## Slide 21

# What do we See when we Look at Networks

Tommaso Venturini
CNRS – Centre Internet & Société
www.tommasoventurini.it

Tommaso Venturini, Mathieu Jacomy, and Pablo Jensen, 2019
What Do We See When We Look at Networks an Introduction to Visual Network Analysis and Force-Directed Layouts.
*Social Science Research Network*
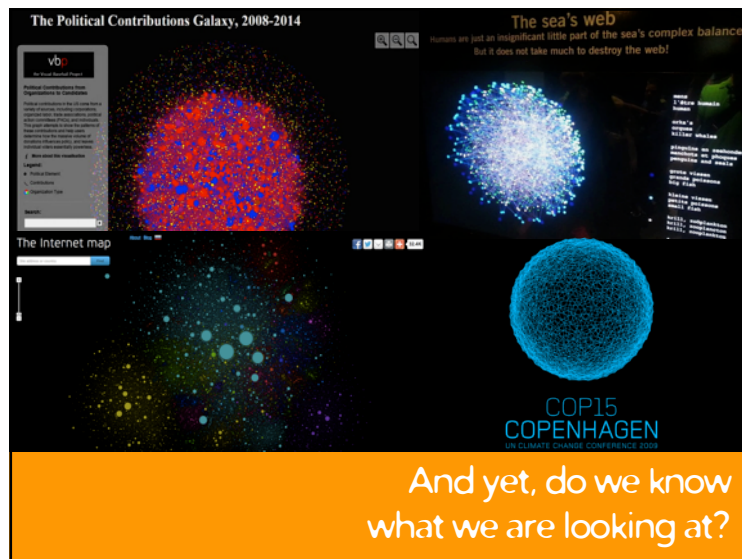https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3378438.

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## Slide 22

"Tools such as Gephi have made network analysis accessible to broad audiences that happily produce network diagrams without having acquired robust understanding of the concepts and techniques the software mobilizes.

This more often than not leads to a lack of awareness of the layers of mediation network analysis implies and thus to limited or essentialist readings of the produced outputs that miss its artificial, analytical character"

Bernhard Rieder and Theo Röhle, 2017.
"Digital Methods From Challenges to Bildung"
In Schäfer M.T and van Es K. (eds.) *Datafied Society*
pp.109–24. Amsterdam: University Press.

Taking responsability

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## Slide 23



The Political Contributions Galaxy, 2008-2014

The sea's web
Humans are just an insignificant little part of the sea's complex balance.
But it does not take much to destroy the web!

The Internet map

COP15
COPENHAGEN
UN CLIMATE CHANGE CONFERENCE 2009

And yet, do we know what we are looking at?

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## Slide 24

Part 1:
# Why are we* obsessed by networks?

(* digital STS scholars)

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**Actor-Network Theory (ANT)**

**Social Network Analysis (SNA)**

**Digital Networks**

A productive conflation

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Actor-Network Theory (ANT) explains how material–semiotic networks come together to act as a whole... These networks are transient, existing in a constant making and re-making... relations need to be repeatedly "performed" or the network will dissolve.
https://en.wikipedia.org/wiki/Social_network

Social Network Analysis (SNA) investigates social structures through graph theories. It characterizes structures in terms of nodes (individual actors, people, or things within the network) and the ties or edges (relationships or interactions) that connect them.
https://en.wikipedia.org/wiki/Social_network_analysis

Digital Networks

The Internet is the global system of interconnected computer networks... It is a network of networks of millions of private, public, academic, business, and government networks.
https://en.wikipedia.org/wiki/Internet

The World Wide Web is an information space where documents and other web resources are... interlinked by hypertext links, and can be accessed via the Internet.
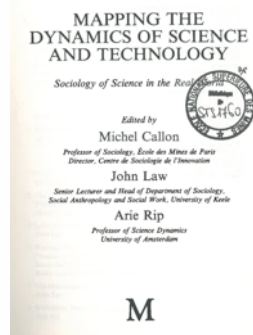https://en.wikipedia.org/wiki/World_Wide_Web

A few definitions
(from Wikipedia)

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Callon, M., Law, J., & Rip, A. (1986).
*Mapping the Dynamics of Science and Technology.* London: Macmillan.

MAPPING THE
DYNAMICS OF SCIENCE
AND TECHNOLOGY

*Sociology of Science in the Real World*

Edited by
Michel Callon
*Professor of Sociology, École des Mines de Paris
Director, Centre de Sociologie de l'Innovation*

John Law
*Senior Lecturer and Head of Department of Sociology,
Social Anthropology and Social Work, University of Keele*

Arie Rip
*Professor of Science Dynamics
University of Amsterdam*

M

Instead of following the actors we may therefore follow the texts. We may not, in this way, find out everything there is to know about scientists and laboratories. However, the study of texts is well suited to our particular and limited task: that of studying scientific change.

The force of such texts also resides in the fact that they contain links with other texts (references to the literature), work and institutions... In sum, texts make possible the construction of linkages between existing entities and the formation of novel entities.

Where the conflation started

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1. The theoretical idea that collective phenomena are best described not by their substances, but by their relations (**actor-network theory**).
2. The methodological appeal for new techniques to analyse and represent the connections between social actors (**network analysis**).
3. The intuition that the inscriptions left by collective actions could be re-purposed for social research (**network data**).

Felicitously confounded by the ambiguity of the word 'network'

1. a conceptual topology (space of connections VS space of coordinates)
2. a set of computation techniques (the mathematics of graphs)
3. an hyper-textual organization of inscriptions (the relational datasets)

The 3 ingredients of the conflation

**Slide 29:**

a theory without methods
(actor-network theory)

**+**

a methods without theory
(social network analysis)

A marriage made in heaven

29

**Slide 30:**

a theory without methods
(actor-network theory)

**+**

a methods without theory
(social network analysis)

Once you can get information as bores, bytes, modem, sockets, cables and so on, you have actually a more material way of looking at what happens in Society. **Virtual Society thus, is not a thing of the future, it's the materialisation, the traceability of Society**. It renders visible because of the obsessive necessity of materialising information into cables, into data.

Latour, B. (1998).
Thought experiments in social science: from the social contract to virtual society
In 1st *Virtual Society?* Annual Public Lecture. Brunel University, London.

...and in earth

30

**Slide 31:**

We took to the Web to study public debates on science and technology, but we found 'issue- networks' instead... Following hyperlinks among pages dealing with a given issue, we found that these links provided a means to demarcate the network that could be said to be staging the controversy in the new medium

Marres, N., & Rogers, R. (2005). Recipe for Tracing the Fate of Issues and their Publics on the Web.
In L. Bruno & P. Weibel (Eds.), *Making Things Public*. Karlsruhe/Cambridge Mass: ZKM/MIT Press.
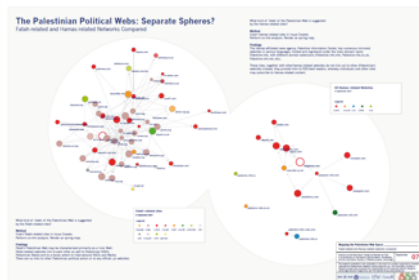
Exploiting the relationality of digital traces for social sciences

31

**Slide 32:**

It is obvious to try to apply standard citation analysis techniques to the web's hypertextual citation structure. One can simply think of every link as being like an academic citation

And the other way around

32

It is obvious to try to apply standard citation analysis techniques to the web's hypertextual citation structure. One can simply think of every link as being like an academic citation (p.2)

Page, L., Brin, S., Rajeev, M., & Terry, W. (1998)
The PageRank Citation Ranking: Bringing Order to the Web

## And the other way around

33

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a theory without methods
(actor-network theory)

a methods without theory
(social network analysis)

+

a major technological and economic innovation
(digital networks)

## From conflation comes power (and responsibility)

34

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Part 2:
Are we talking about
the same networks?

(probably not)

35

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1. Partiality of digital inscriptions
2. (Lack of) Heterogeneity of nodes and edges
3. (Lack of) Reversibility of nodes and networks
4. Dynamics of relational change

## Networks are not networks

36

## Slide 37

Platforms are not the Web

The Web is not the Internet

The Internets is not the digital

Not all inscriptions are digital

1. Partiality of digital inscriptions
### Not everything is digitally inscribed

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## Slide 38

Platforms are not the Web

The Web is not the Internet

The Internets is not the digital

Not all inscriptions are digital

Not everything is inscripted



1. Partiality of digital inscriptions
### Not everything is digitally inscribed

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## Slide 39

Boullier, D. (2015). Pour des sciences sociales de troisième génération : des traces numériques aux répliques. In P. M. Menger (Ed.), Big Data, entreprises et sciences sociales. Paris: Open Editions Press.

|  | 1st generation | 2nd generation | 3rd generation |
|---|---|---|---|
| Concept of social | Society/(ies) | Opinion(s) | Vibration(s) |
| Type of inscription | Registers/Inquiries | Audience/Polls | Traces/Vibrations |
| Validation principle | Exhaustiveness | Representativeness | Traceability |
| Major players | States | The mass media | Brands |
| Operational Actors | National Institutes | Polling organisations | Web platforms |
| Authors | Durkheim | Gallup Lazarsfeld | Callon, Latour, Law |

1. Partiality of digital inscriptions
### Tracing is translating

39

## Slide 40

[an actor-network] is distinguished from a simple network because its elements are both heterogeneous and are mutually defined in the course of their association.

Callon, M. (1986). The Sociology of an Actor-Network: The Case of the Electric Vehicle. In M. Callon, J. Law, & A. Rip (Eds.), *Mapping the dynamics of science and technology* (pp. 19–34). London: Macmillan.
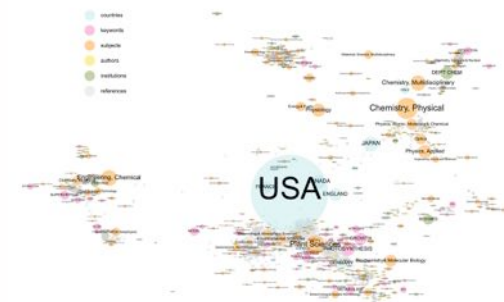


2. Heterogeneity of nodes and edges
### heterogeneous nodes and parallel edges

40

**Slide 41**

Borra E., Weltevrede E., Ciuccarelli P., Kaltenbrunner A. ... Venturini T. (2015)
Societal Controversies in Wikipedia Articles.
*Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*

2. Heterogeneity of nodes and edges
**negative connections**

41

**Slide 42**

To try to follow an actor-network is a bit like defining a wave-corpuscle in the 1930s: any entity can be seized either as an actor (a corpuscle) or as a network (a wave). It is in this complete reversibility—an actor is nothing but a network, except that a network is nothing but actors—that resides the main originality of this theory

Latour, B. (2010). Networks, Societies, Spheres: Reflections of an Actor-Network Theorist. In International Seminar On Network Theory: Network Multidimensionality In The Digital Age. Annenberg School for Communication and Journalism, Los Angeles, United States.

Ego networks and 'whole' networks

3. Reversibility of nodes and networks
**Ego-networks VS global networks**

42

**Slide 43**

Mark Zuckerberg
Business Person · Mark Elliot Zuckerberg is an American programmer, Internet entrepreneur, executive, and philanthropist. He is the Chairman, Chief Executive Officer, and co-foun... See More

3. Reversibility of nodes and networks
**actors VS infrastructures**

43

**Slide 44**

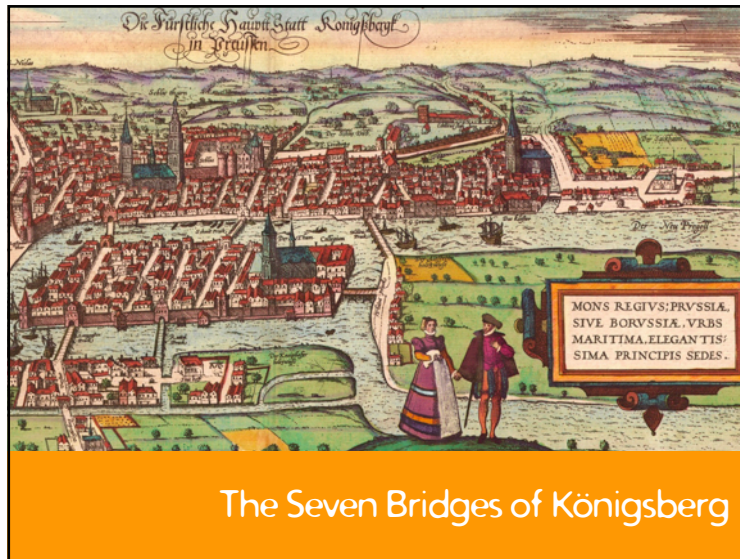Reality is a process. Like a chemical body it passes through successive states

Callon, M. (1986b). Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. In J. Law (Ed.), Power, action and belief: a new sociology of knowledge? (pp. 196–223). London: Routledge.

Latour, B., Mauguin, P., & Teil, G. (1992). A Note on Socio-technical Graphs. *Social Studies of Science.*
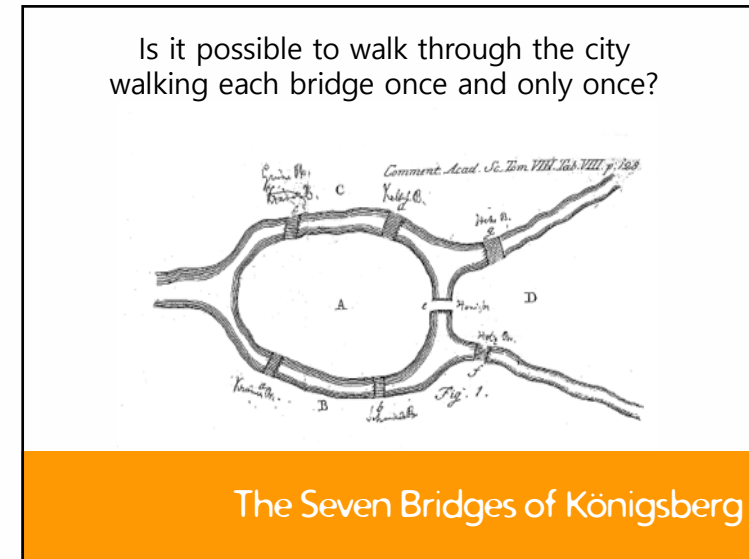
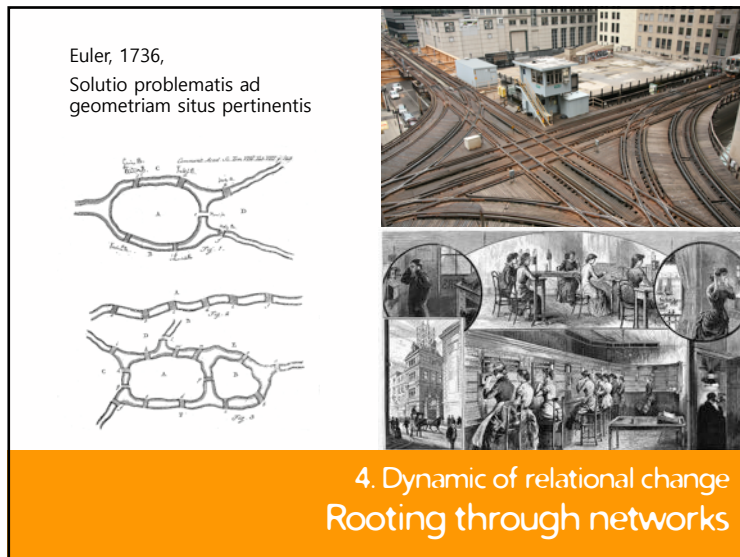4. Dynamic of relational change
**The puzzle of network dynamics**

44

The Seven Bridges of Königsberg

45

Is it possible to walk through the city walking each bridge once and only once?



The Seven Bridges of Königsberg

46

Euler, 1736,

Solutio problematis ad geometriam situs pertinentis



4. Dynamic of relational change
Rooting through networks

47

Venturini, T., Baya Laffite, N., Cointet, J.-P., Gray, I., Zabban, V., & De Pryck, K. (2014). Three maps and three misunderstandings: A digital mapping of climate diplomacy. *Big Data & Society*, 1(2).

4. Dynamic of relational change
From networks to streams

48

4. Dynamic of relational change
Change *in* networks / Change *of* networks

49

Venturini, T., Munk, A., & Jacomy, M. (2016). Actor-Network VS Network Analysis VS Digital Networks Are We Talking About the Same Networks? In D. Ribes & J. Vertesi (Eds.), DigitalSTS: A Handbook and Fieldguide (forthcoming).

Venturini, T. (2012). Great expectations: méthodes quali-quantitative et analyse des réseaux sociaux. In J.-P. Fourmentraux (Ed.), *L'Ère Post-Media. Humanités digitales et Cultures numériques* (Vol. 104, pp. 39–51). Paris: Hermann.

50

Part 3:

becoming sensitive to
the density of association

(maybe we are talking about
the same networks after all)

51

Both of these approaches reject a priori reifications such as 'the social' or 'society'… Both of these approaches consider the production of meaning as an activity of connecting/disconnecting and analyse how actors come to be created through collaborations of other actors in different contexts… For both approaches, the ties precede the nodes. (p. 878).

Mutzel, S. (2009). Networks as Culturally Constituted Processes: A Comparison of Relational Sociology and Actor-network Theory. *Current Sociology*, 57, pp. 871–887.

The ties precede
the node and the network

52

## Slide 53

Munster, A. (2013). *An Aesthesia of Networks*.
Cambridge Mass: MIT Press

An Aesthesia of Networks
Conjunctive Experience in Art and Technology
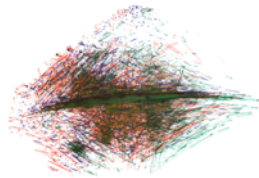
Anna Munster
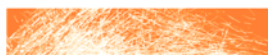
A diagram of a network, then, does not look like a network but ==maintain the same qualities of relations== – proximities, degrees of separation, and so forth – that a network also requires in order to form.

==Resemblance should here be considered a resonating== rather than a hierarchy (p. 24).

**Resonance not resemblance**

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## Slide 54
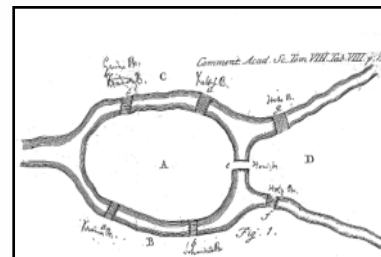
Euler, 1736,
Solutio problematis ad geometriam situs pertinentis

« Hoc porro modo si operatio ad finem perducatur, multa inveniuntur, quae non erant in quaestione; in quo procul dubio tantae difficultatis causa consistit »

"If, in this way, the work could be brought to a conclusion, many irrelevant factors would arise; therein without doubt lies the reason for the difficulty"

(translation in Fleischner, H. 1990. Eulerian Graphs and Related Topics. Amsterdam: Elsevier)
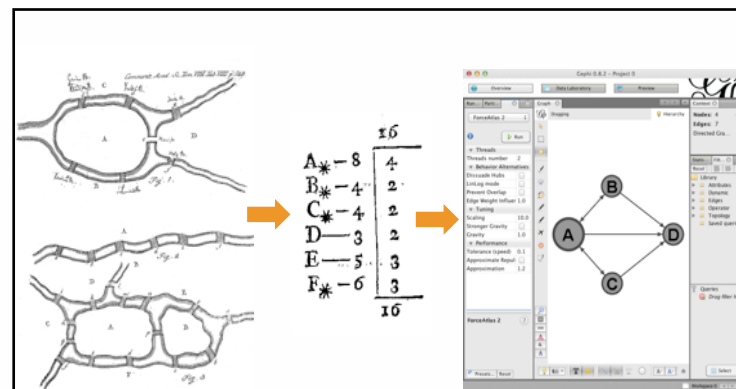
**The Seven Bridges of Königsberg**

54

## Slide 55

**From map to math**

55

## Slide 56
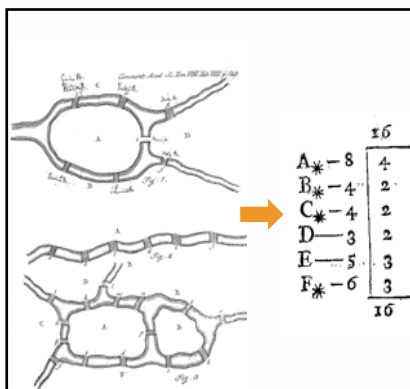
**and from graph to graphic**

56

## Slide 57

"the expression of an individual position can be better visualised through a sociogram than through a sociometric equation"

Moreno, Jacob. 1934. Who Shall Survive?
Washington, DC: Nervous and Mental Disease Publishing.

"If we ever get to the point of charting a whole city or a whole nation, we would have an intricate maze of psychological reactions which would present a picture of a vast solar system of intangible structures powerfully influencing conduct, as gravitation does bodies in space. Such an invisible structure underlies society and has in influence in determining the conduct of society as a whole"

Moreno, Jacob, April 3, 1933, *The New York Times*

### Networks as maps
(Jacob L. Moreno, April 3, 1933, The New York Times)

## Slide 58



EMOTIONS MAPPED BY NEW GEOGRAPHY

Charts Seek to Portray the Psychological Currents of Human Relationships.
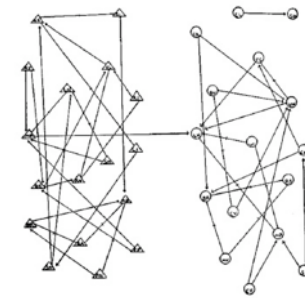
Jacob L. Moreno, April 3, 1933, The New York Times

### Networks as maps
(Jacob L. Moreno, April 3, 1933, The New York Times)

## Slide 59



### Geographical maps
(space is a condition of elements' position)
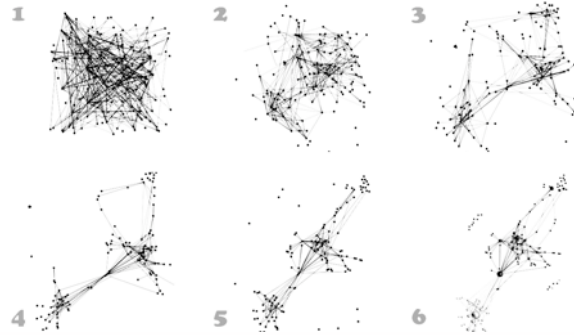
## Slide 60



London Underground 1933 Map (Harry Beck)

### Network maps
(space is a consequence of elements' position)

Jacomy, M., Venturini, T., Heymann, S., & Bastian, M. (2014).
ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network
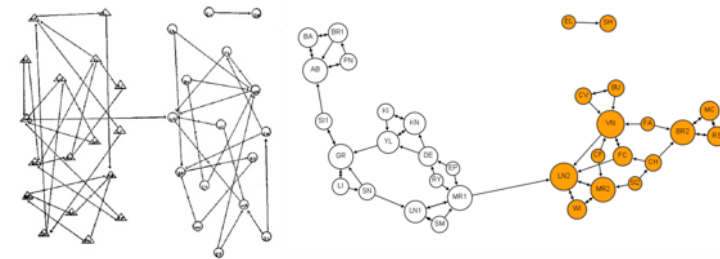Visualization Designed for the Gephi Software *PloS One*

Force-Directed Spatialisation

61



Grandjean, Martin (2015).
Social network analysis and visualization: Moreno's Sociograms revisited
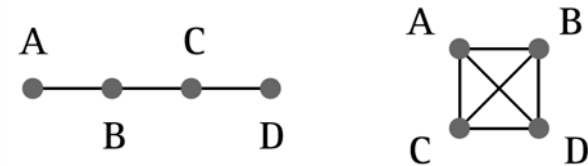www.martingrandjean.ch/social-network-analysis-visualization-morenos-sociograms-revisited/

Reading networks as maps

62



But which type of maps?

63



A multi-dimensional object
in a two-dimensional space

64

"As representations for the community structure of networks, layouts subsume clusterings, thus quality measures for layouts subsume quality measures for clusterings, and in fact prominent existing quality measures for layouts – namely, energy models based on the pairwise attraction and repulsion of vertices – subsume a prominent existing quality measure for clusterings – namely, the modularity measure of Newman and Girvan"

Noack, Andreas. 2009.
"Modularity Clustering Is Force-Directed Layout." *Physical Review* E 79(2).
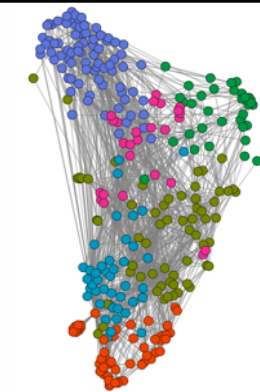
(c-elegans neural network colour by modularity classes)

## Modularity clustering is force-directed layout

65



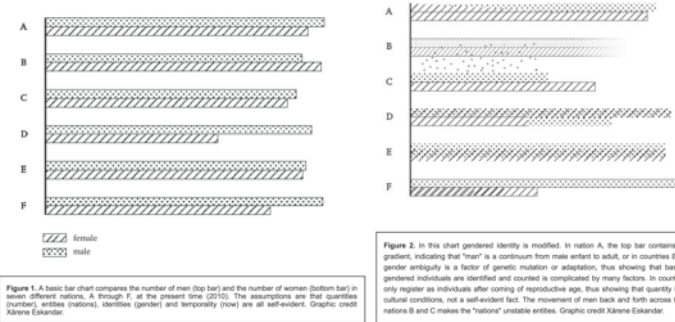Drucker, J. (2011). Humanities Approaches to Graphical Display. *Digital Humanities Quarterly*, 5(1), 1–20.
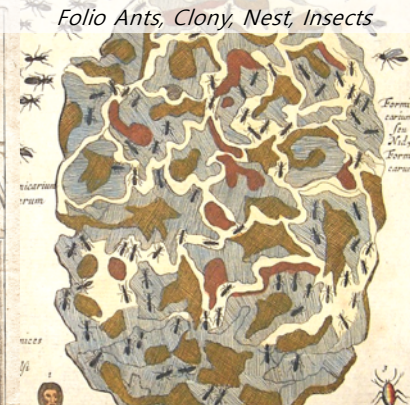
## The value of ambiguity for social and human sciences

66



Thomas Hobbes, 1651
*The Leviathan*

Merian & Jonston, 1718
*Folio Ants, Clony, Nest, Insects*
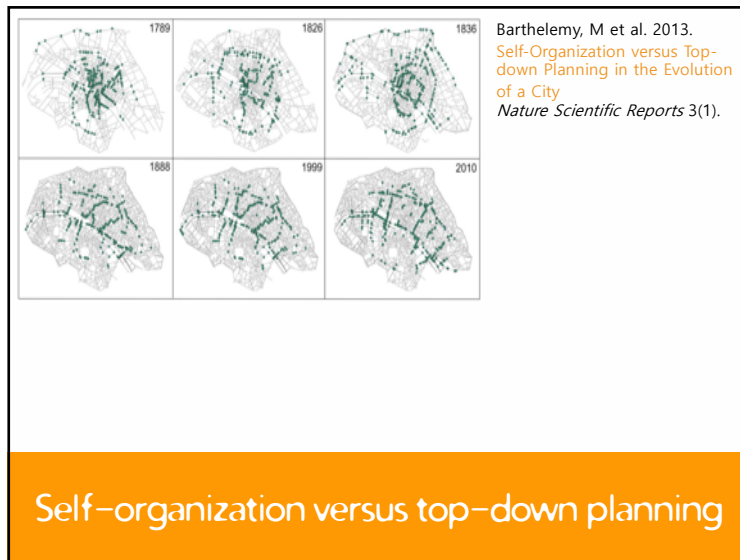
## Beyond micro/macro divide

Michel Callon and Bruno Latour. 1981.
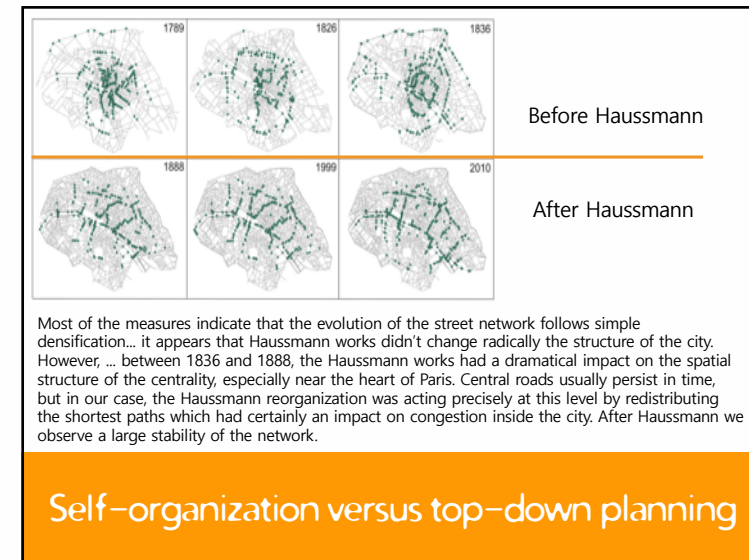"Unscrewing the Big Leviathans How Do Actors Macrostructure Reality?"

67



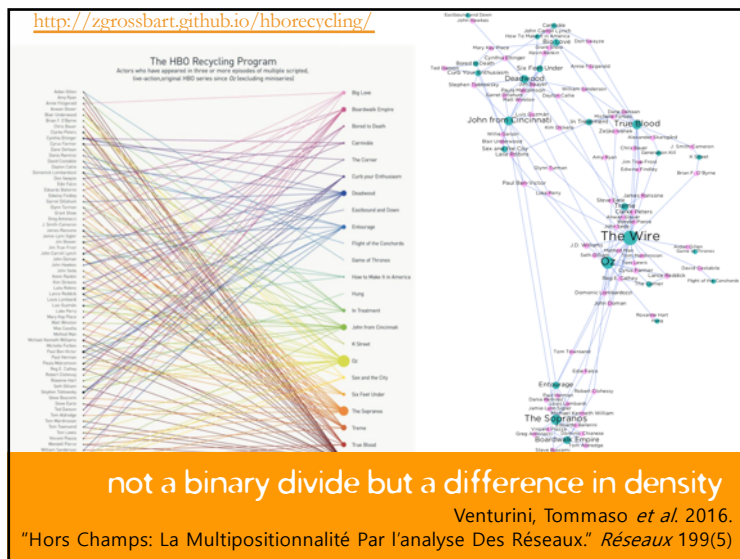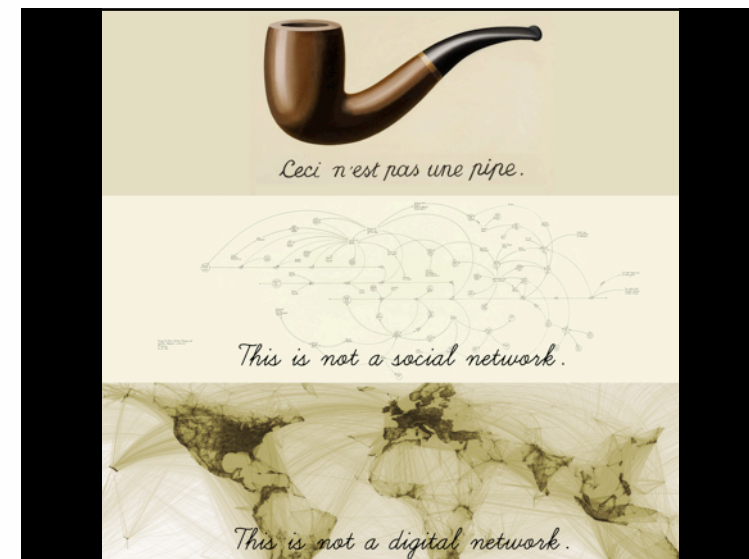## Inside / Outside (Armin Linke)

68

## Slide 69

Barthelemy, M et al. 2013. *Self-Organization versus Top-down Planning in the Evolution of a City* Nature Scientific Reports 3(1).

1789  1826  1836
1888  1999  2010

Self-organization versus top-down planning

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## Slide 70

1789  1826  1836

Before Haussmann

1888  1999  2010

After Haussmann

Most of the measures indicate that the evolution of the street network follows simple densification... it appears that Haussmann works didn't change radically the structure of the city. However, ... between 1836 and 1888, the Haussmann works had a dramatical impact on the spatial structure of the centrality, especially near the heart of Paris. Central roads usually persist in time, but in our case, the Haussmann reorganization was acting precisely at this level by redistributing the shortest paths which had certainly an impact on congestion inside the city. After Haussmann we observe a large stability of the network.

Self-organization versus top-down planning

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## Slide 71

http://zgrossbart.github.io/hborecycling/

The HBO Recycling Program
Actors who have appeared in three or more episodes of multiple scripted, live-action,original HBO series since (excluding miniseries)

not a binary divide but a difference in density

Venturini, Tommaso *et al*. 2016. "Hors Champs: La Multipositionnalité Par l'analyse Des Réseaux." *Réseaux* 199(5)

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## Slide 72

Ceci n'est pas une pipe.

This is not a social network.

This is not a digital network.

72

Professor — you should not confuse the network that is drawn by the description and the network that is used to make the description.

Student — ...?

Professor — But yes! Surely you'd agree that drawing with a pencil is not the same thing as drawing the shape of a pencil. It's the same with this ambiguous word, network.

Latour, Bruno. 2003. "On Using ANT for Studying Information Systems: A (Somewhat) Socratic Dialogue." In The Social Study of Information and Communication Study, eds. C. Avgerou, C. Ciborra, and F.F. Land. Oxford: University Press, pp. 62–76.

## Networks as maps
(Jacob L. Moreno, April 3, 1933, The New York Times)

73



Obrigado!
tommasoventurini.it

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