Analytical Sociology: A *Lego* Approach to Empirical Research

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Henning and Clemens invited us to think about the question of "(...) which theoretical
frameworks, modeling tools and research strategies are best suited to study social mechanisms."
The point that I would like to make in this brief statement is that, if we accept a certain
understanding of the concept of social mechanism, namely that mechanism-based thinking is a
sort of <u>reverse engineering</u> (on this concept, see Eilam, 2005), than the "modeling tool" we
should give priority for mechanism-oriented model building is object-oriented computational
simulation.

Recently I have suggested that the analytical sociology program can be expressed as a set of seven
principles that implies in turn a corresponding set of ideal-typical research steps (see Manzo 2014:
7-10)[1]. Among these principles, P5 proposes agent-based computational modeling as *the* pivotal
tool of the analytical sociology research strategy. "Pivotal" does not mean "exclusive". To me,
"pivotal" means "essential" when a specific task is at hand, this task being the <u>reconstruction</u> of
the connection between the *explanans* and the *explanandum*.

I chose purposively the term "reconstruction". This is the point that I would like to make: we can
accept the "pivotal" role of agent-based computational modeling *only if* we accept a specific
understanding of what a mechanism-based explanation is.

If we consider that a mechanism basically is an intermediate variable and, as a consequence, we
believe that a model of a mechanism can be studied by more or less refined versions of statistical
analysis or experimental designs, then we cannot accept, probably even not understand, my claim.

By contrast, if we accept that a mechanism primarily is a *system of small-scale entities and events* that
triggers a *process* that in the end generates *large-scale entities and events*, then we should accept that the
theoretical proof that the *explanans* leads to the *explanandum* can only be provided by <u>recreating</u>
the small-scale system, the process it potentially triggers, and the large-scale consequences the

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[1] These principles are: (P1): use concepts that are as clear and precise as possible to describe both the facts to be
explained and the explanatory hypotheses/facts mobilized to explain them, while avoiding all linguistic obscurity and
convolutedness; (P2): mobilize the best quantitative and qualitative empirical information available and use the
technical tools best suited to describing the facts to be explained; (P3): in order to explain the social outcome(s)
described, first formulate a "generative model," that is, a model of a (set of) mechanism(s), where a mechanism is a
set of entities and activities likely to trigger a sequence of events (i.e., a process) likely to bring about the outcome(s);
(P4): in order to formulate the "generative model," provide a realistic description of the relevant micro-level entities
(P4a) and activities (P4b) assumed to be at work, as well as of the structural interdependencies (P4c) in which these
entities are embedded and their activities unfold; (P5): in order rigorously to assess the internal consistency of the
"generative model" and to determine its high-level consequences, translate the "generative model" into an agent-
based computational model; (P6): in order to assess the generative sufficiency of the mechanisms postulated,
compare the agent-based computational model's high-level consequences with the empirical description of the facts
to be explained; (P7): in order to prove that the hypothesized micro- and network-level assumptions are not only
generative sufficient but also empirically grounded, inject as much individual- and relational-level quantitative,
qualitative, and/or experimental data as possible into the agent-based computational.

process generates. This is the meaning I assign the term "reconstruction". "Reconstruction" means "to recreate" the connection between A and B.

According to this understanding of the concept of mechanism, a mechanism-based explanation amounts to a *reverse engineering* operation In studying social phenomena, we know the outcome but we do not know what generates it. Thus, we face a similar challenge as a software engineer who see how a software behaves but does not know why it behaves the way it is. The software engineer does not know the code that generate the software behaviors. When can he claim that he has understood (explained) the software behavior? When he is able to crack the code. What is the proof that this is the case? The proof is the software engineer's capacity to *recreate* or *reconstruct* the software behavior on the basis of the cracked code.

In my opinion, the deep meaning of the concept of mechanism implies the same operation: the connection between the mechanism postulated and the observed high-level pattern should be proved by recreating the connection itself, rather than by just verbally stating or sketching the existence of this connection. The functioning of a mechanism must be designed and its consequences must be triggered, not just inferred on the basis of the mechanism's supposed signature. As provocatively stated by Epstein (2006: xii), "if you do not grow it, you do not explain it."

To use a metaphor, this understanding of the concept of mechanism implies a *Lego* approach to empirical research in sociology. Entities, properties, activities, and the connections among them must be combined like when we lock together Lego plastic blocks. As long as we do not find the right way to lock them together the Lego cannot be built. We prove that we have understood the Lego when we re-build it. In mathematics, this kind of proof is labeled a "constructive" proof (Borrill and Tesfatsion 2010).

There is one method that makes it possible to implement this operation of reconstruction. This method is simulation. There is one specific style of programming that make it possible to combine entities, properties, and activities similarly to Lego. This is object-oriented programming. That is why I regard objet-based computational simulation as the most powerful way we have today to study theoretical models of social mechanisms.

To avoid misunderstandings, let me stress again that this statement holds provided one accepts that the primary, distinctive function of a mechanism-based explanation is to reconstruct the outcome of interest. In one opts for a difference understanding of the concept of mechanism and/or if one is interested in other research tasks (like the empirical test of the mechanism postulated), then other methods are needed.

References

Borrill, P. and Tesfatsion, L. (2010) Agent-Based Modeling: The Right Mathematics for the Social Sciences? Working Paper no. 10023, Iowa State University, Department of Economics.

Eilam, E. (2005) *Reversing: Secrets of Reverse Engineering*, John Wiley Publishing, Inc., Indianapolis.

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