Class's title: "**Analytical Sociology**"
University: Sorbonne University
Level: Master 2nd year ("Contemporary Sociology")
Dates: 2nd semester
Time: 1.30pm
Location: see sessions' description below
Language: French
Instructor's contact: gianluca.manzo@sorbonne-universite.fr

Overview

The class focuses on the dynamic links between small-scale behaviors and large-scale outcomes. In particular, the class explores a specific class of mechanisms bridging levels, namely *social multipliers*, in which the dynamic interdependence among actors' behaviours create a non-linear relation between actions and resulting structures. Three forms of behavioral interdependences will be especially studied: a/ aggregate-mediate interdependences, b/ space-based interdependences, c/ and, network-based interdependence.
Within this framework, research examples from classics, contemporary research and instructor's current work will be used to address a variety of macroscopic patterns and dynamics, including collective action, spatial segregation, systemic crises, opinion diffusion, homophilious social networks, educational inequalities, and the diffusion of technological innovations.
The class has two minimal goals. First, it is intended to provide students with the conceptual and methodological bases needed to navigate the international literature on the analysis of complex social dynamics that nowadays develops at the intersection of social sciences, psychics, and computer science. Second, the class aims to provide students with a set of theoretical and methodological basic building blocks that they may combine to set out an original research design for their Master or PhD dissertation.
The class is based on mathematical models and computer simulations but techniques are not the primary focus of the class. Thus previous knowledge in formal models and programming is a plus but it is not required.

Session 1: Theoretical and methodological principles

Session 1 introduces the general principles behind the models and the tools discussed in the class. These principles falls within a research program currently named "analytical sociology". The version of this research program animating the class focuses on three essential elements: a/ building explanations that bridge levels of analysis; b/ using dynamic interdependence structures as bridging mechanisms; c/ designing formal models to help theory building and testing. During *session 1*, as to (a), special attention is devoted to the so-called "Coleman boat"; as to (b), three different forms of behavioral interdependence are introduced; as to (c), the basic logic of agent-based modeling and simulation is presented.

Suggested readings (in chronological order)

Erikson E. (2013) Formalist and Relationalist Theory in Social Network Analysis. *Sociological Theory*, 31(3) 219–242.

Manzo G. (2014). Data, Generative Models, and Mechanisms: More on the Principles of Analytical Sociology. In G. Manzo (ed.), *Analytical Sociology: Actions and Networks*, Chichester, Wiley, p. 4-52.
G. Manzo (2021). "Does analytical sociology practice what it preaches? An assessment of analytical sociology through the Merton award", in G. Manzo (ed.) *Research Handbook on Analytical Sociology*, Cheltenham, UK: Edward Elgar (Research Handbooks in Sociology Series), pp. 1-47.
Manzo G. (2014). Potentialités et limites de la simulation multi-agents : Une introduction. *Revue Française de Sociologie*, 55, 4, 653-688.
Manzo G. (2020). "Agent-based models and methodological Individualism: are they fundamentally linked?", *L'Année Sociologique*, 70, 1, 197-229.

Session 2: Local thresholds, collective action, and spatial segregation

How does heterogeneity in actors' preferences translate into systemic patterns when actors' choices are interdependent? *Session 2* addresses this question by introducing two classical models, namely Granovetter's models of collective action and Schelling's model of racial segregation. Both models study how behavioral interdependence can create non-linear and unexpected macroscopic, but they illustrate two different forms of interdependence, aggregate-mediated and space-based interdependence respectively. The conceptual structure of the two models is presented and an agent-based implementation is introduced to show how this kind of models can be studied and modified.

Suggested readings (in chronological order)

Schelling T. C. (1971). Dynamic Models of Segregation, *Journal of Mathematical Sociology*, 1, p. 143-186.
Granovetter M. (1978). Threshold Models of Collective Behavior, *American Journal of Sociology*, *83*, 6, p. 1420-1443.
Bruch, E., & Mare, R. (2006). Neighborhood choice and neighborhood change. *American Journal of Sociology*, 112(3), 667–709.

Session 3: Information cascades, systemic crises, and opinion diffusion

How does actors' interdependence turn heterogeneity in actors' beliefs into homogeneity, thus generating unexpected (and possible undesirable) systemic patterns? *Session 3* addresses this question by introducing two classical models in which aggregate- and/or space-mediated interdependence is based on imitation. In particular, Merton's classical concept of self-fulfilling prophecy and the original "voter model" are introduced and translated into an agent-based model in order to show how "systemic crises" and "opinion clusters" can emerge from the bottom-up and irrespectively from actors' intentions.

Suggested readings (in chronological order)

Merton R. (1948). The Self-fulfilling Prophecy. *The Antioch Review*, 8 (2), 193-210.
Easley D., Kleinberg J. (2010). Information Cascades. In Easley D., Kleinberg J. (2010). *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*, Cambridge University Press, Cambridge (ch. 16).

Session 4: Random networks

In order better to understand network-based interdependences implied by macroscopic phenomena studied in sessions 7-11, *session 4* first introduces the concept of network and presents elementary node- and network-level descriptive statistics. Then, the simplest theoretical model of social network, i.e. Erdos and Renyi's model, is introduced. Algorithms and functions to manipulate (and visualize) network data and to generate random networks are also presented and explained.

Suggested readings (in chronological order)

Jackson M. O. (2008) *Social and Economic Networks*, Princeton University Press, Princeton (chs. 2, 4, and 5).

Session 5: Small-world networks

Real-world networks typically look different from random networks *à la* Erdos and Renyi. In particular, observed social networks tend to be more locally densely connected and more reachable. *Where do the co-existence of cliques and reachability come from*? Thus, *session 5* first describes Granovetter's original observations and intuitions on "strong" and "weak ties", and, then, introduces a second theoretical models of social networks, i.e. Watts and Strogatz's model, that was designed to capture the co-existence of "strong" and "weak" ties. Algorithms and functions to generate "small-world random networks" are also presented and explained.

Suggested readings (in chronological order)

Travers J., Milgram S. (1969). An Experimental Study of the Small World Problem. *Sociometry*, 32, 4, 425-443.

Granovetter M. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380.

Watts D. J., Strogatz, S. H. (1998). Collective dynamics of 'Small-world' networks. *Nature*, 393, 440–442.

Centola, D., & Macy, M. W. (2007). Complex contagions and the weakness of long ties. *American Journal of Sociology*, 113(3), 702–734.

Session 6: Scale-free networks

Real-world networks differs from both random networks *à la* Erdos and Renyi and "small-world" random networks *à la* Watts and Strogatz in one important respect, namely the distribution of node's degree. *Where does asymmetry in degree distribution come from*? *Session 6* introduces a third fundamental theoretical models of social networks, i.e. Barabasi&Albert's model, that was designed to capture the observation that a few nodes tend to concentrate a large fraction of links. Algorithms and functions to generate "scale-free" networks are presented and explained.

Suggested readings (in chronological order)

De Solla Price D. J. (1965). Networks of Scientific Papers. *Science* 149 (3683), 510–515.

Barabási A. L., Albert, R. (1999). Emergence of scaling in random networks. *Science*, 286(5439), 509–512.

Barabási A. L., Bonabeau Eric (2003). Scale-FreeNetworks, *Scientific American*, 288, 60-69 (2003).
Barabasi A.-L. (2009). Scale-free Networks: A Decade and Beyond. *Science* 325, 412-13.

Session 7: Homophilious network generation

One of the most recurrent features of real-world social networks is homophily, i.e. the tendency of nodes with similar attributes to be linked together more frequently than one may expect given the distributions of these attributes. *Where do homophilious networks come from*? *Session 7* introduces a formal model, originally outlined by James Coleman and, more recently, refined by John Skvoretz, that explains homophilious networks through simple actors' behaviours that are interdependent. An agent-based implementation of Skvoretz's model is presented and simulated in order to show some counter-intuitive consequences fueled by the aggregate-mediated interdependence among actors' decision to form a link.

Suggested readings (in chronological order)
Lazarsfeld PF, Merton RK. (1954). Friendship as a social process: a substantive and methodological analysis. In *Freedom and Control in Modern Society*, ed. M Berger, pp. 18–66. New York: Van Nostrand.
McPherson J., Smith-Lovin L., & Cook J. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27, 415–444.
Skvoretz J. (2013). Diversity, Integration, and Social Ties: Attraction versus Repulsion as Drivers of Intra- and Intergroup Relations. *American Journal of Sociology* 119: 486-517.

Session 8: Network-based externalities and education inequalities

How does heterogeneity in actors' preferences and resources translate into systemic pattern of inequality when actors tend to follow others' choices along homophilious-social-networks lines? To address this question, *Session 8* first introduces the concept of "network externalities", and, then, applies it to educational inequalities. A formal model of educational choices is presented and, by means of agent-based simulations, it is shown how educational imitative behaviours spread through socially segregated social networks and generate distributions of education across social groups that strongly resemble actual distributions in contemporary France.

Suggested readings (in chronological order)
DiMaggio P. Garip F. (2011). How network externalities can exacerbate intergroup inequality. *American Journal of Sociology*, 116(6), 1887–1933.
DiMaggio P., Garip F. (2012) Network effects and social inequality. *Annual Review of Sociology*, 38, 93–118.
Manzo, G. (2013) Educational choices and social interactions: a formal model and a computational test. *Comparative Social Research*, 30, 47–100.

Session 9: Social networks, simple contagions, and virus propagation

How do social networks facilitate or obstruct the propagation of virus? This question is addressed by discussing a case study concerning the diffusion of SARS-CoV-2 in France when two network

features are considered: a/ the presence of individual with an exceptionally high number of contacts (i.e. network hubs); b/ various level of local clustering of social contacts. First, real-world physical contact networks are described. Then, this a synthetic network mimicking the distribution of contacts observed in France is introduced within an agent-based based computational model, and Sars-CoV-2 is let spread across the network. Simulation is used to demonstrate how network features can be exploited to intervene mitigate the virus epidemic.

Suggested readings (in chronological order)

G. Manzo, A. van de Rjit (2020). "Halting SARS-CoV-2 by Targeting High-contact Individuals", *Journal of Artificial Societies and Social Simulation*, **23,** 4 (10), http://jasss.soc.surrey.ac.uk/23/4/10.html.

Session 10: Social networks, complex contagions, and innovation diffusion

How do social networks facilitate or obstruct the adoption of new products, social practices, or technological devices? This question is addressed by discussing a case study concerning the diffusion of technological innovations among Muslim and Hindu potters leaving in rural contexts in North-western India. First, real-world networks concerning patterns of influences and parental links among potters are described. Then, a formal model relating actors' network location and the probability of adopting the new technique is introduced. Agent-based simulations are used to assess how important differences in Muslim and Hindu networks are for the explanation of the speed at which the new technology spreads within the two communities.

Suggested readings (in chronological order)
Coleman James, Elihu Katz, Herbert Menzel The Diffusion of an Innovation Among Physicians *Sociometry*, Vol. 20, No. 4 (Dec., 1957), pp. 253-270
G. Manzo, S. Gabbriellini, V. Roux, F. Nkirote M'Mbogorihttp, "Complex Contagions and the Diffusion of Innovations: Evidence from a Small-N Study", *Journal of Archaeological Method and Theory*, 25, 4, 1109-1154

Assessment

Students are warmly invited to attend each class. Attendance counts for 20% of the final mark. The remaining 80% is based on a writing assignment. The student is invited to choose one of the classical papers listed below and write a critical analysis of it. The length of the text should not exceed 5000 words while not being below 2000 words. The text should clearly answer the following questions:

1/ what is the phenomenon investigated by the author(s)?
2/ what is (are) the specific research question(s) addressed?
3/ what are the theoretical hypotheses that the author(s) want to investigate?
3/ are there any empirical data, and, if so, how they were collected?
4/ what methods are employed?

5/ what are the main substantive results?
6/ what are the limitations of the analysis?
7/ what is the connection between the article chosen and the class?
8/ how the article is useful for your own training?
9/ can you imagine to develop this piece research to address a topic related to the society where you live?

The critical note must be sent to the instructor **no later than** *[depending on the year]*.

Readings for the writing assignment

Coleman James, Elihu Katz, Herbert Menzel (1957). The Diffusion of an Innovation Among Physicians *Sociometry*, 20, 4, 253-270
Hägerstrand T. (1965). A Monte Carlo Approach to Diffusion. *European Journal of Sociology*, 6, 1, 43-67.
Travers J., Milgram S. (1969). An Experimental Study of the Small World Problem. *Sociometry*, 32, 4, 425-443.
Schelling T. C. (1971). Dynamic Models of Segregation, *Journal of Mathematical Sociology*, 1, p. 143-186.
Granovetter M. (1978). Threshold Models of Collective Behavior, *American Journal of Sociology*, *83*, 6, p. 1420-1443.