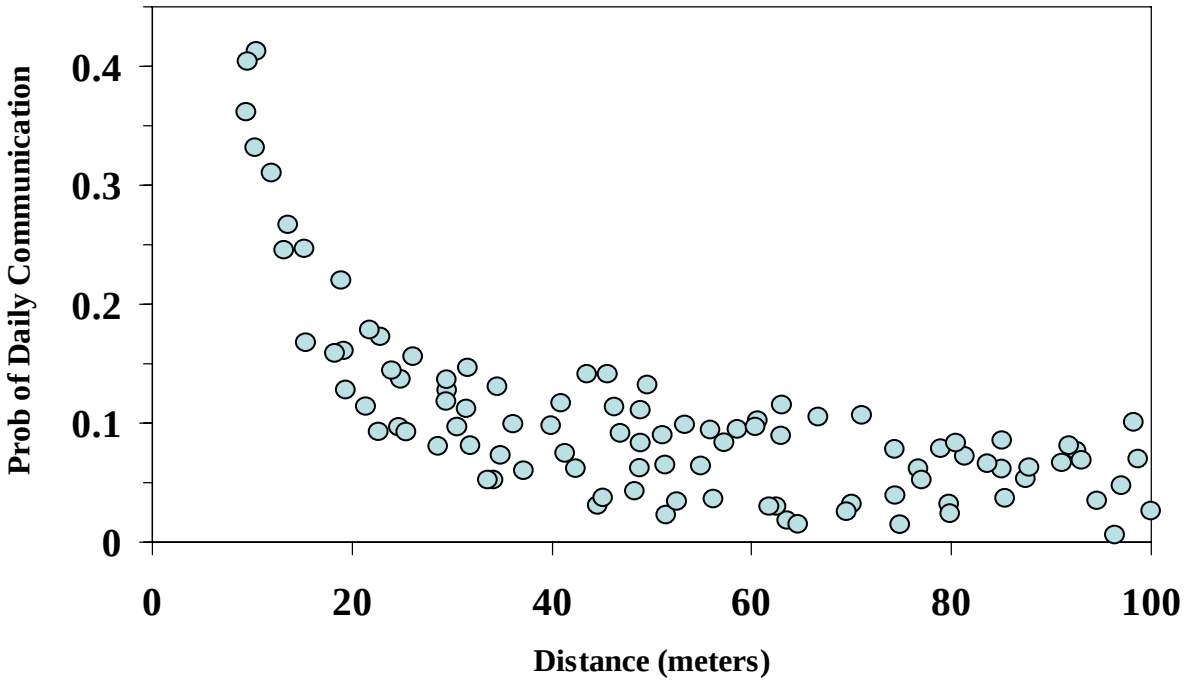
Micro

- Structure of a network affects what knowledge exists, who has it & how accessible it is
  - Shape of the network: Cliques? Random?
  - Distribution of centrality: Some key players?

Macro

Propinquity

- People tend to interact with those who are physically proximate



From research by Tom Allen

Homophily

Who do you discuss important matters with?

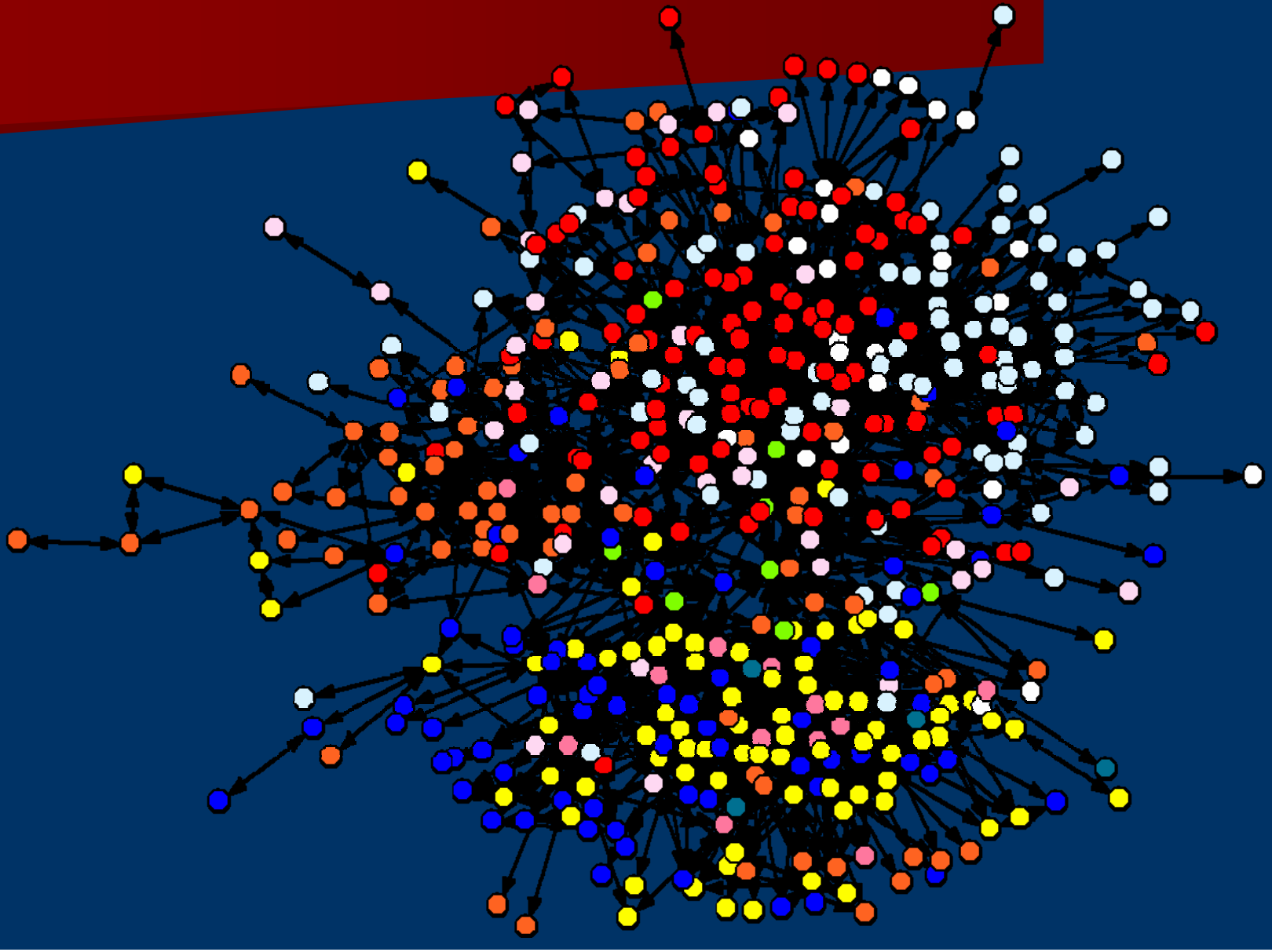
	Male	Female
Male	1245	748
Female	970	1515

	White	Black	Hisp	Other
White	3806	29	30	20
Black	40	283	4	3
Hisp	66	6	120	1
Other	21	5	3	34

Age	< 30	30-39	40-49	50-59	60+
< 30	567	186	183	155	56
30 - 39	191	501	171	128	106
40 - 49	88	170	246	84	70
50 - 59	84	100	121	210	108
60 +	34	127	138	212	387

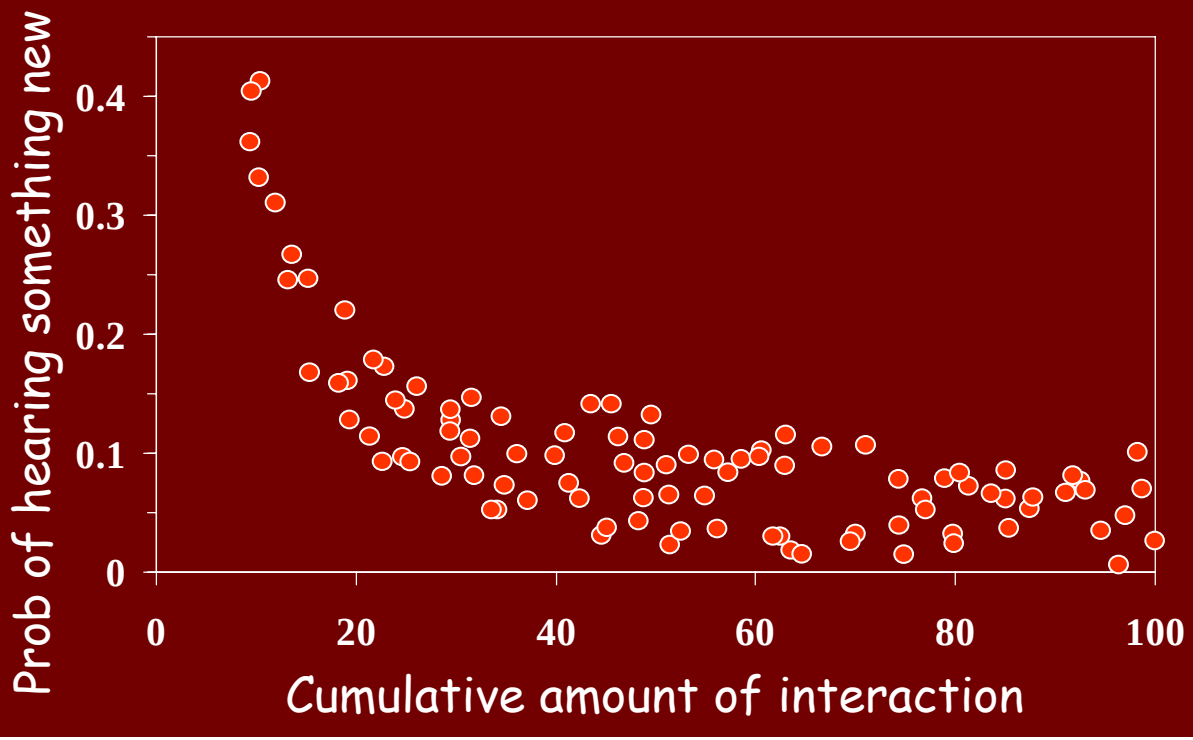
Source:
Marsden, P.V. 1988. Homogeneity in confiding relations. *Social Networks* 10: 57-76.

Rand collaboration network



Homophily is self-perpetuating

- Interaction → shared knowledge → more interaction
- People get locked into "network cages"



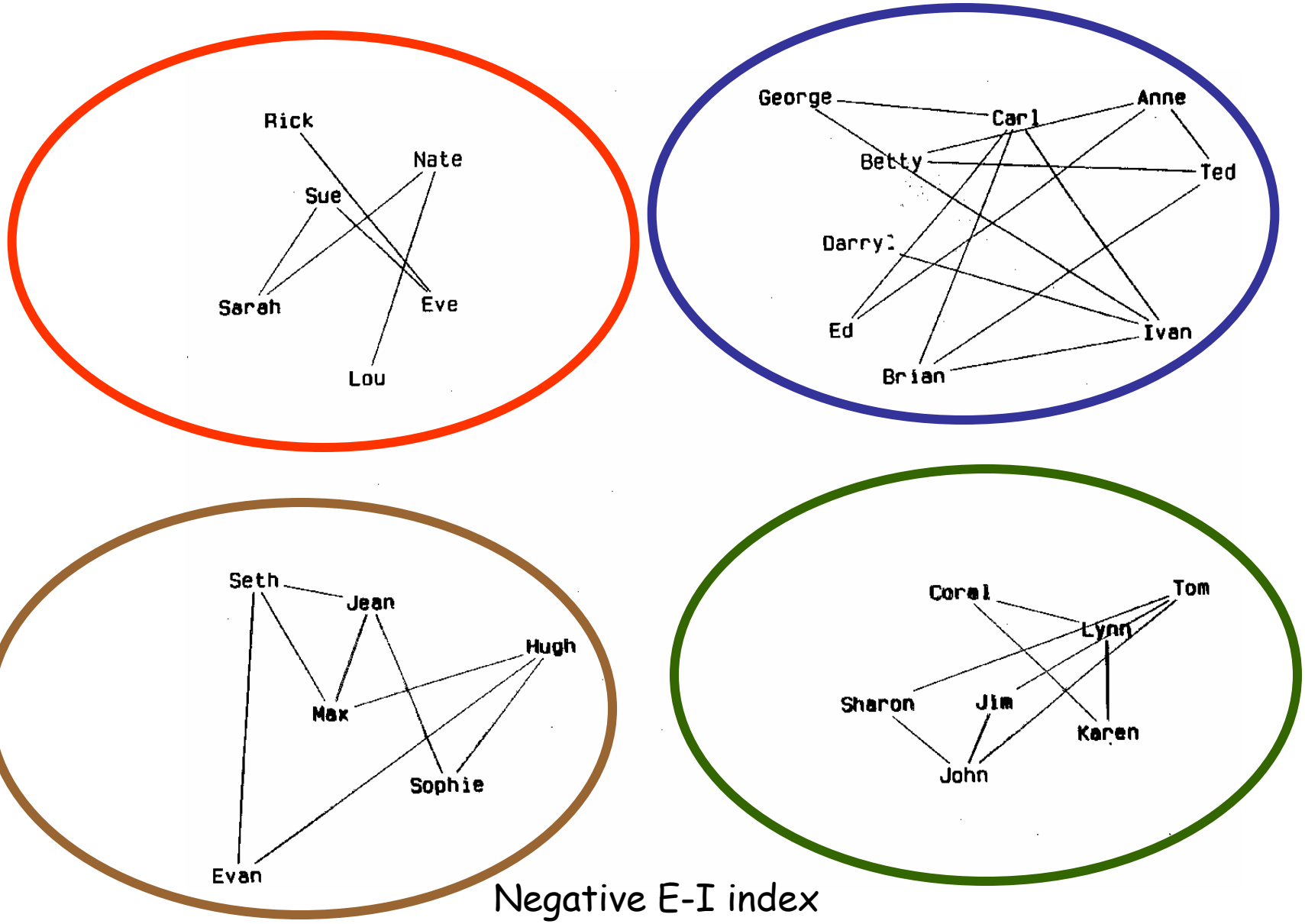
E-I Index

- We can measure the relative homophily of a group using the E-I index

$$\frac{E - I}{E + I}$$

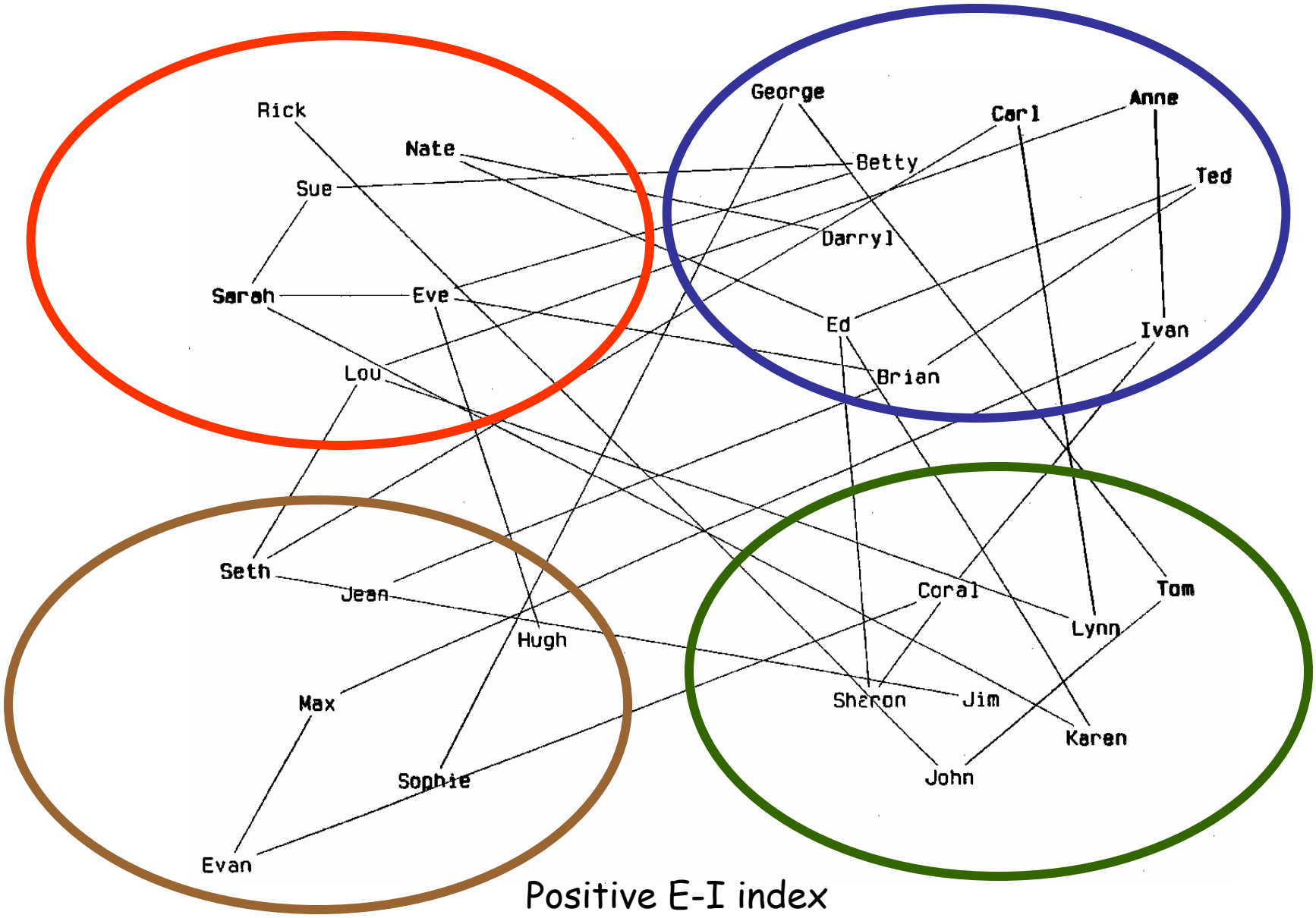
  - E is number of ties between groups (External)
  - I is number of ties within groups (Internal)
- Index is positive when a group is outward looking, and negative when it is inward looking
  - E-I index is often negative for close affective relations, even though most possible partners are outside a person's group

The Natural or Homophilous Organization



Negative E-I index

The Optimal or Heterophilous Organization



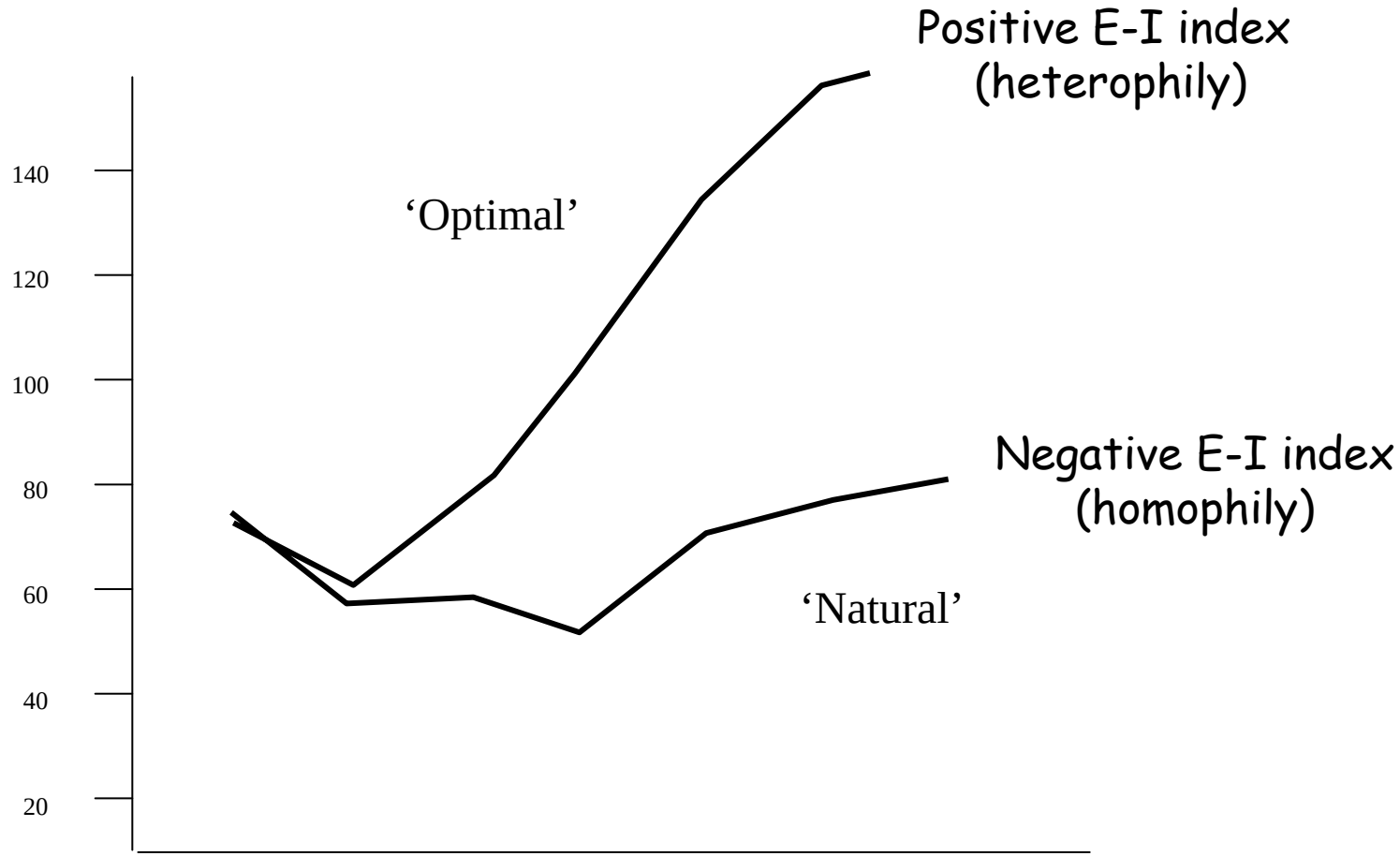
Positive E-I index

Krackhardt & Stern Experiment

- MBA class divided into two independent organizations
  - Each subdivided into 4 departments, with some interdependencies
- Measure of overall performance
  - financial performance, efficiency, human resource metrics
- Staffing controlled by the experimenter
  - "natural org" placed friends together within departments
  - "optimal org" separated friends as much as possible (high E-I value)
- As game unfoled, the experimenter introduced organizational crises, such as imposing layoffs

Krackhardt, D. & Stern, R.1988. Informal networks and organizational crises. Social Psychology Quarterly 51(2): 123-140

Experimental Results



6 trials at 3 universities. Results shown for most dramatic trial.

Why?

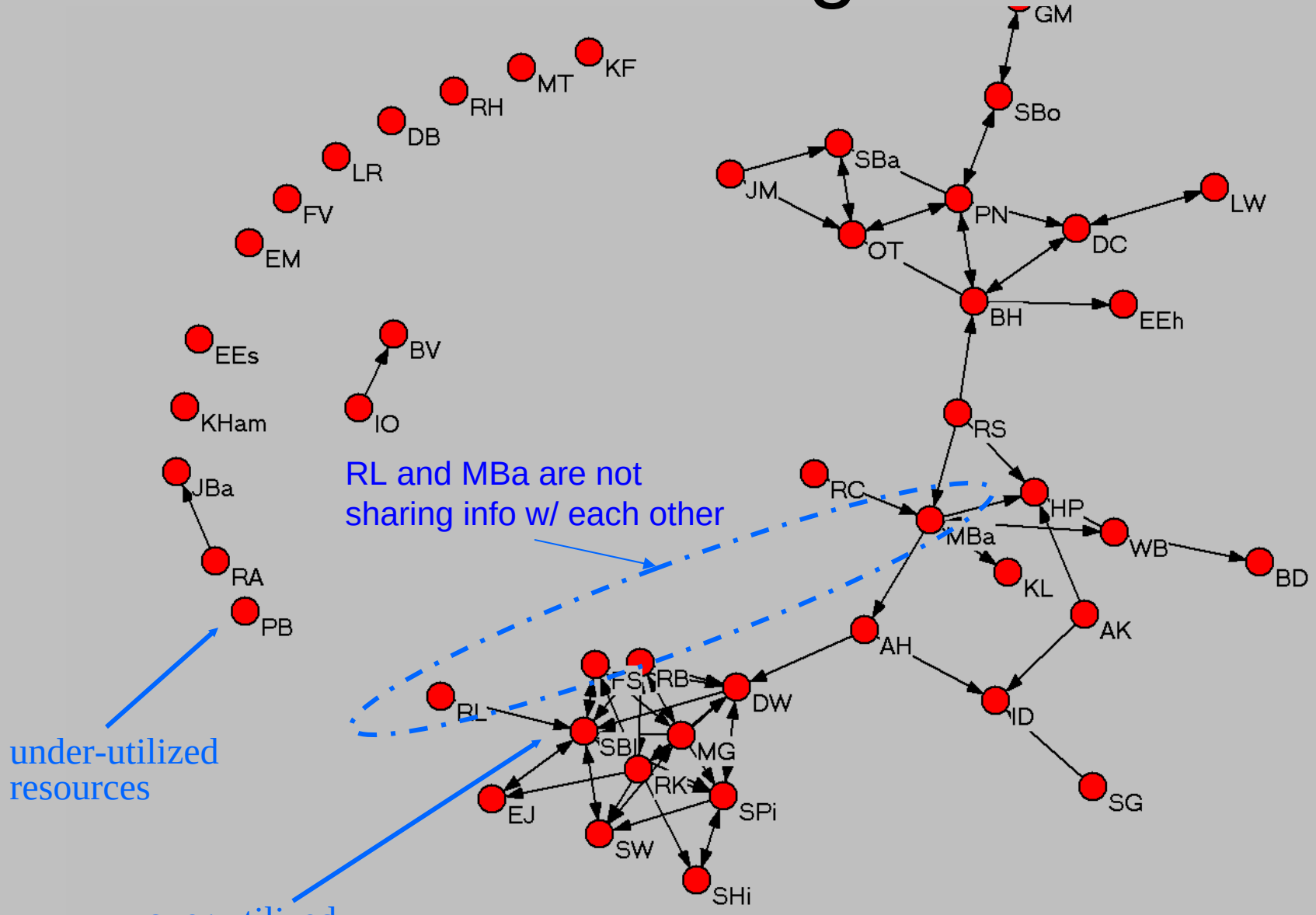
- In crises, organizations need to share information and solve problems across departments
- With positive E-I index, we see joint problem-solving and information sharing
- With negative E-I index, we see blaming, information hoarding
- Therefore, performance is better in orgs with positive E-I index

What else does knowledge sharing interaction depend on?

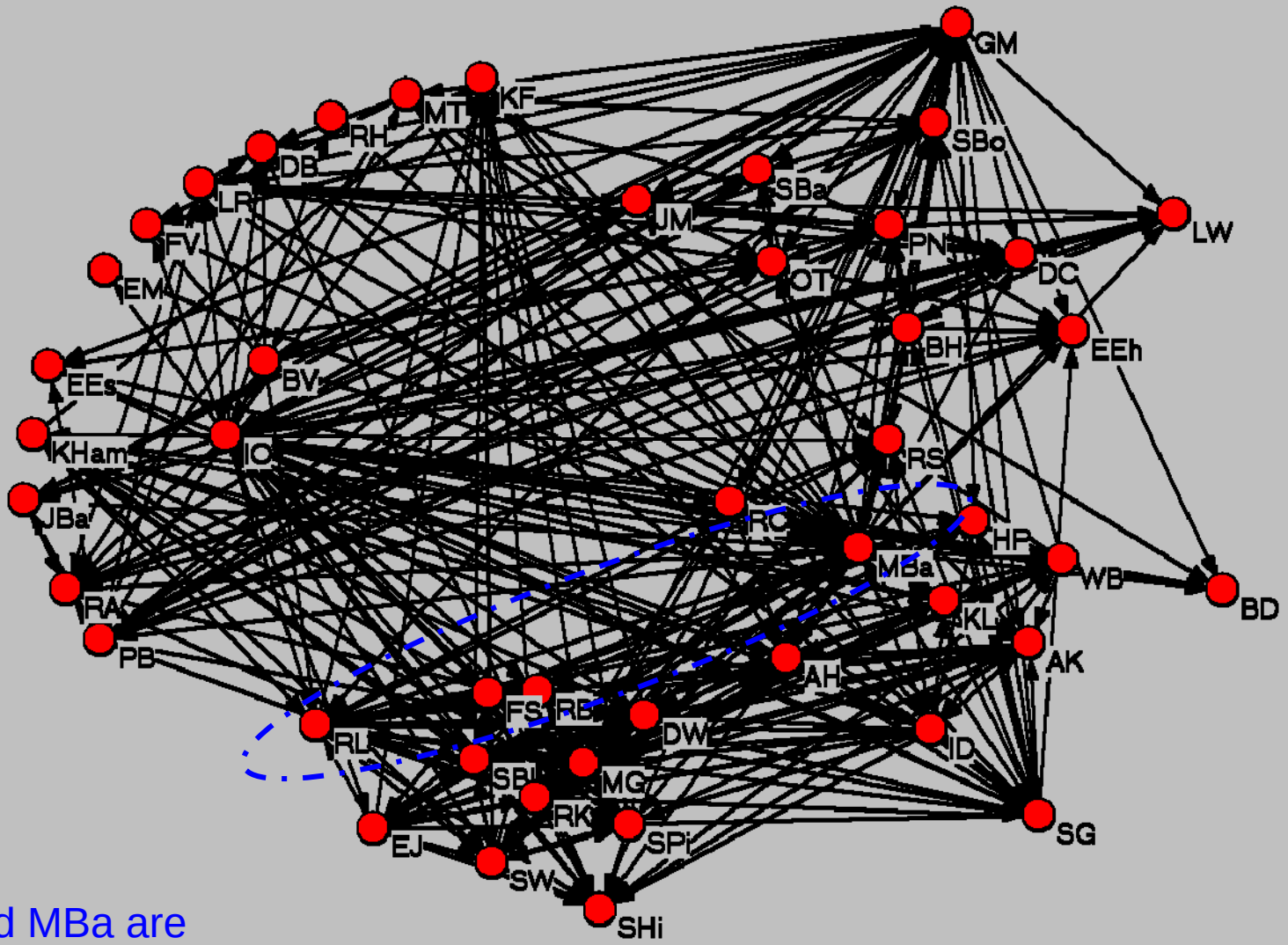
- Does A know what B's area of expertise is?
- Does A have good impression of B's knowledge?
- Does A have access to B?
- Does A feel the costs of approaching B are too high?

Borgatti, S.P. and Cross, R. 2003. A Social Network View of Organizational Learning. *Management Science*. 49(4): 432-445 .

Information Seeking

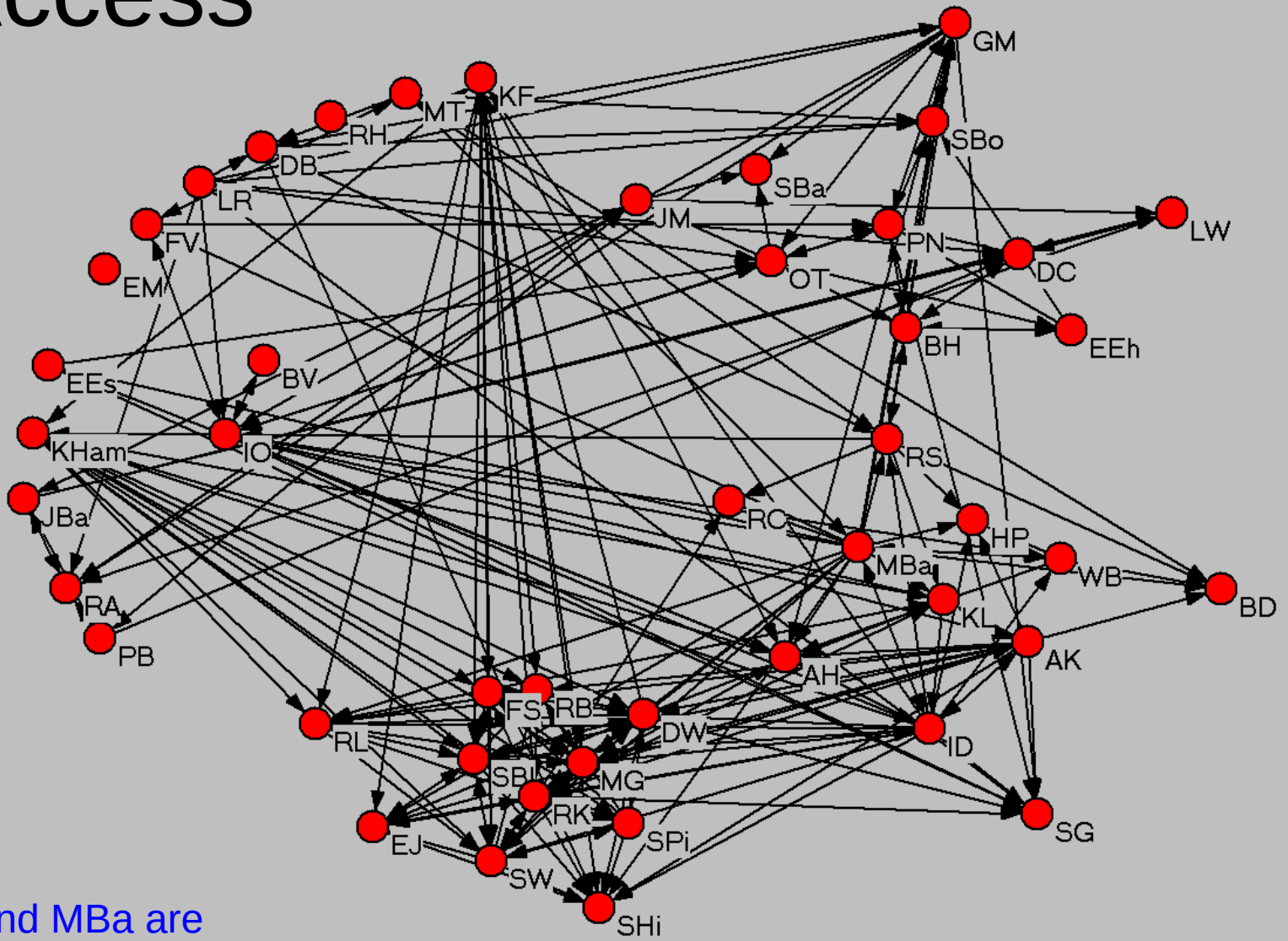


Costs



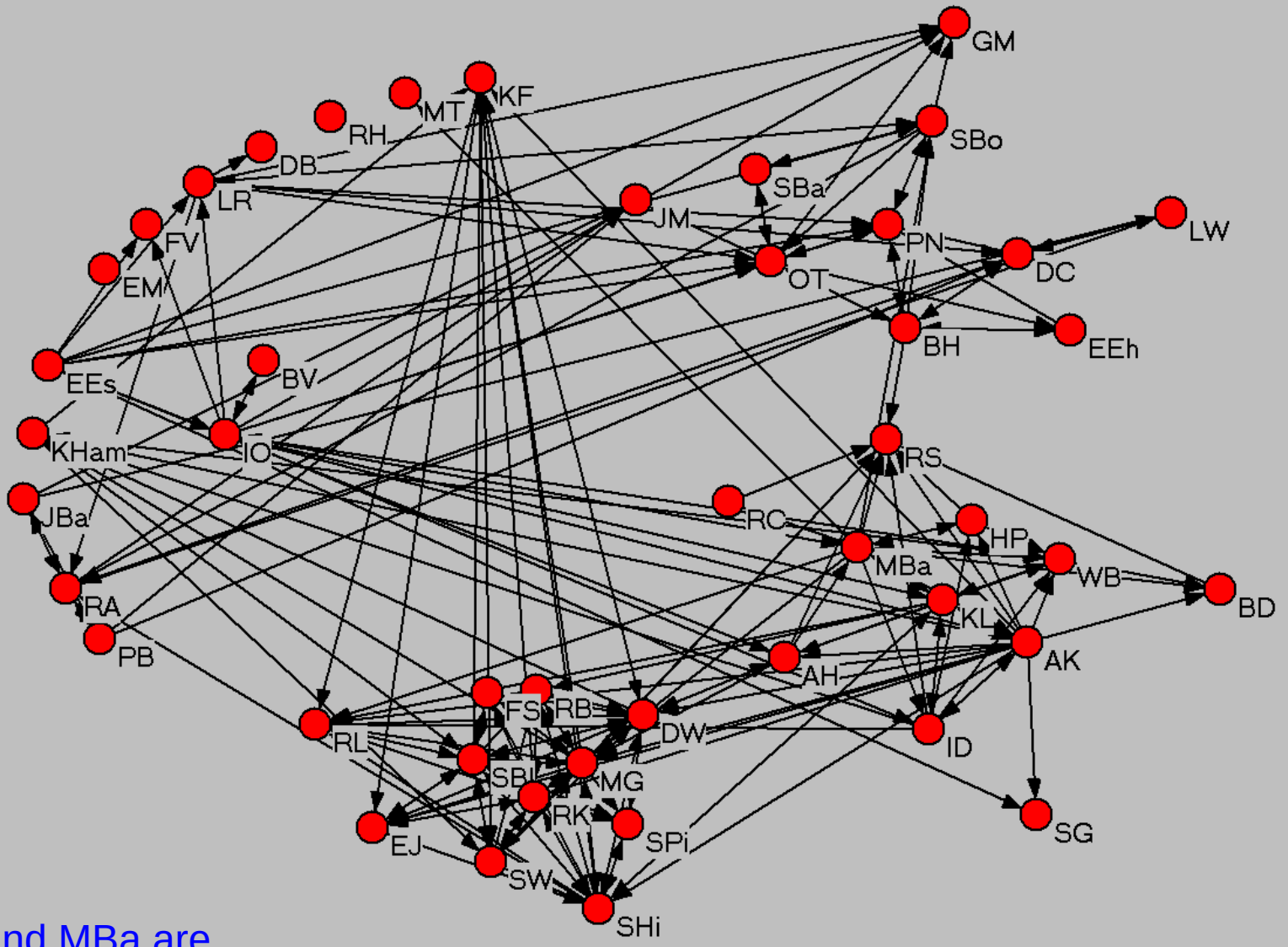
RL and MBa are
connected on security, so that's not the problem

Access



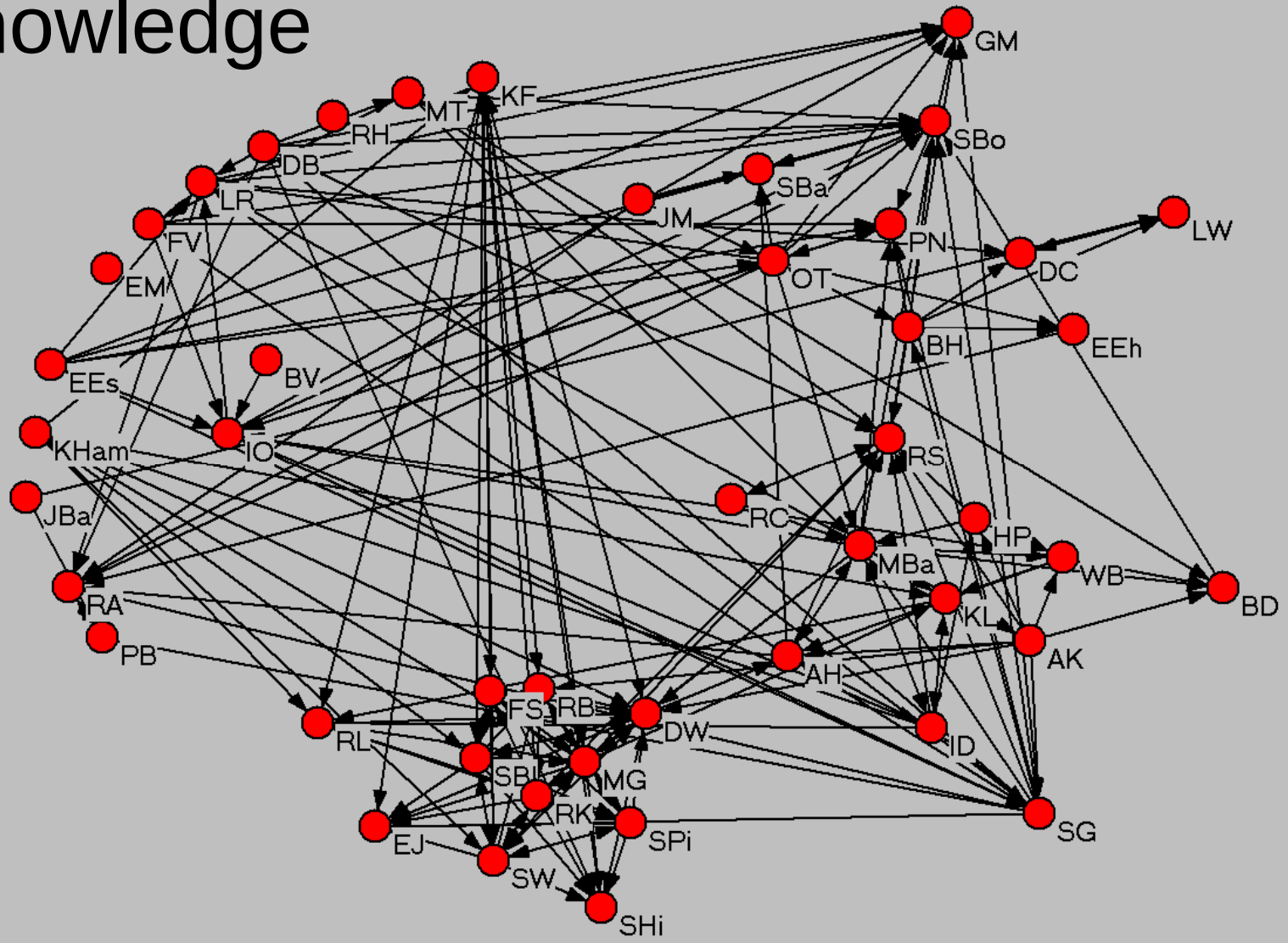
RL and MBa are
connected on Access, so that's not the problem

Knowing what they know about



RL and MBa are
connected on Knowing, so that's not the problem

Values –whether A values B's knowledge



The problem: RL and MBa are NOT connected on Values relation (they don't have positive impression of each others' level of knowledge).

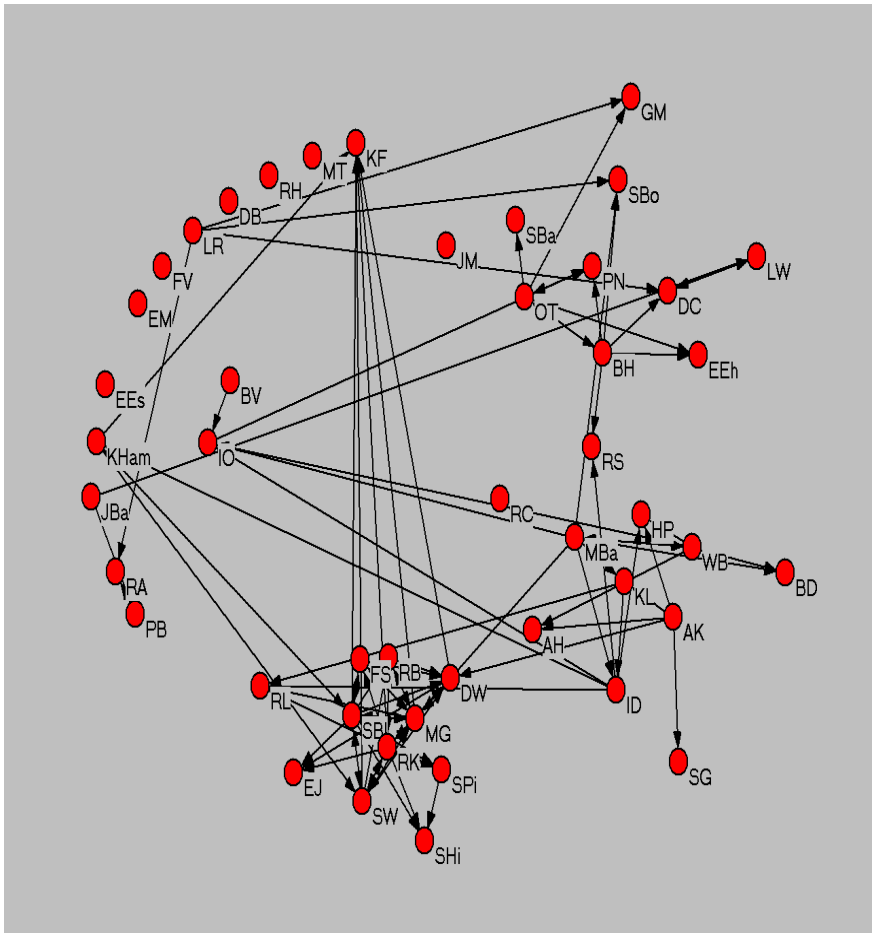
Tailored Interventions
when the problem is …

- Knowing (people don't know much about each other)
  - knowledge fairs, intermediation or skill profiling systems
- Valuing (people have poor reputations or low levels of knowledge)
  - skill training programs, job restructuring
- Access (people cannot easily interact)
  - co-location, peer feedback, recognition/bonuses or technologies.
- Security (not safe to admit ignorance)
  - peer feedback, face to face contact, cultural interventions.

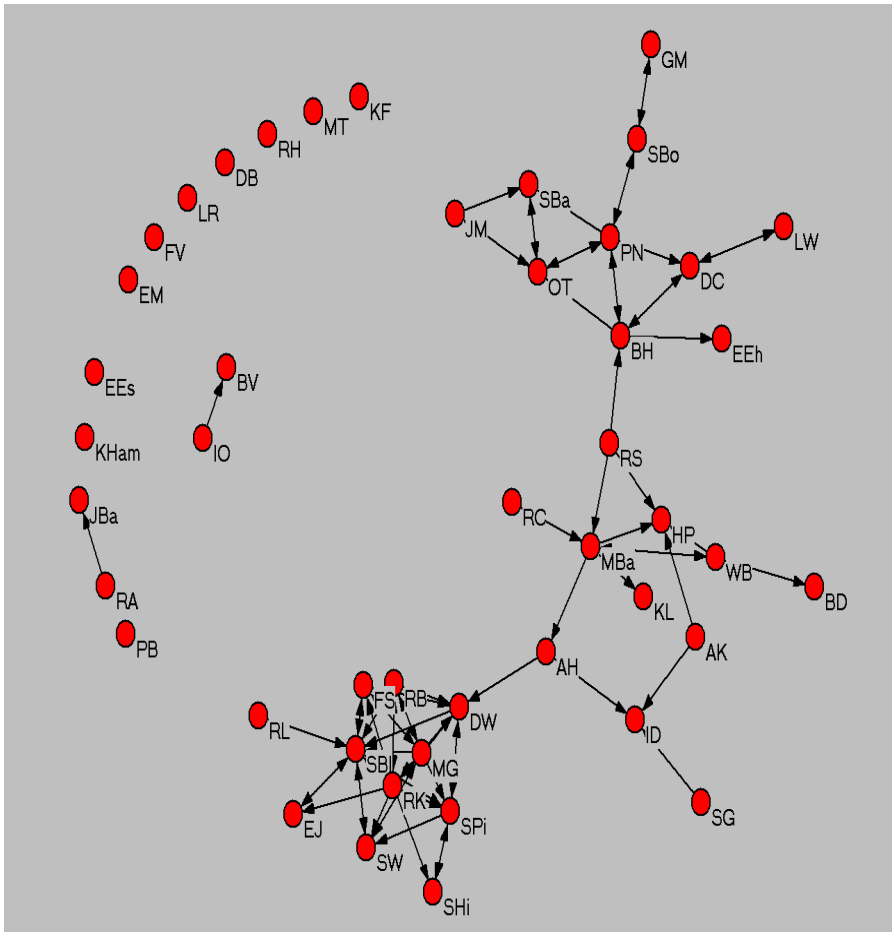
Predicting the future

- If we know what the factors are that need to be in place before A will seek advice from B (e.g., knowing what B's area is, having access, etc.), then
  - We can make a map that puts a line between any pair of persons who have all the right conditions for seeking advice from each other
    - In short, a map of potential advice seeking
  - In effect, predict the eventual pattern of information flow

Potential vs actual information seeking

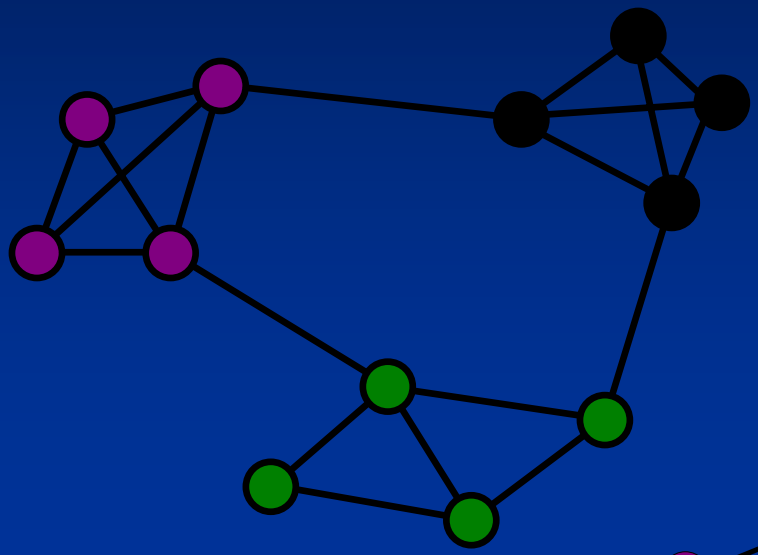


Potential information seeking
(based on regression of information seeking on relational conditions)

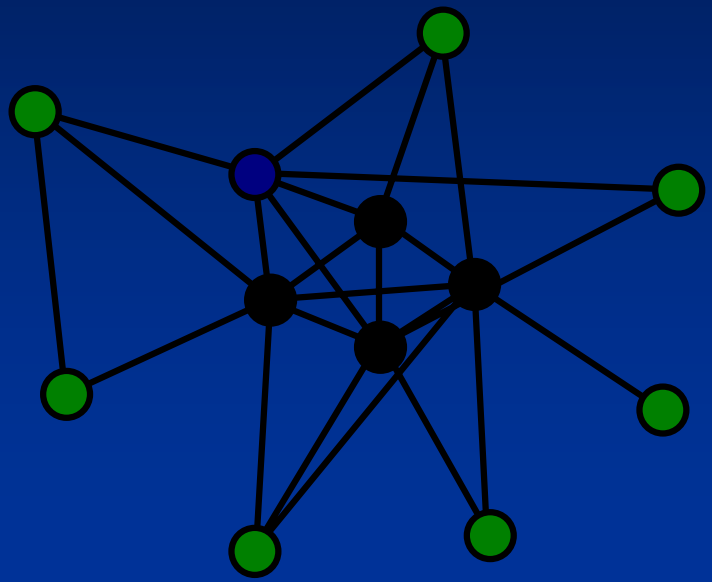


Present information seeking

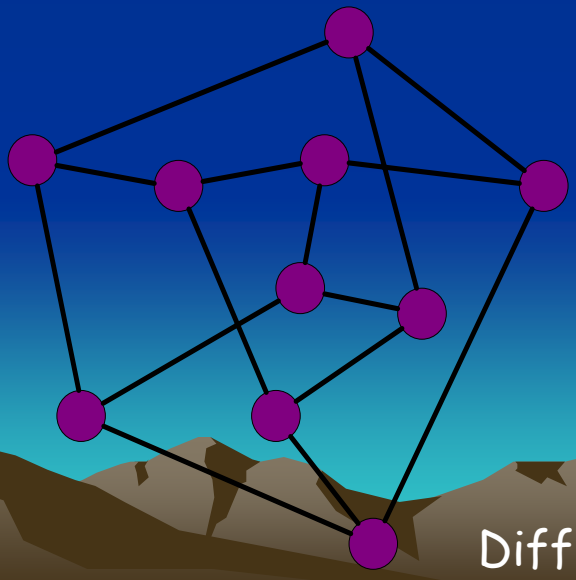
The structure of networks of interaction must affect the diversity and distribution and exploitability of knowledge



Clique network



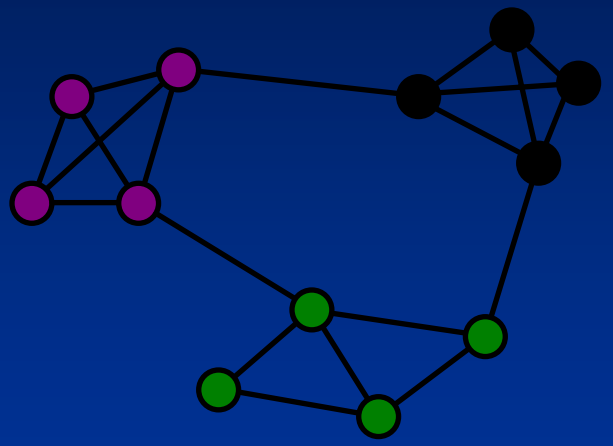
Core/periphery net



Diffuse network

Clique networks

- Knowledge hoarding
- Global diversity, local homogeneity
- Radical innovation



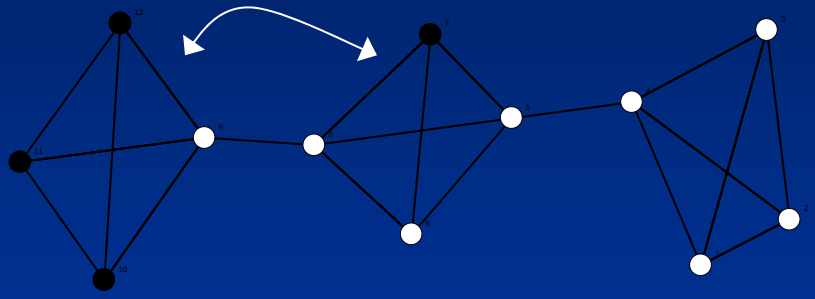
"I would never have conceived my theory, let alone have made a great effort to verify it, if I had been more familiar with major developments in physics that were taking place. Moreover, my initial ignorance of the powerful, false objections that were raised against my ideas protected those ideas from being nipped in the bud."

– Michael Polanyi (1963), on his contribution to physics

Krackhardt Viscosity Simulation

- When adoption of innovation is governed by friends' adoption
  - Then is better to concentrate initial adopters rather than intermingle with general pop - but not too much!

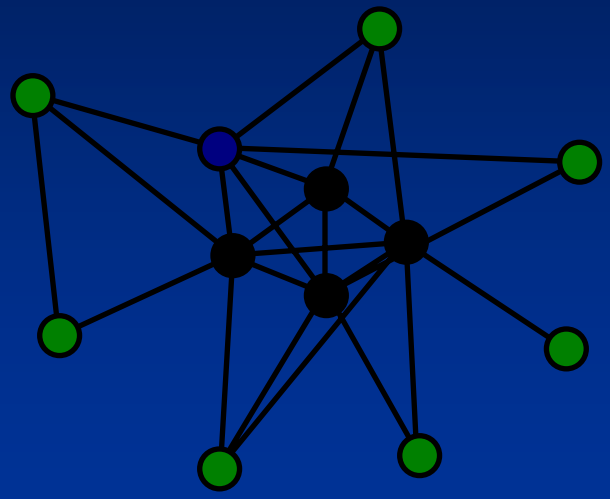
Viscosity = rate of immigration



Low Migration	Medium Migration	High Migration
Only local cluster adopts – not enough movement to support global adoption	Global adoption occurs – innovation spreads to all clusters	Status quo wins – innovation dies out everywhere

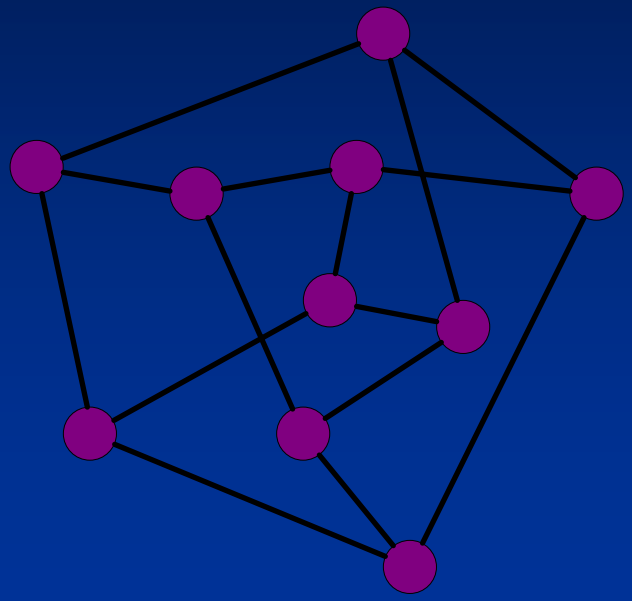
Core/Periphery Structures

- Sharing best practices
  - Group identity
  - Groupthink?
- Efficient coordination
- Central homogeneity peripheral diversity
  - But core are gatekeepers of innovation

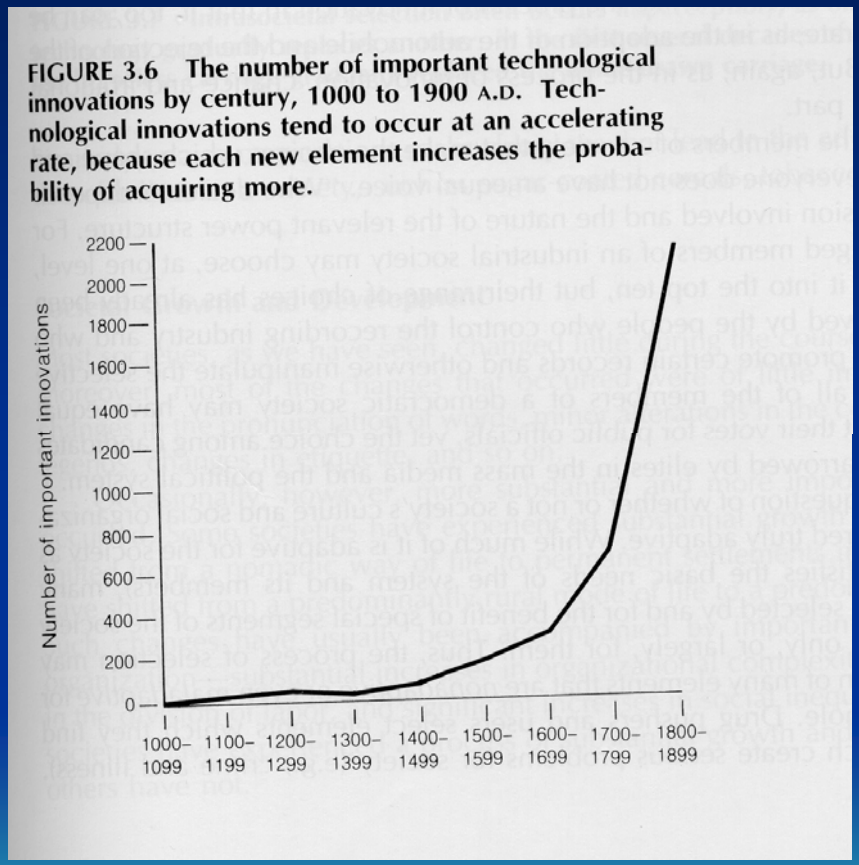


Diffuse Structures

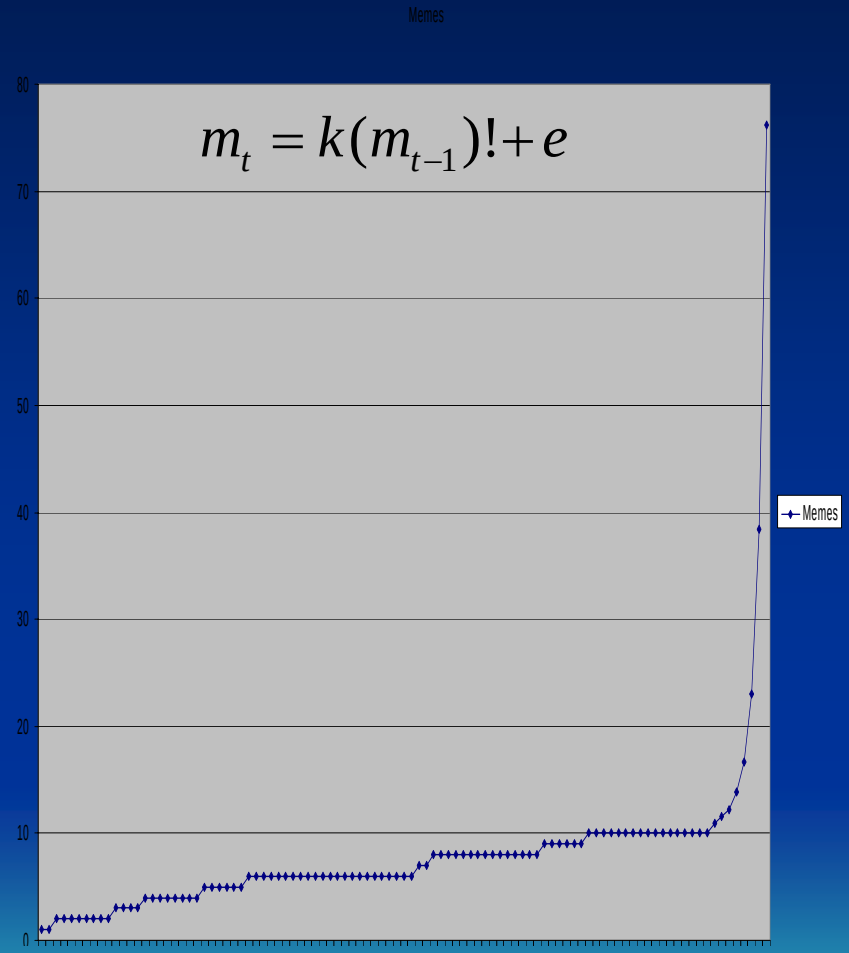
- Global homogeneity
  local diversity
- Knowledge sharing
- Incremental innovation
- Individual creativity
  - Each individual is well-connected to non-connected others



Recombination → Innovation



Growth in human technological innovation. (Lenski & Lenski)



Growth in the number of combinations as a function of number of elements

March's (1991) simulation examined organizational learning as a function of learning rates, turnover, environmental turbulence, etc. Simulation uses vector with values {-1, +1} to represent reality (a series of true/false propositions). Individuals consist of vector of beliefs {-1,0,+1} where value of 0 means no opinion yet. The "organization code" is like a super-individual with beliefs {-1,0,+1}.

Individuals learn only from the organizational code (w/ probability p1) and the code learns from individuals smarter than itself (w/ prob p2), where smartness is determined by correlation with the reality vector.

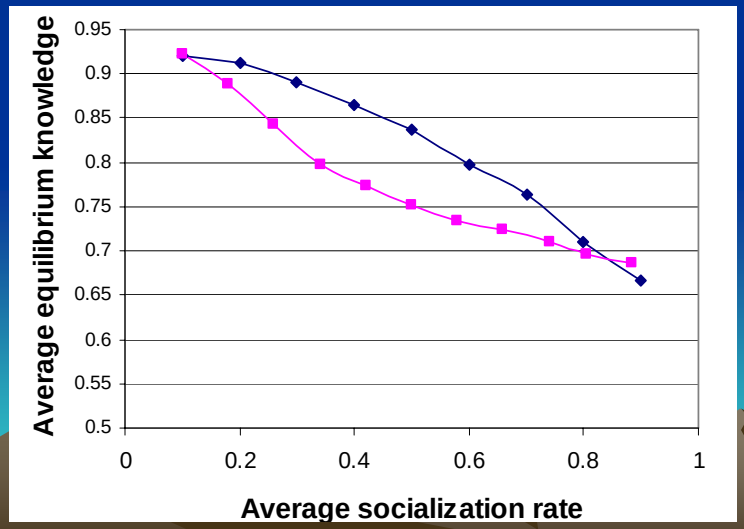
Organizational code is a convenient fiction that ignores actual processes of individuals learning from each other. What is the cost of ignoring these interactive processes? Are the results in any way artifactual as a result?

Use of a single org code precludes modeling of subcultures. Do the results hold when multiple cultures exist?

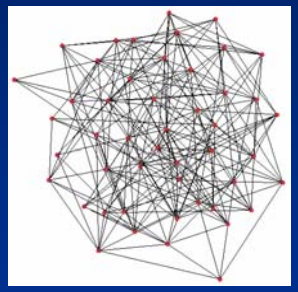
Use of the organizational code precludes investigation into how structure of communication network affects org learning performance. E.g., do centralized networks learn better? Also prevents investigation into how the distribution of knowledge across network positions affects org learning performance, not to mention individual performance.

Individuals learn from those in their network neighborhoods smarter than themselves (w/ probability p1).
Networks can be empirically measured or simulated with varying structural characteristics, such as density and shape.

Each of March's results is tested using simulated networks in which nodes are connected at random with each other with varying levels of density (no. of ties in network).
Most results hold up, but one is strongly contradicted.

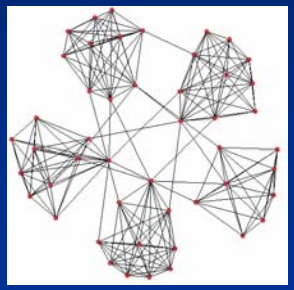


We consider diffuse (random) networks versus clumpy networks.

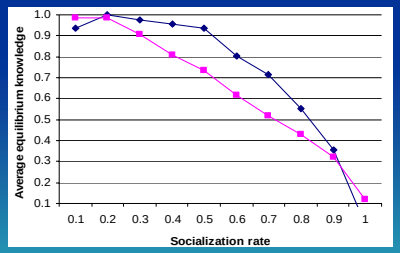


Diffuse

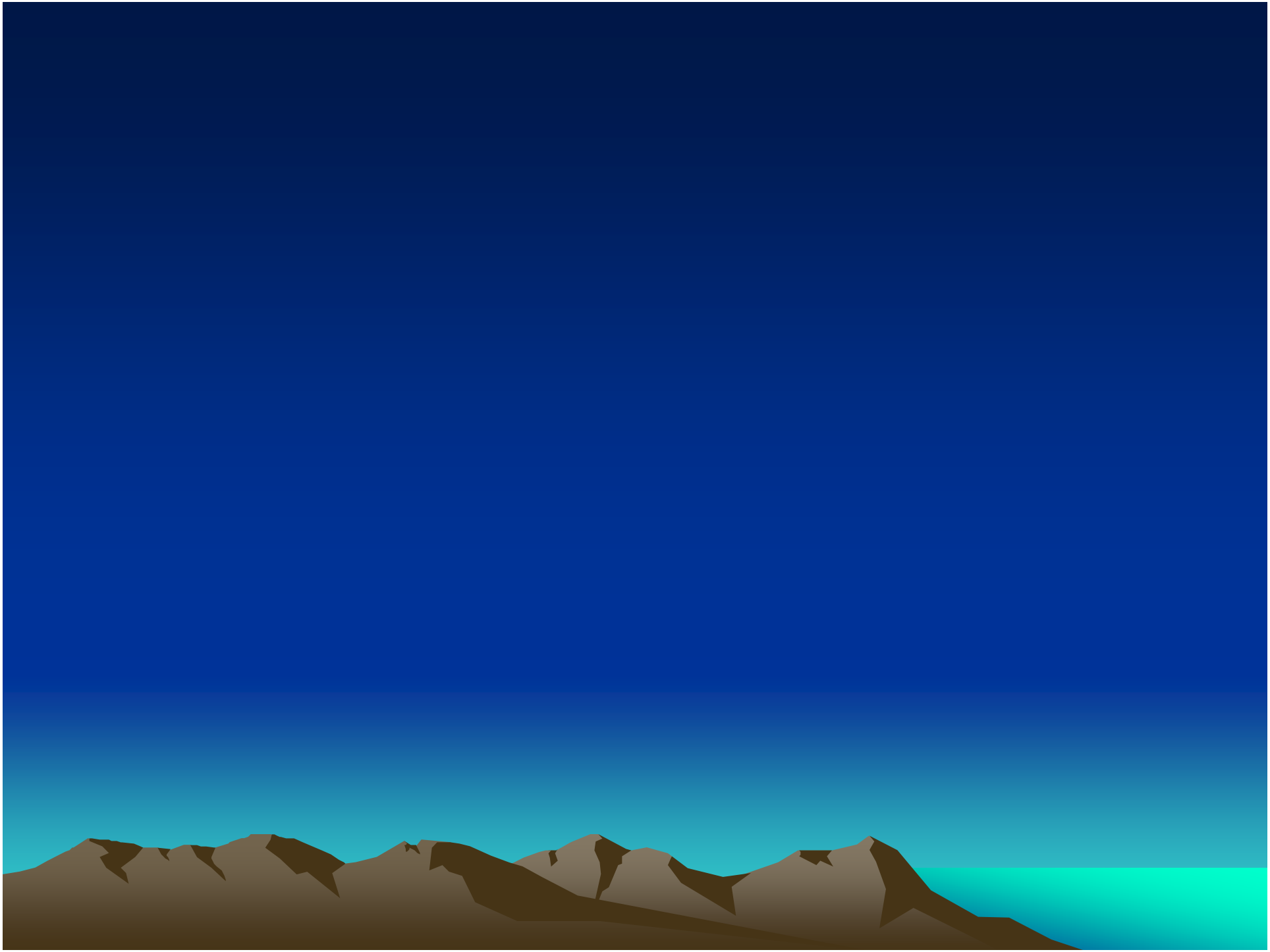
Clumpy



Results show that, under stable conditions, clumpy networks outperform diffuse networks by retaining pockets of diversity.



However, when there is turnover, diffuse networks slightly outperform clumpy ones, presumably because they spread information better.

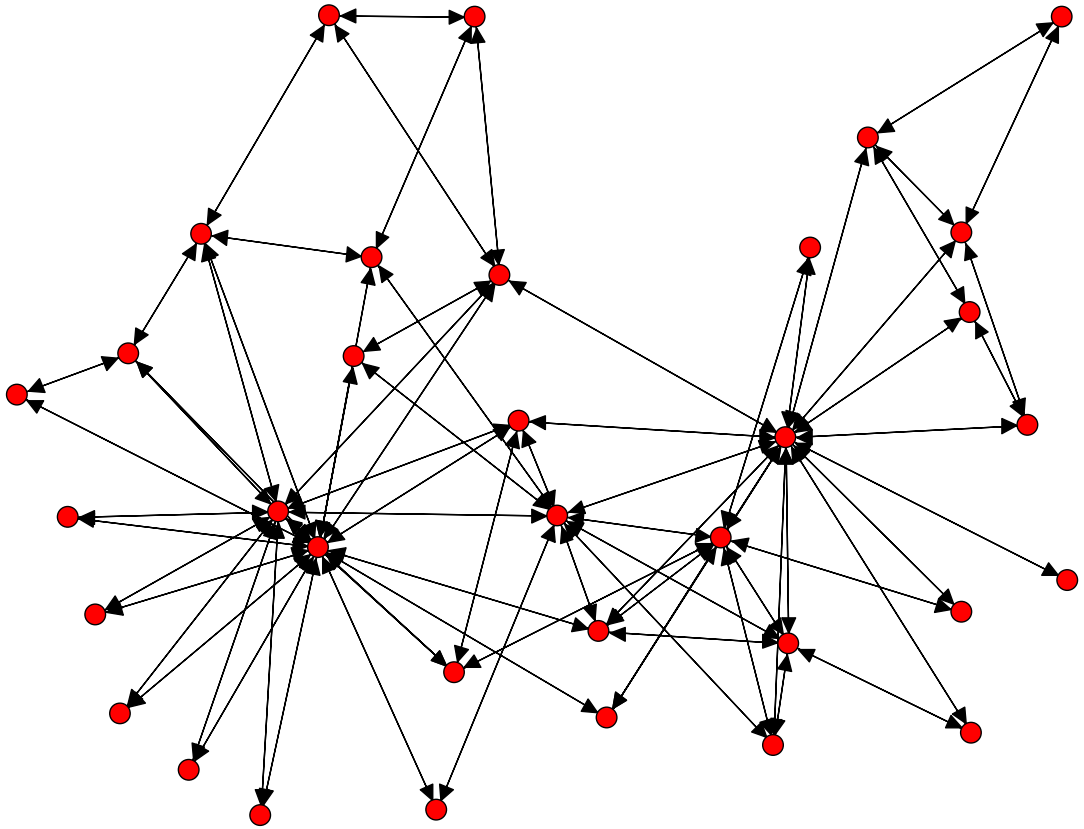


Diversity of Inputs

- Network size
  - More ties = more diversity
- Weak ties
  - More weak ties = more diversity (because they are less homophilous)
- Betweenness (struct. holes)
  - More non-redundant ties = more diversity
- Alter heterogeneity
  - Alters are heterogeneous with respect to demographics, attitudes, experiences, etc.

Key Players

- Presence of a few individuals with very high connectivity makes networks searchable
  - Particularly if key players are highly visible



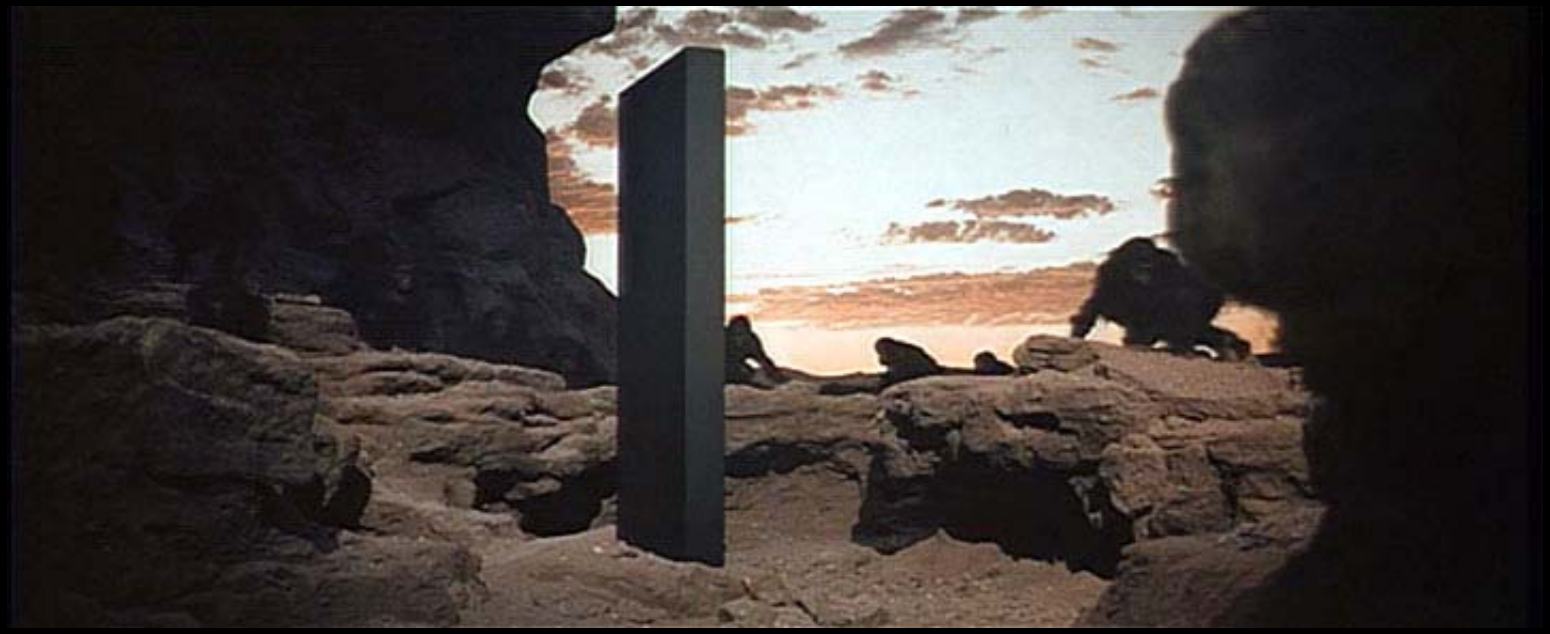
Another consequence of reputational and prestige systems?

Summary

- If we are interested in what knowledge is created and how it is distributed, we should be interested in social networks
- At the micro level, social relationships control knowledge sharing & co-creation
  - Central people more knowledgeable
  - High betweenness → more creative
- At macro level, structure of social networks affects types of innovation

A look ahead

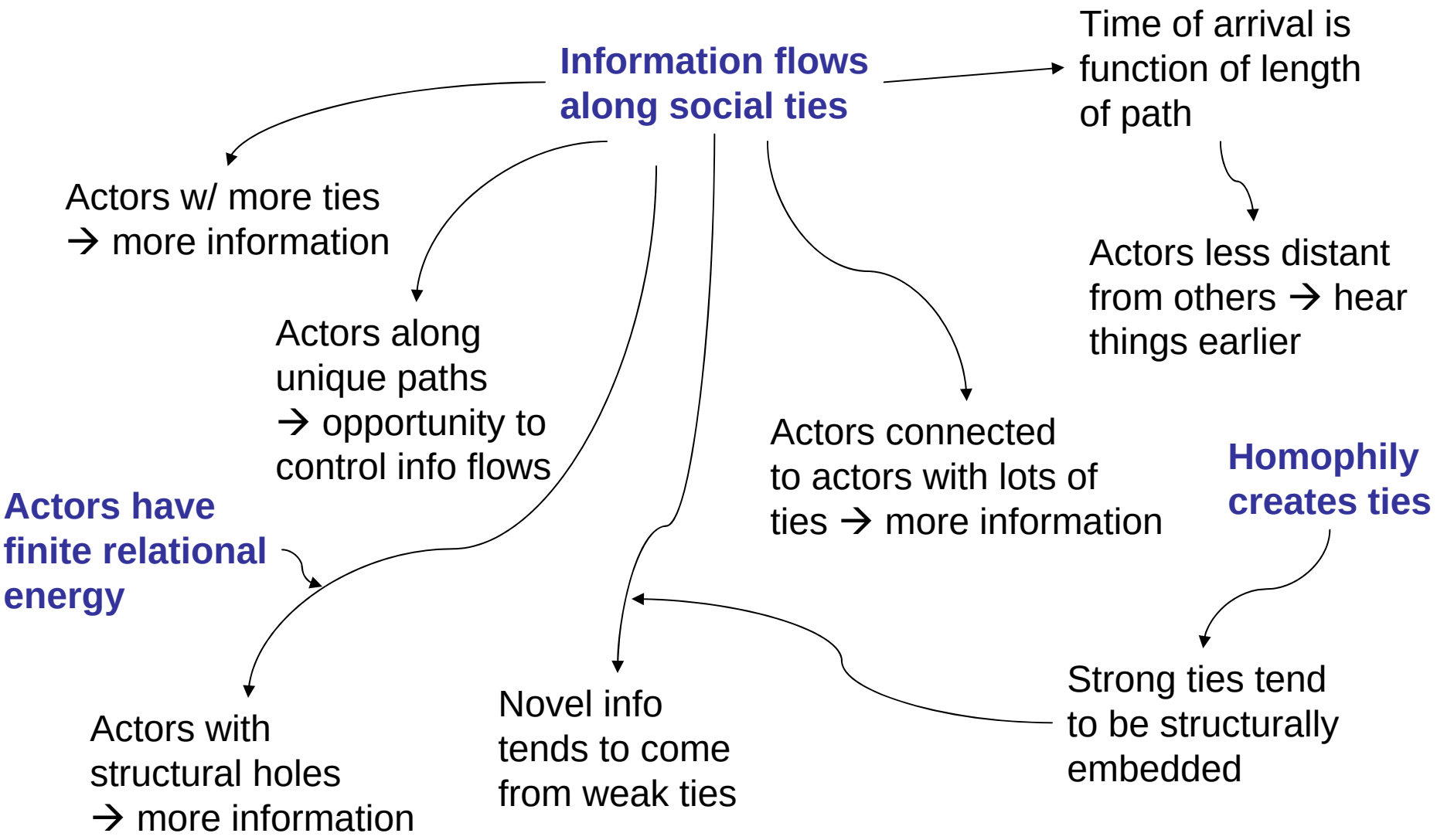
- Combining cognitive with structural models
- Dynamic flows of knowledge over time




THE END

Example:

Distribution-of-Information Theory



The Fundamental Questions

- Quality
  - What kind of knowledge does a person have?
- Quantity
  - How much knowledge does a person have?