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Title: How Social Sciences could be benefit from ABSS practices.
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"Replicants are like any other machine, they're either a benefit or a hazard... If they're a benefit, it's not my problem." (Deckard to Rachel, "Blade Runner",1982)

There exists an epistemological controversy on the validity -or benefits- of Agent-Based Social Simulation (ABSS) methodologies as an approach to knowledge, and to providing sound results for social sciences research. Computer simulations come to a bigger accessibility starting from the decade of the ninety, coinciding with microcomputer's extension of use, although first experiments can be identified from the seventies [1]. The scientific debates held until now will sketch a panorama where it stress a) a few highlight topics [2] [3] [4] and b) an internal breakup within ABSS practitioner's community [5] [6]. We aim to expose in a systematic way these match points for an ordered discussion. We defend that ABSS practices could bring some benefits to Social Sciences research, so regarding artificial or simulated societies, *if they're a benefit, it IS our problem.*

Simulation in social sciences implies a set of methodologies with a vast potential, both for the modelling and the comprehension of social processes, and it proves to be pertinent when there is a need for analysing dynamic social systems, with complex emerging results starting from the interaction between multiple agent behaviours [7]. However, the high complexity of a such a system can happen as from a comparatively simple elementary activity [8], so there is no need to build a complicated simulation to model a complex object system.

Simulations allows the generation of artificial agents with attributes adjusted to the real world, with bounded rationality, the capability of emotions and pro-activity [9]. So that a "model of human beeing" is implied in the debate [10], but research about agents and their interactions comes across included within the theory of complexity. In ABSS, agents can be individuals, institutions, organizations or countries, as well of rules, norms, resources or even some cognitive contents. The interactions that carry out simulated agents necessarily are not linear in respect of causality. In most of the cases, these agents are changeable in time -they coevolve with the whole system- and they appear to be reactive to his environment, so that attempting to establish a mathematical solution, by means of equations that may gather up all this information, proves to be extremely complicated. Is at this point where ABSS has evidenced to be best-suited for the formalization of social theories [11] [12].

Therefore, simulation approach seems to be a matter of formalization for social phenomena. A number of practitioners defend that position, and it could be argued that some of the benefits of ABSS are related to the "fine-grain" attention during the abduction/retroduction phase of research process. A second position, that we discuss later, is that simulation is essentially a substitute for experimentation, so it really shines in the inductive phase of research.

Of course, these are not incompatible positions. Regarding formalization of social phenomena, what does allow computational programming (ABSS), with respect to mathematical techniques? In short: larger concretion, less abstraction and, specially, it permits us examining more expressive details by means of *pseudo-experiments*. A simulation run of a computer program allows to treat, more easily than equation systems, the processes that do not entail a well-established order, or even with some sort of concurrent or parallel causality. Another advantage for the use of simulations is than a modular program can be build with relative ease to permit us establishing changes of initial parameters without need to reprogram everything again, or even changing certain parts of the program; but mathematical formalization lacks that peculiarity. This kind of techniques

permits the forging of simulation systems that envisage the possibility of highly heterogeneous agents. Prediction of social phenomena proves to be extremely unlikely, not just because of non-linear aggregate behaviours, but also because any "publicity" of social prognosis can affect itself the future development of the system *per se* [1]. So, it could never be leave out of account than the outcome that one gets from the ABSS procedures can not be consider *solutions* -as in an AI expert system simulator-, but merely we can refer to them like *pseudo-experimental* evidences -as data output generated in laboratory conditions-. So that there is a still an open debate about the suitable use of the ABSS approach: prospective solutions, or experimental toolbox?

Most of simulations in social science research are build-up from a set of agents programmed with relatively simple behavioural rules and attributes. What really proves to be interesting is the analysis of the aggregated and complex behaviour of agents when we put them to interact [1] [9]. Simulation can help us in the quest of emergence of particular tendencies or behavioural patterns that are recurring, the same way that in the elucidation of the existence of dominant strategies. Should be noted that all these mentioned goals pertain to the core of social investigation [13] [5].

In a similar way than the classical debates referring to human agency [14], within the AI's domain when becomes reference to agents there is not a common consensus definition. The term is used to describe those autonomous programs that can control its own actions based in the perceptions of his operative environment [15]. So, depending on the set of properties foreseen while programming, agents can be categorized into the following -not necessarily excluding- categories: *a)* Agents with *autonomy*, competent to operate under the regulation of his own actions; *b)* Agents with *social capability*, able to interact with another agents; *c)* Agents with *re-activity*, able to perceive his environment and to react to it; *d)* Agents with *pro-activity*, that not only can react to his environment but they have the capacity to establish an initiative to pursuing an objective [16].

ABSS methodology allows the design of intelligent agents at such a "micro-level" of detail that both qualitative and quantitative approach can be easily setting up simultaneously. As a matter of fact, simulation experiments with ABSS models are a third way to traditional methods of access to knowledge: not fully inductive nor fully deductive [17]. The aim of ABSS to incorporate the best part of both induction and deduction is completed with the alleged claim that it can help intuition through *pseudo-experiments* that can reveal generative or emerging properties otherwise called *second-order* effects [18]. This "bridge" status claims for a more in deep epistemological debate.

As a conclusion, we can highlight three relevant aspects of ABSS practices: *a)* unavoidably calls for the detailed specification of "model of human been" needed to design the basic agents; *b)* offers us the opportunity to represent and generate the complex dynamics of social change processes in a not-complicate and generative way; *c)* allow us to establish both a micro-level of analysis (making comprehensible the attributes and individual's behaviours) and a macro-level of analysis (extracting the global properties of the whole social system).

The implications of ABSS simulation approach over truth and knowledge access, causality, the status of scientific theories, dynamics of complexity, or human nature specification makes it a fertile playground for the epistemic debate. The consideration of the benefits at the abductive phase of research could bring new insights into relevance and methods for generating sound hypothesis -in a "explosive" way, like mutation and crossover biological mechanisms-, while the consideration of the benefits at the inductive phase of research -mainly "evaluative", like the natural selection interaction process itself- could bring new light to the role of experiments in research practices.

References:

1. Gilbert, N., & Troitzsch, K. G. (2006). *Simulación para las ciencias sociales :Una guía práctica para explorar cuestiones sociales mediante el uso de simulaciones informáticas* (2ª ed.). Madrid etc.: McGraw-Hill.
2. EPOS Series. <http://www.essa.eu.org/> (23/02/2006).
3. Axelrod, R. (2003) "Advancing the Art of Simulation in the Social Sciences", *Japanese Journal For Management Information System*, Special Issue on Agent-Based Modeling, Vol. 12, No. 3, Dec. 2003.
4. Marney, J.P.; Tarbert, H.F.E. (2000) "Why do simulation? Towards a working epistemology for practitioners of the dark arts", *Journal of Artificial Societies and Social Simulation* vol. 3, no. 4, <http://www.soc.surrey.ac.uk/JASSS/3/4/4.html>
5. Conte, R.; Edmonds, B.; Moss, S.; Sawyer R.K. (2001) "Sociology and Social Theory in Agent Based Social Simulation: A Symposium", *Computational & Mathematical Organization Theory* 7, 183–205, 2001.
6. Deffuant, G.; Jager, W.; Moss, S. (2005). "Dialogues concerning a (possibly) new science", ESSA 2005 Conference, Koblenz.
7. Lozares, C. (2004) "La simulación social, ¿una nueva manera de investigar en ciencia social?", *PAPERS: revista de sociología*, 72, 2004, pp. 165-188.
8. Maturana, H.R.; Varela, F.J. (1987). *The tree of knowledge: The biological roots of human understanding*. Boston: Shambhala Publications.
9. López Paredes, A. (2004). *Ingeniería de sistemas sociales diseño, modelado y programación de modelos basados en agentes*. Valladolid: Universidad de Valladolid, Secretariado de Publicaciones e Intercambio Editorial.
10. Simon, H. A. (1996). *The sciences of the artificial* (3rd ed.). Cambridge, Mass. etc.: The MIT Press.
11. Taber, C.S., Timpone, R.J., eds. (1996) *Computational modeling*. London: Sage Publications, Thousand Oaks.
12. Axelrod, R. (2006) "Agent-Based Modeling As A Bridge Between Disciplines", en Kenneth L. Judd and Leigh Tesfatsion (Eds.), *Handbook of Computational Economics*, Vol. 2: Agent-Based Computational Economics, Handbooks in Economics Series, North- Holland, pp. 1565-1584.
13. Boudon, Raymond (1981) La Logica de lo Social. Madrid: Rialp Ediciones, S.A.
14. Giddens, Anthony (1988) *La constitución de la sociedad: bases para la teoría de la estructuración*. Buenos Aires, Amorrortu.
15. Huhns, M. N., & Singh, M. P. (1998). *Readings in agents*. San Francisco: Kaufmann.
16. Wooldridge, M. y Jennings, N. R. (1995). *"Agent theories, architectures and languages: A survery". en inteligents: ECAI-94 workshop on agent theories, architectures and languages. amsterdam. springer.* Berlin
17. Macal, C. M. & North, M. J. (2007) "Agent-based modeling and simulation: Desktop ABMS", en Henderson, S. G.; Biller, B.; Hsieh, M.; Shortle, J.; Tew, J. D. & Barton, R. R. *(ed.) Proceedings of the 2007 INFORMS Winter Simulation Conference,* 2007.
18. Epstein, J. M., & Axtell, R. (1996). *Growing artificial societies: Social science from the bottom up*. Washington, D.C.: Brookings Institution Press.

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