L8. Follow the network

Olivier Godechot
Sciences Po – Campus Reims
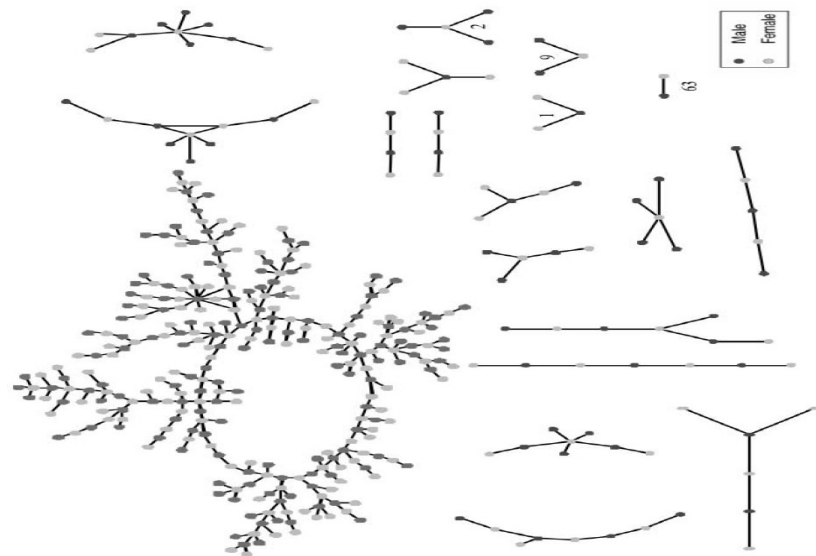Inquiries in Sociology

Prologue 1. Chains of affection

Simulation. Structure of teenager love and sex stories

Bearman, Peter S., James Moody, and Katherine Stovel. 2004. "Chains of affection: The structure of adolescent romantic and sexual networks." American journal of sociology 110 (1): 44-91.

- Puzzle: strange spanning trees

Difficulty to reproduce those structures

- Spanning tree as a mystery
- Simulation in order to reproduce the structure
  - Matching the degree the distribution
  - Matching the degree distribution + isolated dyads
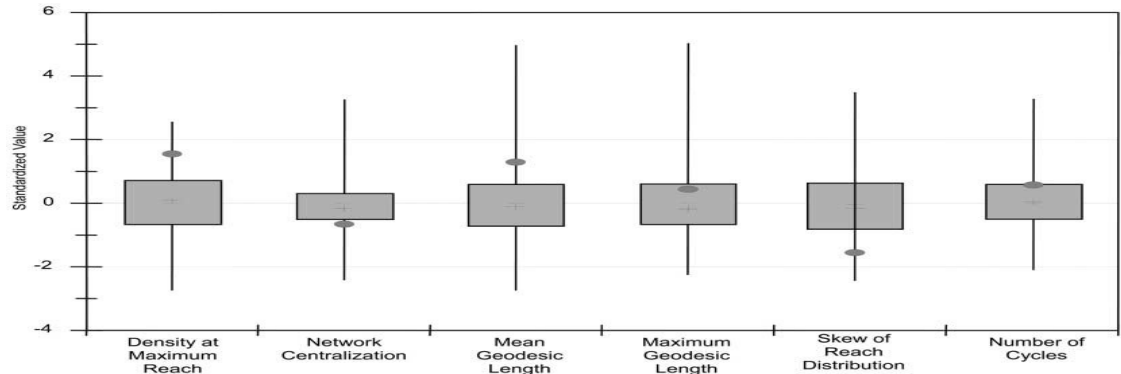 - Cycles anomalies

Simulated networks preserve observed degree distribution
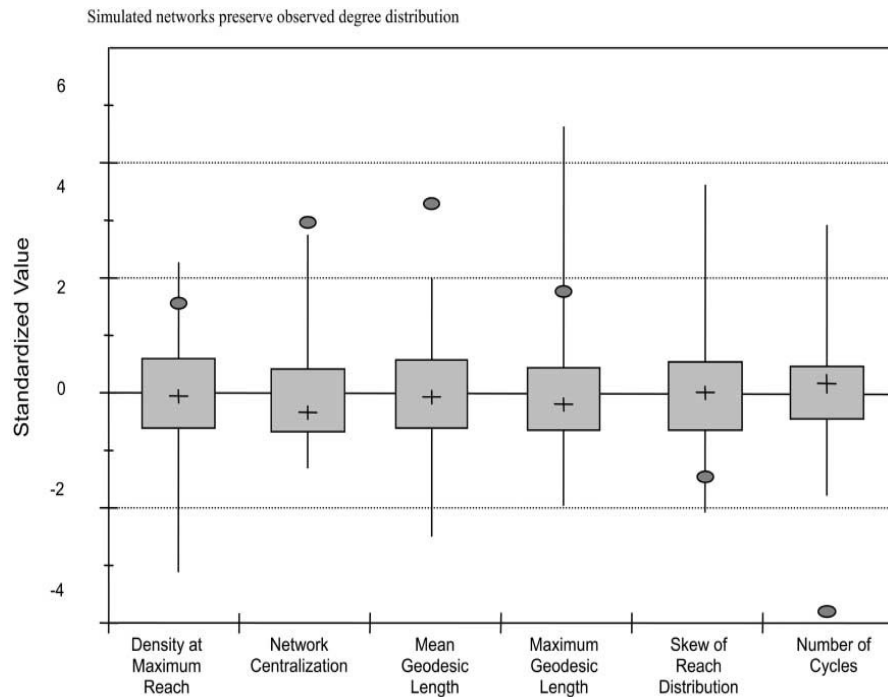
Devalued unions and the structure of the network

- The special case of 4-degree cycles
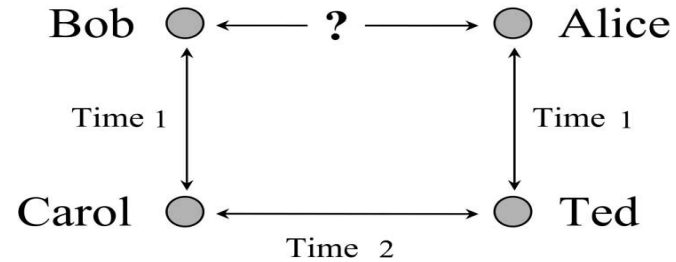
- Constraining the network

Consequences on epidemics propagation

- Organization of relations through spanning trees with little cycles
- Strong extension of the network
  - High propagation of the sexual disease if very contagious
  - Low propagation of the sexual disease if little contagious.
- Prevention targeting a core (drug addicts, homosexuals) might be debatable

Miracles happen (sometimes)
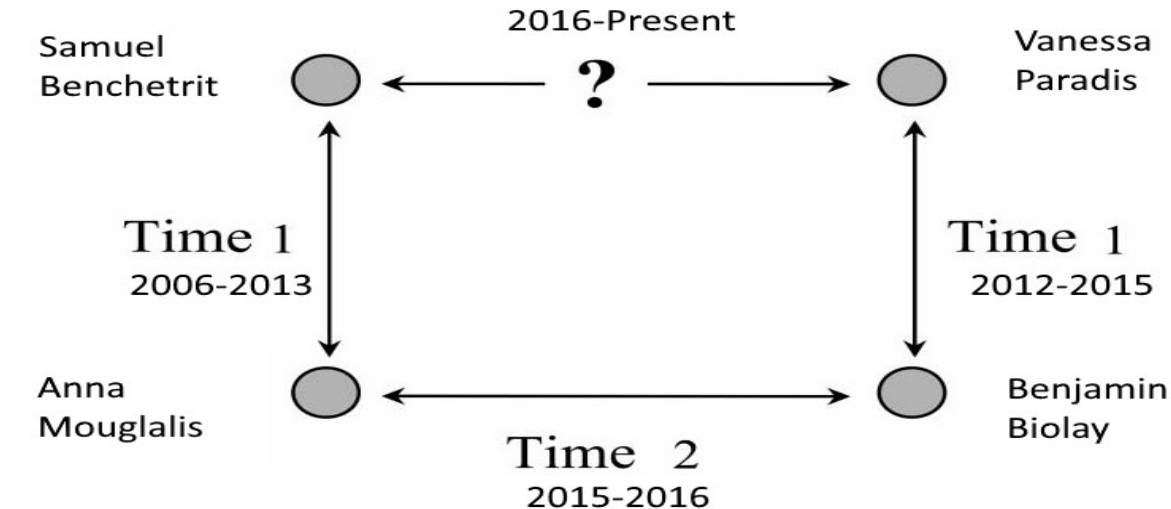
Prologue 2. "It's a small world, Dude!"

Milgram experience

Travers and Milgram. 1969 « [An Experimental Study of the Small World Problem](#) », *Sociometry*

- Goal: Measuring the size of a network
- Send a document to a broker living in Sharon (Boston suburb) uniquely through a network chain of intermediaries.

- Three distinct groups recruited through announcement:
  - Boston random,
  - Nebraska random
  - Nebraska shareholders
- Information provided initial subjects:
  - name
  - address
  - occupation and employer
  - University and year of graduation
  - Date of military service
  - Wife's maiden name

Success of chains: 29%

- 217 chains started
- 29% succeeded
- Depends on the starting group
- Most failure at the launch of the chain.
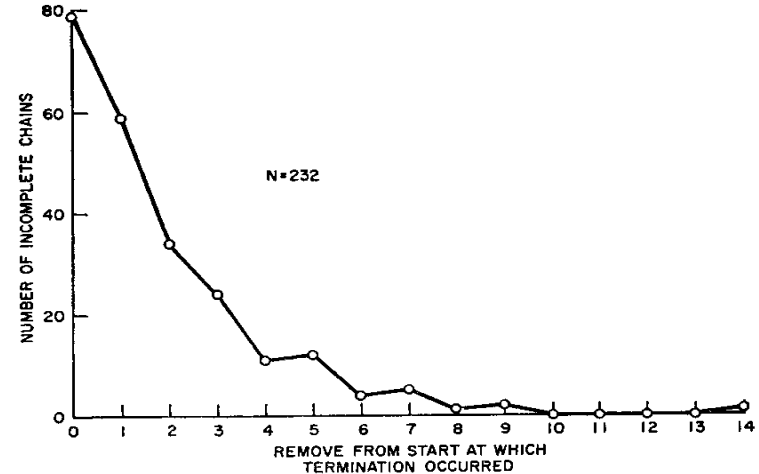
FIGURE 2

Lengths of Incomplete Chains

	Nebraska Random		Nebraska Stock.		Boston		Total	
Complete	18	(24%)	24	(31%)	22	(35%)	64	(29%)
Incomplete	58	(76%)	54	(69%)	41	(65%)	153	(71%)
	76	(100%)	78	(100%)	63	(100%)	217	(100%)

6-degrees world
Average length : 5.2 intermediaries
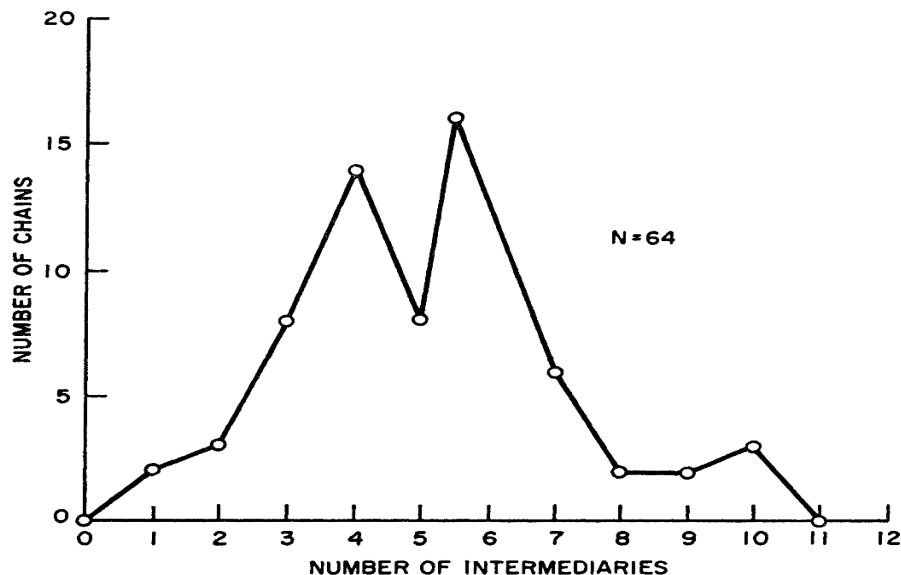
FIGURE 1

Lengths of Completed Chains

Means	
Starting Population	**Mean Chain Length**
Nebraska Random	5.7
Nebraska Stockholders	5.4
All Nebraska	5.5
Boston Random	4.4
All	5.2

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Specificity of a small world

Watts, D.J.; Strogatz, S.H. (1998). "Collective dynamics of 'small-world' networks.". *Nature* **393** (6684): 409–10.
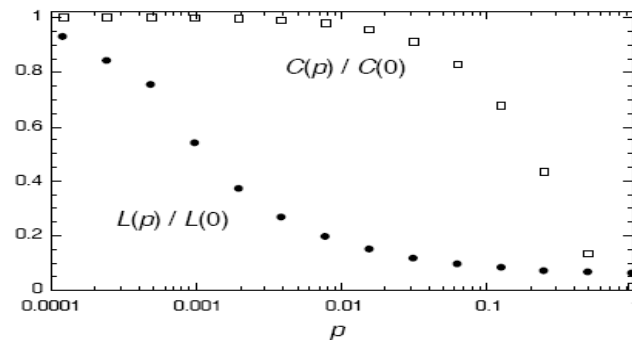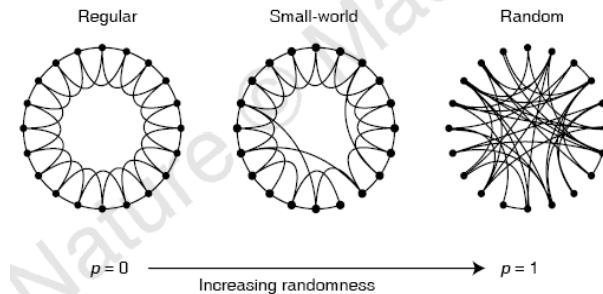
- Regular lattice
  - Long distance.
  - Strong clustering (neighbors interconnexion)
- Random network
  - Short distance. Weak clustering
- "Small worlds" networks
  - Short distance. Strong clustering
  - Examples
    - Social: IMDB film actors
    - Artificial : Power Grid

    - Natural: Neural network of C. Elegans worm

Size of the network. Prolongation

Leskovec, Jure, and Eric Horvitz. 2008. "Planetary-Scale Views on a Large Instant-Messaging Network", International World Wide Web Conference Committee

- 1 month of observations (June 2006) of MSN conversations.
- 30 billion conversations between 240 millions distinct users.

- MSN: 180 million persons
  - 6.6 degrees of separation
  - 48% of the persons are less than 6 degrees
  - 78% are at less than 7 degrees
  - Longest "shortest path": 29
- Study on Facebook
  - A little less than 5 degrees of separation

I. Why networks ?

Sociology is relational

- Social: a hard to define concept
  - Collective
  - Interpersonal
  - Relation matters
- Many classical key concepts of sociology have a relational component
  - Integration (Durkheim)
  - Exploitation (Marx)
  - Domination (Weber, Bourdieu)

- Classical anthropology => Kinship relations at the heart of the research program
  - Lévi-Strauss, *Elementary structures of Kinship*
- A school of sociology devoted to interaction
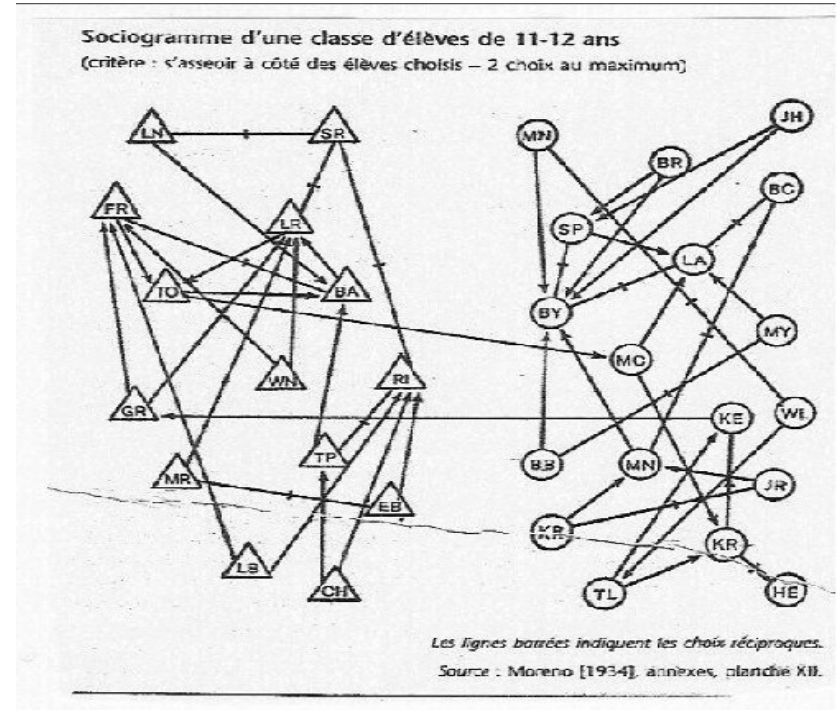 - Goffman: *ritual of interactions*

Network as a standardization of relations

- Interaction in interactionist school
  - Ex. E.Goffman, Stigma. How disabled people manage stigma
  - Decompose and interpret each relation
  - Contextual effects

- Network study
  - Aggregation of ties, contacts set into equivalence
  - High level of standardization

Jacob Moreno's sociometry

Moreno Jacob, 1934, *Who shall survive?*, 1954 *Les fondements de la sociométrie (in French)*

- Romanian Jewish physician, from Vienna, migrating to the US. Becomes psychiatrist. Inventor of psychodrama. Outsider in academia.
- Next to whom do you want sit?
  - Sociodrama inspired from psychodrama
  - Showing the invisible structures of a group.

Sociogramme d'une classe d'élèves de 11-12 ans
(critère : s'asseoir à côté des élèves choisis – 2 choix au maximum)

Les lignes barrées indiquent les choix réciproques.
Source : Moreno [1934], annexes, planche XII.

II. Key network concepts

Key network concepts

- 1. Homophily

- 2. Social exchange

- 3. Information

- 4. Embeddedness and Trust

- 5. Influence

- 6. Power

1. Homophily

McPherson, Smith-Lovin, Cook, 2001, « Birds of a Feather: Homophily in Social Networks'', Annual review of sociology, 27, p. 4151-444.
- Survey of homophily (in the United-States)
- Forms of homophily
  - Ethnicity
  - Gender
  - Age
  - Religion
  - Education, occupation and social classes

- Factors
  - Geographic
  - Family
  - Units of tie formation : education and work.

Friendship mobility:
a structure very close to social mobility

Godechot, 1996, « Les déterminants sociaux de l'amitié », unpublished manuscript

Amis: Répondants	Agriculteurs	Artisans Commerçants	Cadres et chefs d'entreprises	Professions Intermédiaires	Employés	Ouvriers	*Population des répondants ayant des amis*
Agriculteurs	**46%**	9%	5%	6%	12%	**21%**	*8%*
Artisans Commerçants	9%	**25%**	**16%**	14%	15%	**21%**	*7%*
Cadres et chefs d'entreprises	1%	9%	**48%**	**22%**	12%	7%	*16%*
Professions Intermédiaires	2%	10%	**18%**	**33%**	**20%**	17%	*16%*
Employés	4%	9%	8%	**17%**	**37%**	**26%**	*18%*
Ouvriers	6%	9%	5%	11%	**18%**	**52%**	*35%*
Population des amis	*8%*	*10%*	*15%*	*17%*	*20%*	*30%*	*n=5627*

Homophily: Outlook from MSN.

	Real	**Random**
Age	0.162	0.030
Gender	0.426	0.434
Country	0.734	0.046
Language	0.798	0.030

Leskovec, Jure, and Eric Horvitz, 2008, « Planetary-Scale Views on a Large Instant-Messaging Network », *International World Wide Web Conference Committee*

- 1 month of observations (June 2006) of MSN conversations.
- 30 billion conversations between 240 millions distinct users.
- Strong homophily of language, country, age
- No gender homophily !
- Bias due to the young population

2. Social exchange.
Creating ties and fostering solidarity

Lévi-Strauss, Claude. 1947. *Les structures élémentaires de la parenté*.
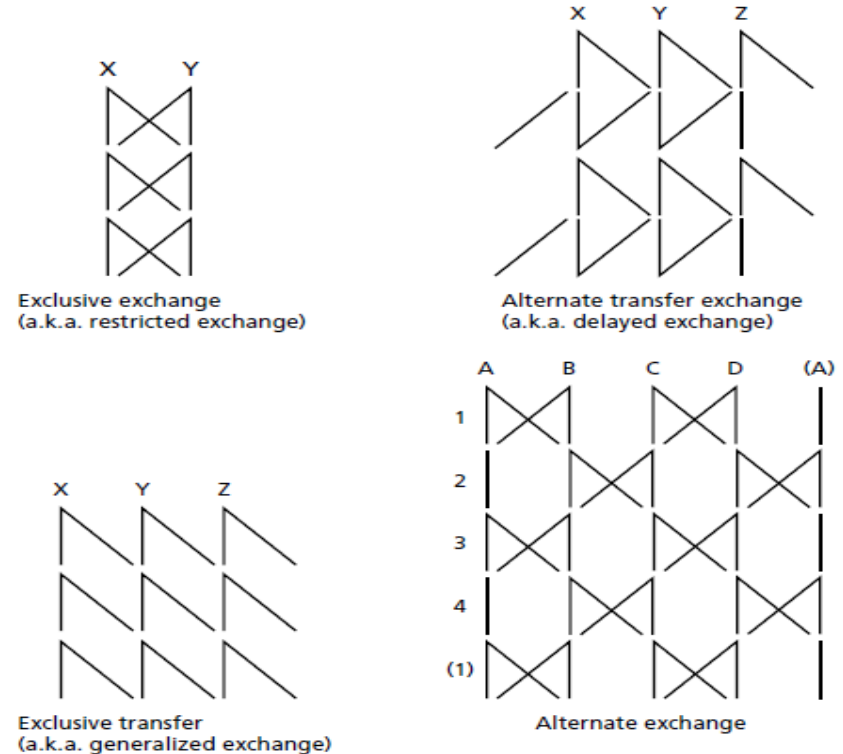
- Linking the ban on incest and structures of kinship
  - Obligation to "give" daughter or sister
  - Mauss's gift theory. Obligation
    - To give
    - To receive
    - To reciprocate
  - Expectation of reciprocity from the group to which you give a woman

- Kinship rules: Rules setting all together
  - Ban of incest
  - Reciprocity obligation
  - Respecting structural equivalence between siblings
    - Brothers
    - Sisters
    - Mother's brothers
    - Mother's brothers' daughters
- Two types of exchange
  - Restricted exchange
  - Generalized exchange

Forms of kinship

Héran, 2009, *Figures de la parenté,* Puf.

- Cross-lateral cousins => restricted exchange
- Mother's brother's daughter => generalized exchange
- Father's sister's daughter => delayed exchange
- Paternal grand-father's sister's grand daughter => alternate exchange

Figure 1   Four elementary forms of kinship according to Héran (2009)

Exclusive exchange
(a.k.a. restricted exchange)

Alternate transfer exchange
(a.k.a. delayed exchange)

Exclusive transfer
(a.k.a. generalized exchange)

Alternate exchange

Note: Héran represents males with a vertical bar |, females with an oblique bar \, marriage with the lower junction \/, and a brother and a sister with the upper junction /\. He also uses a single bar for representing same-sex siblings and same-sex parallel cousins.

3. Information. The strength of weak ties

Granovetter, Mark. 1973. "The strength of weak ties", *American Journal of sociology*

FIG. 1.—Forbidden triad

- Weak ties provide new and non-redundant information

➔ Getting a job

– "Of those finding a job through contacts, 16.7% reported that they saw their contact often at the time, 55.6% said occasionally, and 27.8% rarely (N=54)."
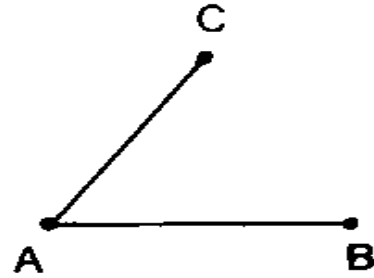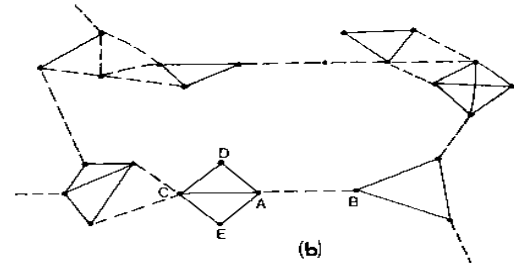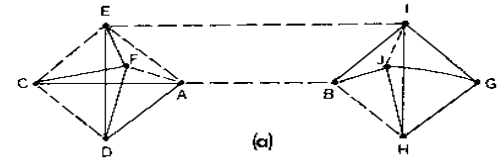

(a)

(b)

FIG. 2.—Local bridges. *a*, Degree 3; *b*, Degree 13. ———— = strong tie; ———— = weak tie.

4. Embeddedness and Trust.

Granovetter. 1985. "Economic Action and Social Structure: The Problem of Embeddedness", *American Journal of Sociology*, 91(3): 481-510.

- Two approaches of the economy: under-socialization or over-socialization.
  - Economics -> under-socialization. All agreements through markets
  - Sociology –> over-socialization. Group identity essential
  - The meso-level of concrete relations overlooked.
  - Level important for understanding the genesis of norms of trust, opportunism and reciprocity

Impacts of embeddedness on economic life

Uzzi, B. 1996. "The sources and consequences of Embededdness for the performance of Organizations : the network effect", *American Sociological Review*, 61 (4), 674-698

- Repeated business partners are more than business partners.
  - Information
  - Trust
  - Help
- Effect of embeddedness on failure
  - Decrease failure probability
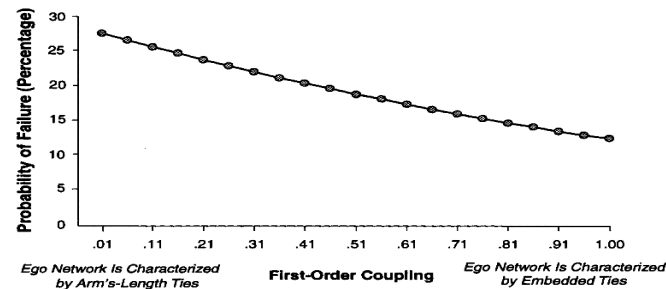 - Up to a certain point

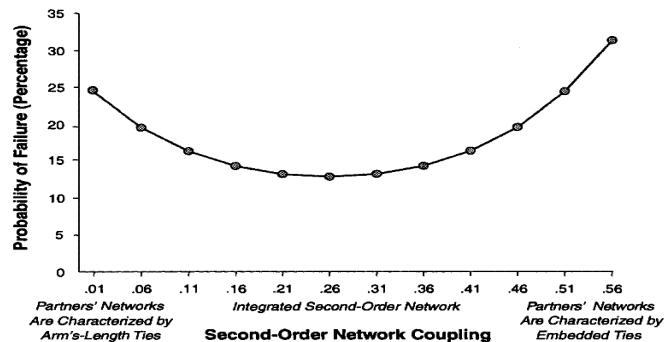Figure 3. Predicted Effect of First-Order Network Coupling on Failure

Figure 4. Predicted Effect of Second-Order Network Coupling on Failure

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5. Influence. Smoking and drinking behaviors among adolescent

Steglich, Snijders, and Pearson. 2010. "Dynamic Networks and Behavior: Separating Selection from Influence." *Sociological methodology* 40(1): 329-393.

- Teenager interactions: smoking and drinking.
  - Selection based on homophily: birds of a feather flock together *(Qui se ressemble s'assemble)*
  - Influence: ("*Qui s'assemble se ressemble*")
- 3 waves enabling to measure
  - the network and its evolution
  - the behavior and its evolution

- Complex modeling
  - SAOM (Stochastic Actor Oriented Models) with *Siena* software
- Selection
  - teenagers choose friends with similar behaviors in terms of alcoholism (0.73) and to lesser extent in terms of smoking (0.27)
- Influence
  - Teenagers change their smoking habit (2.63) and of alcoholism (6.70) in order to resemble to their friends' behavior.
- Influence dominates selection (especially for alcohol)

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6. Power. Structural holes

Burt, Ron. 1992. *Structural holes,* Harvard University Press
--. 1995. "Capital Social, Trous structuraux et l'entrepreneur",
   *Revue française de Sociologie*, 36(4): 599-628

- Structure holes ➔ no direct links between ego's contacts.
- Tertius Gaudens
  - Informational Advantage.
    - Non redundant Information
    - Local monopoly over information circulation
  - Strategic
    - Divide and conquer
- Structural holes as an advantage
- That might be intentionally looked for

53.6 contrainte pesant sur Jim
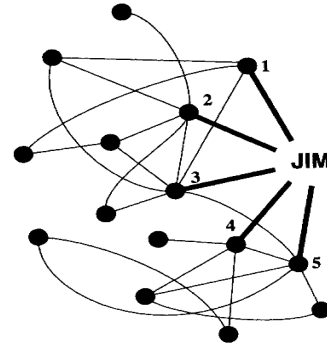
Les trous structuraux séparent des contacts non redondants. Un trou structural est un tampon, comme un isolant dans un circuit électrique. Du fait du trou qui les sépare, deux individus procurent des bénéfices de réseau qui s'additionnent plus qu'ils ne se recouvrent.
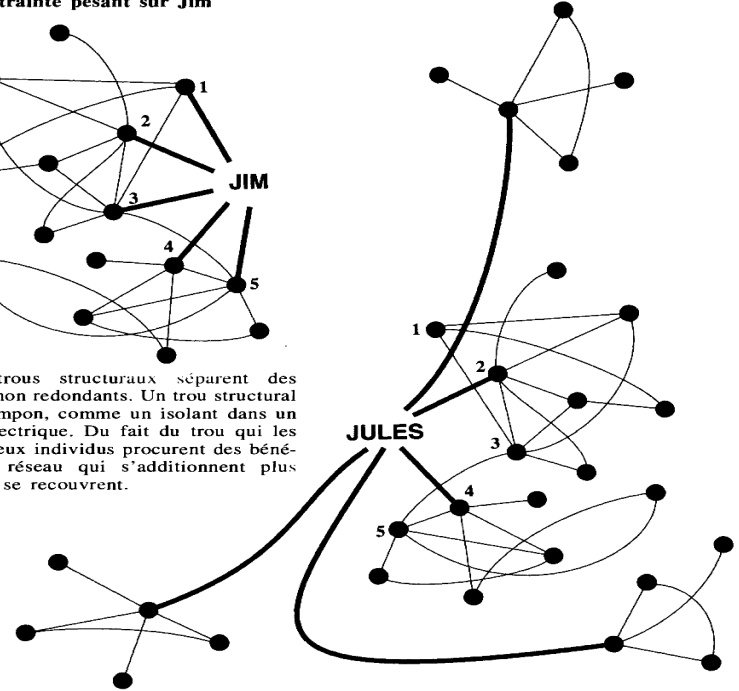
20.0 contrainte pesant sur Jules, successeur de Jim

FIGURE 1. – *Construire des trous structuraux.*

Efficiency of structural holes

- Burt (1992-2006), shows the positive impact of structural holes on promotion, wages, good ideas…

FIGURE 4. — *Le capital social.*
Les promotions rapides des directeurs entrepreneuriaux.
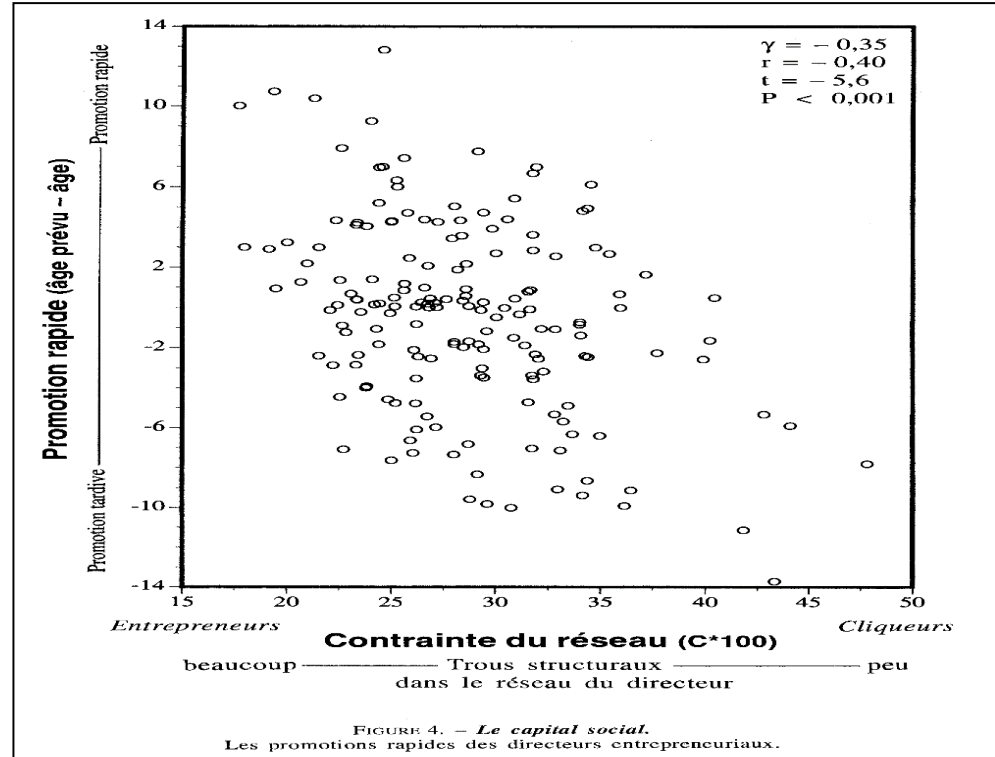
III. How network?

The sampling problem

- What's specific with an inquiry on network?
  - Qualitative interview possible
  - And to some extent observations (Desmond, 2012)
- However, standardization moment necessary for reconstituting network

- Quantitative approach
  - Surveys
  - Administrative data
  - Experiments
  - Internet data
- What's specific in network survey inquiries?
  - ➔ The sampling problem
  - Networks are difficult to sample
  - A sample of individuals➔ difficult for reconstituting the network

Ego's contact....

- Interrogate only on ego's contact
  - Graph of little interest : star
  - Other forms of statistical and graphical exploration (Héran, 1987)
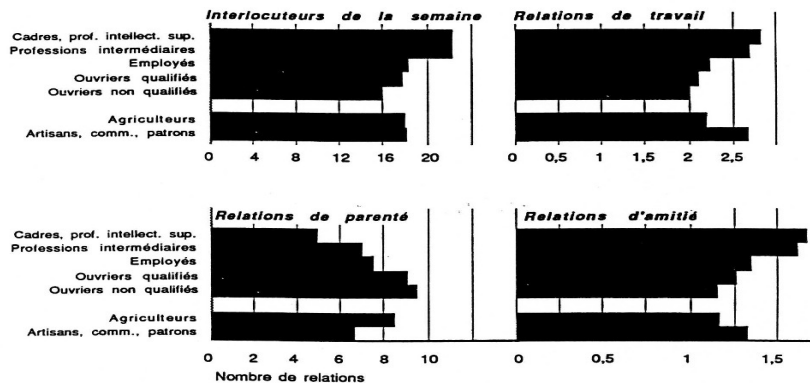
- Granovetter (1974). *Getting a job*
- Smilde (2005)

The contacts between ego's contacts

- Collection technology
  - Name generator

    Wellman : « Who are the persons, beyond your household, from which you feel the closer? »

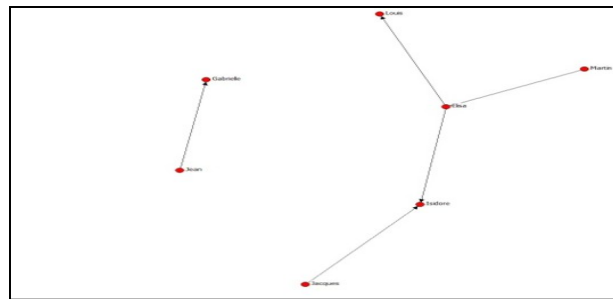   Burt (GSS) : Who are the persons with who you discuss of important things? »
  - Time Schedule (*Contacts* Survey - Héran)
  - Address book
- Connection matrix
  - Cost of completion increases a lot when number of contacts are important
  - The x < 10/15 contacts the most important.

| Jean |
| Martin |
| Jacques |
| Elisa |
| Louis |
| Gabrielle |
| Isidore |

	Jean	Martin	Jacques	Elisa	Louis	Gabrielle	Isidore
Jean						X	
Martin				X			
Jacques							X
Elisa					x		X
Louis							
Gabrielle							
Isidore							

Collection and representation of an ego network

- Ex.: Gribaudi, 1998
  - Part 1. Time schedule of 15 last days listing important meetings.
  - Part 2. One file on each subject in order to describe its characteristics.
  - Part 3. Other important persons not met during last 15 days.
  - Part 4 and 5. Relations between Ego's contacts according to EGO.
- Representation: Discard EGO from the graph.
- Facebook. Application Social Graph.
- Network according to ego… with some limits
- This ego-network is a complete network … among ego's contacts.
- But contacts have other contacts than ego's contacts…
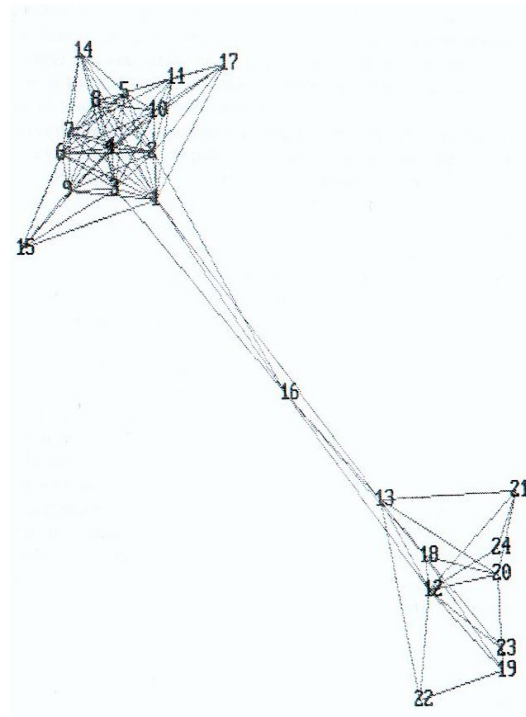
Complete network

- Mostly valued type
  - Network difficult to sample
  - Distances, structural positions are sensible to one vertex (a shortcut)
- Technique
  - Name generator applied to a complete population
  - Presentation of a list of names
  - Exhaustive

Lazega, E. (2001). *The collegial phenomenon*

Co-workers' network: "*Because most firms like yours are also organized very informally, it is difficult to get a clear idea of how the members really work together. Think back over the past years, consider all the lawyers in your firm.* **Would you go through this list and check the names of those whom you have worked with.** *By « worked with » I mean that you have spent time together on at least one case, that you have been assigned to the same case, that they read or used your work product or that you have read or used their work product; this includes professional work like Bar association work, administration, etc.*"

+ Advice network and friendship networks

Implicit hypotheses

- Researcher: Knows the complete list of the member of the network

- Presentation of the list helps memory work and avoids bias
  - Bias: valued links are better memorized.

- List not too long to manipulate
  ➔ collaboration of respondents.

- Relaxing the closure constraint: Penalva 2008

- Establishing an early list of contacts

- Question on the links with the list.

- Question on other links not in the list.

- Re-introducing this actors in the list for other future respondents (but contacts dependent on order of interviews)

Complete network

- Collection cost potentially important

- Arbitrary of the closure of the population
  - Criticized by ego-network adepts

- The full network… The world population (including dead people)

Administrative complete networks

- Network through administrative/web sources with preferably electronic traces
  - Transactions
  - Communications
  - PhD thesis
  - Movies
  - Bibliography. Citations, co-citations, co-authorship.
  - Internet "social networks"

IV. Processing networks

Collecting and analyzing network phenomena

- All methods possible

- But more or less adapted to some targets: standardization / exhaustivity

- Observation, interviews, survey, experiments, administrative data, simulation

Observations

- Method not so easy to mobilize
  - Partiality
  - Material difficult to standardize
  - Subjective bias
- But possible
  - Anthropological Kin Networks

Barnes, J. A. 1954. "Class and committees in a Norwegian island parish." *Human relations* 7(1): 39-58.

- Intensive fieldwork through observations and informal discussions
- Findings: no real class barriers: from candle to candle everyone connected

Desmond, M. 2012 "Disposable ties and the urban poor." American Journal of Sociology 117(5): 1295-1335.

- Findings: Evicted poors don't rely on king strong ties but on disposable ties: poverty companion acquaintances

Interviews

Bidart, Degenne, and Grossetti. 2020 *Living in networks: The dynamics of social relations,* Cambridge UP.

- Long qualitative interviews with 90 young persons from Caen (last year of highschool).
  - Elite and deprived high schools
  - 4 waves: 1995, 1998, 2001, 2004
  - Name generator: by context (school, work, leisure, family) and contacts within those context
    - People with whom you talk more
      ➔ 7000 contacts

- Main Findings
  - Most relations at short distance
  - Strong homophilia
  - Social capital strongly linked to economic and cultural capital
  - Strong turnover : 40% of the contacts disappear
  - Reason: disappearance of the context
  - However, possibility to decouple a relation from a given context => multi-context or relation of its own

Interviews (pros and cons)

- Rich data on the context of the contact

- Generally, ego networks (or eventually full network if everybody interviewed in a given universe)

- Interview quite "exhausting" → like a police interview

Surveys

- Survey with some specificity
  - Needs a name generator
    - In a complete population (Cf. Lazega Survey)
  - Or a name generator + description of the contacts between the contacts
    - Ego network (cf. Burt style)
- Advantage: less partial
- Network tie has a true meaning
- Economic and cognitive cost of collection

Administrative / Business/ Internet data

- Exploitation of administrative traces of networks

- Cost of collection low

- Potentially exhaustive

- But
  - The tie collected may not be relevant
  - Underestimation connections through alternative/invisible patterns

Experiments

- CF. Milgram experience
- Social exchange theory
  - Cook, Emerson. 1978 "Power, equity and commitment in exchange networks." *ASR*.
  - Large literature

- Impact of the structure of exchange on power, solidarity, fairness
- People in lab play games of exchange
- Manipulation of the communication structure
- Main result of this literature
  - => Exploitation of brokerage power
  - => Impact of direct reciprocity
  - => Impact of generalized exchange

Simulation

- Cf. Bearman et al. ; Watts and Stroegats
- Complexity of network phenomenon
- Try to replicate via computers a social phenomenon
- => make explicit rules of mechanism production

- Confirm mechanism and also show that it is not artifact
  - Buskens, Van de Rijt. 2008 "Dynamics of networks if everyone strives for structural holes." *AJS*.
- Agent based modeling
  - => explore social mechanism via the simulation of a network

  Manzo, Gianluca, and Arnout van de Rijt. "Halting SARS-CoV-2 by targeting high-contact individuals." *arXiv preprint arXiv:2005.08907* (2020).