

The Whole is Greater than the Sum of its Parts: Some Remarks on the *Oxford Handbook of Analytical Sociology*

Commenting on *The Oxford Handbook of Analytical Sociology* (hereafter, *The Handbook*), edited by Peter Hedström and Peter Bearman, is a difficult task. The monumental size of the book—30 chapters written by 38 different scholars—makes it hard to provide an overview which would be at the same time deep and synthetic. In addition, the book is clearly the latest instance of a complex intellectual movement whose principles have been coded for almost a decade, first, by Hedström and Swedberg (1998) and, then, by Hedström (2005). As a consequence, a sound review of *The Handbook* should also assess the extent to which some progress has been made over this period of time.

In order to reach an acceptable balance among these three requirements, I decided to review *The Handbook* by themes rather than by chapters. In particular, instead of linearly following their succession across the four parts composing the volume—‘Foundations’ (Chapters 1–2), ‘Social cogs and wheels’ (Chapters 3–10), ‘Social dynamics’ (Chapters 11–25), and ‘Perspectives from other fields and approaches’ (Chapters 26–30)—I will use the chapters to discuss some major theoretical and methodological issues that lie at the heart of the current debate about analytical sociology. Criticisms of this approach guided me in the selection of the issues, which mainly refer to the mechanism concept, the theory of action, and agent-based modeling. Behind the apparent heterogeneity of the chapters, *The Handbook* coherently addresses these fundamental points and shows that analytical sociology is progressively refining both its theoretical premises and methodological tools.

Mechanisms, Models of Mechanisms, and Mechanism Scheme

In their introductory chapter, Hedström and Bearman define analytical sociology as a ‘strategy for understanding the social world’ and, more particularly, for ‘predicting and explaining macro-level dynamics’. The most general requirement of the strategy is ‘detailing in

clear and precise ways the mechanisms through which the social facts under consideration are brought about’.

Both the definition and the status of a mechanism are usually considered to be weak points of analytical sociology (Gross, 2009, pp. 360–362; Mayntz, 2004, p. 239). *The Handbook* may help revoke these doubts. First, Hedström and Bearman acknowledge the diversity of the existing definitions and propose to consider a definition coming to sociology from molecular biology and neurobiology as the most satisfactory. According to this definition, a mechanism should be defined as ‘a constellation of entities and activities that are organized such that they regularly bring about a particular type of outcome’. This definition—which was already provided in Hedström’s 2005 book (see p. 25)—is appealing because it is general and precise: it does not restrict the content of a mechanism to any particular type of entities and activities and at the same time makes the basic structure and function of a mechanism explicit. Concerning the epistemological status of a mechanism, then, the editors’ chapter, as well as Hedström and Udehn’s Chapter 2—which is more specifically devoted to Merton’s legacy for analytical sociology—clarify that, while we always build and analyse models of mechanisms, the mechanism itself is a piece of the real world. Moreover, both chapters advise sociologists to present the conceptual core of their models in terms of a ‘mechanism scheme’, i.e. graphical representations clarifying the main relations among the basic components of the hypothesized mechanism. This seems like a useful strategy for thinking and communicating about our models that may facilitate the connection with meta-languages [like the Unified Modeling Language (UML)] adopted in computational sciences to describe the structure of formal models.

As far as the content of mechanisms is concerned, Hedström and Bearman admit that the specific entities and activities composing it depend on the macro-regularity under consideration. They state, however, that ‘actors, their properties, actions, and relations to one another’ should constitute the basic components to which each model of social mechanism should refer. The causal depth of an explanation, they argue, requires a strong commitment to the micro-foundations of social facts under consideration.

Structural Individualism and Theory of Action

The micro-foundation is probably the point which has raised the most serious reservations about analytical

sociology. Social theorists advocating either a relational and processual approach to social phenomena (Abbott, 2007a) or a pragmatist-inspired theory of action (Gross, 2009) dismiss analytical sociology as another form of rational-choice-oriented reductionism. Rational-choice theorists make the same identification of the quest for micro-foundations with the expected utility theory and consequently dismiss analytical sociology because of its lack of originality (Opp, 2007; Diekmann, 2010).

As rational-choice theory presents a broad spectrum of variants (Goldthorpe, 1998), it is not obvious that analytical sociology is anything more than a restatement of rational-choice sociology (for a deeper analysis of this point, see Manzo, 2010). *The Handbook*, however, should at least help clarify some major points of the conception of social action which analytical sociology aims at developing.

On a meta-theoretical level, the editors' chapter makes explicit that the explanatory priority given to individuals' action must be understood in the larger context of the so-called 'structural individualism'. This variant of methodological individualism is at least 30 years old (see Wippler, 1978) and is often badly understood (see Udhen, 2002). It rests on two fundamental premises. First, it admits the 'explanatory importance of relations and relational structures'. More generally, Hedström and Bearman insist on the 'causal efficacy of macro-properties', which relies either on 'processes that operate "behind the back" of individuals, such as various socialization processes' or by 'being components which individuals consciously take into account when deciding what to do' (Chapter 23 by Joel Podolny and Freda Lynn nicely illustrates the latter option: 'status' is considered a 'structural cue', i.e. an 'informational input' which shapes *ego's* decision to confer deference to *alter* or not). The second distinctive feature of structural individualism is that 'it does not imply a commitment to any specific type of motive or intentional state that is assumed to explain why individuals act as they do'. In particular, the editors claim, 'it does not imply a commitment to any form of rational-choice theory'. White's vacancy chains model and Bearman, Mood, and Stovel's model of network formation as well as Merton's analysis of deviance, of reference group, of self-fulfilling prophecies, and of Matthew effects are presented—in Chapters 1 and 2, respectively—as examples of models of mechanisms paying equal attention to different levels of analysis and implying different images of the actor.

Additional elements showing that the criticism of rational-choice-oriented reductionism is misplaced may be found in the second part of the book.

Jon Elster's Chapter 3 considers emotions as one of the main mechanisms of belief formation. In particular, he argues, emotions may amplify the need for urgency—the preference for early actions over later ones—so favouring the formation of low-quality beliefs, i.e. beliefs that result from an underinvestment in information. At the same time, Elster acknowledges the deep social roots of many emotions: anger and envy, for instance, are systematically triggered in the context of the social interactions that actors are embedded in. Elster's Chapter 9 on norms finally explores some macro-level consequences of this loop between emotions, beliefs, and social interactions. In particular, he explains the stability of social and moral norms as the effect of the interdependency between, respectively, the contempt (or the indignation) in the observer of a norm violation and the shame (or guilt) in the norm violator. Elster explicitly states that his account is of a non-rational-choice type because it assumes that both the actor who sanctions and the violator act emotionally and spontaneously.

The transition from emotion to cognition is achieved in Chapters 4 and 7 authored by Jens Rydgren and Daniel Goldstein, respectively. While cognitive mechanisms of belief formation—like categorization, inference, analogy, and cognitive dissonance—constitute the core of Rydgren's analysis, he also stresses the importance of social interactions for the genesis of individuals' beliefs when actors act under uncertainty and/or their beliefs deviate from the majority of those with whom they are in contact. (Michael Biggs's Chapter 13 builds on some of these mechanisms in order to explain the genesis of 'false' beliefs underlying self-fulfilling processes.) Goldstein's chapter is even more radical in criticizing the way that individual-decision making is conceived in standard rational-choice models. Instead of assuming that people collect and weight information, the 'fast and frugal program' Goldstein defends in cognitively oriented social psychology that aims to describe how real actors form their beliefs and reach a decision by developing simple search, stopping and choice rules. Diego Gambetta's Chapter 8 comes back to more socially oriented mechanisms of beliefs formation under uncertainty. In particular, he explores with the lenses of signaling theory how people reach a judgement about the trustworthiness of others' actions. Gambetta insists on the complex interplay between individuals' beliefs, interactions, and the larger context where actions and interactions take place. The

trustworthiness of a signal, he argues, depends on its perceived meaning, which, in turn, is embedded in the cultural context where the signal is emitted (Diane Vaughan's Chapter 29 on 'analytical ethnography' explores some system-level unintentional consequences of ambiguities in signal meaning).

The Handbook thus shows that, while analytical sociology starts with actors' beliefs and desires, it neither takes them for granted nor considers them as a transparent and coherent reality in the eyes of actors. On the contrary, one of the tasks of analytical sociologists is to effortlessly endogenize beliefs, desires, and opportunities by relating them to infra-individual, network-, and system-level entities (concerning opportunities, Trond Petersen's Chapter 6 studies, for instance, the legally generated opportunity structure for discriminating behaviours on the job market). By so doing, analytical sociology now clearly produces more and more psychologically plausible images of actors which go beyond the 'as-if' status of the usual rational-choice assumptions. Programmatic statements about the importance of taking into account individuals' social identity (which are formulated in Chapter 17 on collective action by Delia Baldassarri) as well as the dialogue that *The Handbook* establishes between analytical sociology and behavioural game theory (whose results are commented in Delia Baldassarri's Chapter 17, in Richard Breen's Chapter 26 on game theory, and in Iris Bohnet's Chapter 27 on experiments) also testify to the interest of analytical sociology for richer and more realistic theories of action.

Needless to say, one may object that listing series of ego- and alter-centered mechanisms has nothing to do with a coherent theory of action which enables us to deduce specific observations and establish under which conditions this or that micro-level mechanism is at work. Analytical sociology, however, seems to be on the right track: making an inventory of complexity at the micro-level is the step before mapping it in more structured arrays of nested mechanisms. But why, skeptics may retort, should a more complex theory of action constitute a legitimate and necessary priority? After all, one can consider the psychological realism of our model of actors as a practical matter depending on the type of *explanandum* under consideration (Chapter 5 by Jeremy Freese, who overall seems favourable to cognitively elaborated action theories, also puts forward this old argument). But how would we be able to decide if a given *explanandum* requests a given level of complexity at the micro-level, if we do not have access to the map of this complexity and to the conditions under which one of its areas is relevant? The pragmatic criterion seems inapplicable without a

general framework specifying when a given logic of action is likely to be triggered. In this sense, the quest of analytical sociology for more realism at the micro-level seems justified and should be pursued.

Agent-based Simulations and Empirical Data

Given that explaining system-level regularities by building multi-level theoretical models is the conceptual core of analytical sociology (Stathis Kalywas's analysis of civil war in Chapter 25 is a nice illustration of the interdependency between individual- and group-level dynamics), the fundamental methodological question raised by the approach is how to formally design such models and study their aggregate consequences. Hedström and Bearman's introductory chapter suggest that a particular type of simulation method, namely 'agent-based models', represents an especially powerful solution.

This is another controversial point. Some critics of analytical sociology have already argued that agent-based models enable us to represent only very simplified micro-level mechanisms (Abbott, 2007b; Lucchini, 2008 pp. 9–12) while others remarked that their lack of generalizability may lead analytical sociology to a sort of 'quantified ethnography' (Sawyer, 2007, p. 260). Besides, Richard Breen's Chapter 23 in *The Handbook* itself indirectly casts doubt on agent-based models by claiming that we should give priority to game theory over simulation because 'the relationship between the inputs (individual actions) and output (aggregate or system-level phenomena) is much more transparent in games than it usually is in simulations'.

Several chapters of the third and fourth parts of *The Handbook* help clarify the extent to which these reservations are misplaced. The first criticism tends indeed to take one trait of many current applications as a limitation of the technique itself while the last one transforms a difficulty of the technique into a final weakness. On the other hand, the second objection forgets that analytical sociology considers agent-based models as the pivotal tool of a larger methodological framework. As explicitly argued by Elizabeth Bruch and Robert Mare in Chapter 12 on segregation processes as well as by Ivan Chase and Brent Lindquist in Chapter 24 on the emergence of dominance hierarchies, a complex integration between statistics, computational and mathematical modeling, and experiments is the only way to really disentangle mechanisms operating at several levels of analysis.

So let me first consider whether or not analytical sociology is right in defending agent-based models before discussing the other pieces of the methodological framework which this computational technique is embedded in.

Michael Macy and Andreas Flache's Chapter 11 presents this technique as the 'fullest formal representation' of a non-reductionist form of methodological individualism. On the micro-level side, indeed, when an artificial agent is programmed to represent a real actor, from simple maximizing input–output agents to more sophisticated heuristically oriented, adaptive and learning-based agents, virtually any form of cognitive mechanism and decision-making process can be implemented. In theory, even brain mechanisms may be modeled by programming each agent as an artificial neural network. Moreover, agents (or groups of agents) may differ in terms of cognitive abilities and resources (or other attributes). On the macro–micro-link side, the technique is strongly appealing because it allows researchers to link agents with each other so that the most popular behaviours in agents' local neighbourhoods can be incorporated in agents' future actions.

But, as Macy and Flache stress, putting complex agents into complex networks is certainly not an objective in itself. Agent-based models actually are essential for analytical sociology because they enable us to rigorously deduce the system-level implications of the posited macro-level mechanism and relationally constrained micro-level mechanism. In order to understand the importance of this point, let us go back to the following passage:

One may ask just why there came to be such a radical shift toward a focus on individual behavior in a discipline whose subject matter, after all, is the social system. Part of the answer lies in the invention of techniques. The statistical tools of survey design and analysis began in the 1940s to make possible quantitatively precise statements about samples of independent individuals and the populations (again of independent individuals) they represent, as well as analysis of factors affecting individual behavior. *There was no comparable development of tools for analysis of the behavior of interacting systems of individuals or for capturing the interdependencies of individual actions as they combine to produce a system-level outcome.* The far greater complexity required of tools for these purposes constituted a serious impediment to their development and continues to do so (though some methods such as those generally labeled 'network analysis' move in that direction). The end result is extraordinarily

elaborated methods for analysis of the behavior of a set of independent entities (most often individuals), *with little development of methods for characterizing systemic action resulting from the interdependent actions of members of the system* (Coleman, 1986, p. 1316, italics is mine).

The not-yet-fully-appreciated novelty of agent-based models for sociology is precisely to provide us with a powerful device to deal with the micro–macro transition problem, in particular when constrained individual actions are dynamically interdependent. As correctly pointed out by Richard Breen (Chapter 23), game-theoretic models must also be considered for this task. Their mathematical nature has a cost, however. As stated by Macy and Flache (Chapter 12), both actors and their interdependencies must be heavily simplified in game-theoretic models while this is not the case for agent-based models. As demonstrated by evolutionary games, game theory needs agent-based models when it tries to embed cognitively oriented agents in specific relational topologies (see, for instance, McKenzie, 2007). In this respect, Breen's chapter is partly contradictory in that, while on the one hand, he casts doubt on simulation because of its lack of transparency; on the other hand, he particularly stresses the importance of the class of games which most widely relies on simulation (on the unsoundness of excessively contrasting agent-based simulations and game theory, see Balzer, Brendel, and Hofmann, 2001).

Two chapters of *The Handbook* illustrate the flexibility of agent-based models in dynamically aggregating individual decisions of networked actors. First, Katherine Stovel and Christine Fountain's Chapter 16 on matching mechanisms model recruitment processes with the aim of studying the effect of network homophily on levels of segregation on the job market; secondly, Duncan Watts and Peter Dodds's Chapter 20 on threshold models revisits Granovetter's original model by introducing several types of network topologies and studies their effects on the system-level dynamics.

Even though network topologies are still often taken for granted, agent-based models also make it possible to endogenize the network itself. If, as James Moody correctly argues in Chapter 19, we must improve in designing and testing substantive micro-level mechanisms of link creation and deletion—instead of continuing to model network dynamics in probabilistic terms at the link level—agent-based modeling represents a powerful tool. In this respect, Chris Winship's Chapter 21 on time and scheduling as well as Scott Feld and Bernard Grofman's Chapter 22 on homophily

contain useful insights: both individuals' schedule conflicts and shared foci of activity represent potential network generative mechanisms that agent-based modeling would allow to formalize in a more direct and detailed way.

So, while all these elements signal the potentialities of agent-based models for implementing the complex form of methodological individualism defended by analytical sociology and for advancing the long-standing problem of aggregativity, it would be naïve to underestimate the difficulties raised by this technique. *The Handbook* does not make this mistake. Macy and Flache's Chapter 12 closes honestly by discussing the major limitations of agent-based simulations for which final solutions have not yet been found.

First of all, the richer the posited mechanisms are, the less easy it is to understand the specific sequence of events which is responsible for the aggregate patterns generated by the simulation. This should not be considered, however, as an unsolvable problem. On the one hand, introducing simple mechanisms first and making them progressively more complex only once the dynamic generated by the first set of mechanisms has been understood is a way to increase the transparency of the outcome. On the other hand, appropriate mathematics to describe what is going on in a simulated model is developing and some solutions are already available (Young, 2006). In this respect, Meredith Rolfe's Chapter 18 constitutes a good preliminary study. She outlines a general framework for organizing models of choices under influence according to their basic formal properties and shows the existence of regularities in the way these properties are linked to both the dynamic and the outcome generated by the model.

Macy and Flache point out two other problems related to the explanatory relevance of agent-based models: first, the possibility that several mechanisms are equally compatible with the system-level regularities under consideration and, secondly, the dependence of the simulated output on specific combinations of parameter values.

Here is precisely where *The Handbook* advises linking agent-based simulations to empirical data coming from large-scale surveys, experiments, and qualitative observations. The objective of such multi-faceted methodology is to embed the artificial mechanisms in a web of empirical constraints as rich as available data allow, so trying to minimize the sources of arbitrariness in the simulated model. As Hedström and Bearman claim in their introductory chapter, '[...] the mechanism-based approach is not in opposition to traditional experimental and non-experimental

approaches. Such methods are essential for adjudicating between rival mechanisms and for distinguishing the relevant activities and relations of a mechanism from irrelevant ones'.

Let me pay particular attention to the role of statistical analysis of large-scale data sets. The attitude of analytical sociology towards multivariate statistical methods has indeed been misunderstood since the publication of Hedström and Swedberg's (1998) collection of essays. While they only reminded us of the impossibility of disentangling the structure of mechanisms at work by directly analyzing observational data—which is an old point (see Boudon, 1979) perfectly acknowledged by some of the finest quantitatively oriented sociologists (see Goldthorpe, 2001) and absolutely evident to distinguished social statisticians (see Friedman, 2009)—many interpreted the reminder as a final dismissive statement against statistics itself and descriptive tasks more generally (Opp, 2005, 2007; Reiss, 2007).

The Handbook should help solve the misunderstanding. Hedström and Bearman's Chapter 1 clearly attributes two tasks to the statistical analysis of individual and relational data: first, the definition of the empirical pattern to be generated by simulation and, secondly, the evaluation of the fit of simulated data to empirical ones. Statistics are also essential at the entry of the computational model, however. As Bruch and Mare's Chapter 12 stresses, the results of appropriate statistical analysis and curve fitting procedures can be used to empirically initialize artificial agents' attributes and decision rules (while this idea of micro-validating agent-based models by means of the outputs of previous statistical analyses was at the heart of Hedström's 2005 book, Hedström and Bearman's introductory chapter to *The Handbook* surprisingly does not mention it).

Thus, Hannah Brückner's Chapter 28 on survey methodology is right in claiming that 'surveys are essential for the project of analytical sociology'. The deeper survey designs will become, which is what she wishes, the richer data will be in terms of context, network, and actors' attitudes and reasons that can be used to fill the micro and the relational side of computational models so reducing the risk of erroneous and unrealistically specifying them.

Brückner's argument, however, becomes less convincing when she seems to reiterate the point that appropriate statistics on appropriate empirical data, in particular longitudinal data, would make it possible to reconstitute the mechanisms at work.

The fundamental distinction here is between 'providing' a mechanism and 'inferring' a mechanism. In

the first case, the constellation of entities, their direct and indirect links as well as their macro-constrained actions are explicitly designed and made to unfold over time *in silico*. In the second case, this set of elements is supposed to be at work on the basis of its presumed aggregate signature. Now, no matter how rich the empirical data and how sophisticated the techniques are, multivariate statistical methods cannot ‘provide’ a mechanism in the sense specified, only formal simulated models can.

The Handbook contains a nice example of this structural limitation of statistical techniques. Yvonne Åberg’s Chapter 15 on the risk of divorce presents an original analysis of how the divorce choices of *ego*’s coworkers influence *ego*’s divorce probability in Sweden. The analysis relies on rich longitudinal data and on the estimation of a sophisticated event-history model. However, results neither directly show the existence of any dyadic-interaction-based influence process nor do they allow disentangling of the micro-level mechanisms potentially responsible for it (as Åberg honestly acknowledges).

As I said, in order to build generative computational models on more and more robust micro-level foundations, analytical sociology looks with increasing interest at experiments and qualitative data. Iris Bohnet’s Chapter 27 on laboratory game-theoretic-based experiments on norms of fairness and Diane Vaughan’s Chapter 29 on analytical ethnography testify to this will of analytical sociology of gathering empirical data as rich as possible on actors’ belief, preferences, and values. With regard to experiments, however, it should be noted that, while their auxiliary role in terms of data generation is certain, they are not necessarily able to ‘provide’ a mechanism (in the sense defined above). Salganik and Watts’s Chapter 14 on the success of cultural products clearly illustrates this point. Although they convincingly demonstrate that others’ past choices to download a song strongly influence *ego*’s present choice to listen to the song, their experimental setting does not enable them to say anything on the relationally constrained micro-level mechanisms through which this social influence is generated. In other words, the experiment provides in this case only the sign of a correlation without the sequence of events producing it.

What is the Next Step?

Altogether, the main merit of Hedström and Bearman’s edited book is to show that, partly under pressure from critics, partly because of the dialogue

with behavioural economics, cognitive social psychology, computational sciences, complexity theory, and biology, analytical sociology is progressively enriching. *The Handbook* outlines a theoretical and a methodological framework whose coherence and solidity are now stronger than the critics of analytical sociology are usually ready to acknowledge. The specificity of the approach should now be clearer. While, indeed, the basic pillars of analytical sociology—a complex form of methodological individualism, a broader concept of rationality, a dynamic conception of social networks, a thoughtful use of statistics and experiments, and a strong commitment to computational modeling—have old roots in sociology and several areas of contemporary sociology also focus on some of them, the originality of analytical sociology stems from the integration of these elements under a unitary meta-theoretical framework. The whole more than the parts makes analytical sociology unique in the context of today’s sociology.

The only regret that readers may have is that the absence of one chapter concretely applying the entire framework constitutes an obstacle to the perception of this uniqueness. While several chapters are substantively oriented and built on this or that piece of the framework, no one provides a full application of the integration between a complex form of methodological individualism and the multi-faceted testing methodology lying at the heart of analytical sociology. To definitely convince skeptics about its novelty and power, this seems to me what is needed now. All sociology will go another step further when some of us are able to edit *The Handbook of (Fully) Applied Analytical Sociology*.

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