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Complexity and social sciences

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Abstract

Purpose – *The purpose of this paper is to give an outline of the main topics of an introductory course in complexity and social sciences.*

Design/methodology/approach – *This paper consists of a survey of the main issues and some of the classical literature for an audience with no background in philosophy of science, social philosophy, the literature on complex systems and social choice.*

Findings – *In the didactical framework of the article, it would be more accurate to speak of learning objectives rather than findings. The learning objectives are the acquisition of the basic knowledge for understanding the features, the possibilities and the limitations of scientific explanations and predictions and their applications in the long-term perspective of complex social systems.*

Research limitations/implications – *Again, the implications are didactic. The basic knowledge that constitutes the learning objective of the course serves to give students the instruments for recognizing the main opportunities and obstacles in social forecasting.*

Practical implications – *The practical implications of this paper include making students aware of complexity-related problems in their working environment and of the opportunities and constraints involved in solving them.*

Social implications – *Operators who are aware of the main issues involved can contribute to a more balanced approach to social forecasting: avoiding to raise unrealistic expectations and making more efficient use of the available instruments.*

Originality/value – *This paper summarizes an original combination of elements from the philosophy of science, epistemology, social philosophy and social choice.*

Keywords *Complexity, Rationality, Social choice, Predictions, Social forecasting*

Paper type *Conceptual paper*

1. Past, present and future

Anticipating the future involves both prediction – hence, knowledge – and intervention – the application of knowledge. A fundamental asymmetry between the past and the future is that we, in the present, cannot change the past. What we can change is our knowledge and our representation of the past. As to the future, not only can we shape it, it is inevitable that we do so, unconsciously or deliberately. In the latter case, we need the necessary epistemic and implementation instruments. Knowledge is fundamental for survival. The better we succeed in bridging the gap between what there is – reality – and what we know about it, between ontology and epistemology, the better are our chances of survival. After the scientific revolution, the idea that in a closed and deterministic universe we can achieve perfect knowledge may still have had a certain plausibility, as did the idea of the symmetry between explanation and prediction[1]. But we have discovered since that our epistemological instruments have their limits and that the odds are that the world is neither closed nor deterministic. In such a world, it is no longer true that to every explanation there is a corresponding set of predictions. That goes for the physical world but even more so for the social world, where human ideas, perceptions, knowledge and preferences are important factors that shape reality. The failure of one of the biggest social experiments the

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world has ever witnessed, communism (or socialism), has made it clear that our possibilities to deliberately shape reality according to our preferences has its limitations, too. That is also the case for democratic market systems.

The endeavour to understand and shape reality can be described in game-theoretical terms. We are players in a game against Nature. Of the strategies at our disposal, the one that maximizes our chances of survival is a maximin strategy: trying to make the most of the combination of our limited epistemological and practical instruments. Overestimating our epistemic and practical capabilities may have fatal consequences[2].

2. What can we know about reality?

For the reason mentioned above, a thorough knowledge of epistemology is indispensable. With a variation on the subtitle of *Plato at the Googleplex* by Rebecca Goldstein, *Why Philosophy Won't Go Away*, we may say that epistemology would not go away. Goldstein observes that one of the important tasks of philosophy consist in revealing hidden presuppositions. Where it does so successfully, one can speak of progress[3]. When judging the instruments of social forecasting, we must ask ourselves whether they are coherent with our best knowledge of at least the following philosophical problems:

- the problem of induction;
- the problem of what constitutes scientific knowledge; and
- problems related to the construction and application of models that incorporate elements of different scientific disciplines.

2.1 Induction

For thousands of years, philosophers have held the belief that knowledge is acquired through the accumulation of empirical observations. David Hume gave arguments why this procedure of induction is logically untenable. He thought, however, that induction was psychologically necessary. Karl Popper is more radical: induction is neither logically defensible nor is it a psychological fact; there is no such thing as induction. What has often been considered to be an inductive procedure is in reality a process in which we acquire knowledge by inventing explanatory hypotheses from which we deductively derive observational consequences, which are then put to the test. This method of conjectures and refutations is the cornerstone of Popper's critical rationalism.

2.2 Scientific explanation and prediction

Popper has proposed as the characteristic that distinguishes scientific from other theories that the former are empirically testable. He has called this the demarcation criterion. Whether or not one agrees with Popper's philosophy of science is of secondary importance for accepting this criterion. The idea on which it is based is that in order to be able to obtain feedback on the correctness of the hypotheses that we use to explain and predict reality, we must confront them with facts and with other theories about reality. Rationality consists in the willingness to learn from one's mistakes; that is the crux of falsifiability. The fact that apart from scientific theories, we are also led by metaphysical ideas or research programmes does not clash with this. In the history of philosophy and of science, metaphysical ideas and explanations, which are not falsifiable, have often been reformulated as scientific hypotheses and explanations, which are falsifiable. That is the crux of the following model of scientific explanation.

Its basic idea is that scientific explanations and predictions have the form of sound arguments: logically valid arguments with true premises. They are sets of conditional statements consisting of one or more true universal law-like statements, from which predictions or explanations are deductively derived by means of statements that specify the initial conditions. This model of the logical structure of scientific explanations is known as the Hempel–Oppenheim, the Popper–Hempel or the deductive-nomological model.

Prophecies are incomplete scientific predictions; they either lack law-like statements or initial condition or both; that makes them unfalsifiable. The failure of a prophecy does not teach us anything beyond the fact that it has failed – if it is admitted that is has failed at all: many prophecies are immunized against falsifications by invoking *ad hoc* reasons or conditions why they have *not yet* been realized. *Ad hoc* conditions are tailor-made for the particular situation in which a prophecy, against expectations, has not been confirmed. The fact that a prophecy turns out to be false leaves us without guidelines about how to improve it and the *ad hoc* attempts to rescue it do not make matters any better. That prophecies are usually about events in the remote future or long-term trends introduces a moral element: we ought not to leave to our heirs a set of predictions that do not provide them with the guidelines for improving them in case they turn out to be false.

3. How can we shape reality?

Scientific knowledge is a necessary but not a sufficient condition for shaping the future. What we can do with our knowledge is equally important. The possibilities of applying our knowledge to social reality are subject to limitations, too. That is particularly true for the attempts to shape the more distant future. The main problems of social forecasting derive from three circumstances. First is that the future social environment is shaped by human beings, their preferences, their knowledge (and ignorance) and by the institutions in which knowledge is produced and through which individual preferences are aggregated. Second, individual behaviour is the result of the perceptions, knowledge and preferences of individuals. The interaction between individuals does not produce collective results in a deterministic way: most collective phenomena are the unintended and often undesired results of individual action. This indeterminacy derives from the complex nature of social interaction and from the spontaneous character of the knowledge and preferences of individuals. So even if we could predict future knowledge to obtain reliable results of social forecasting, we would still have to solve the task of predicting future preferences and future interaction patterns (which include power relationships). But we cannot predict future knowledge, as Popper has shown in the following *reduction ad absurdum*. If we could predict future knowledge, we would already have it. But then it would no longer be future knowledge. The world that the social sciences are studying is the domain of complex and emergent phenomena that are the result of, among other things, future knowledge. The third problem has to do with the fact that to influence the world of the future, we must agree on what we want it to be like. In a democratic system that means that citizens be capable of agreeing on collective preferences. The mechanisms for achieving this are subject to limitations.

3.1 Our knowledge of the complex world of the social

Does all this mean that we cannot foresee and successfully shape the social future at all? By no means, but we must avoid the mistake of thinking that we can know and successfully intervene more than is possible. The failure to do so in the past has created problems with which we are grappling today. In human life, there is only 100 per cent reliable fact: we will all die. The next most reliable features of human life lie in the field of demography: the development of the age composition of human populations is foreseeable in the medium and long term with a high degree of reliability. Up till the beginning of the twentieth century, most economics textbooks began with a chapter on demography. For reasons that are still not clear, this attention to demography has disappeared, not only from the textbooks but also from the research agendas of economists. The consequence is that we inhabitants of the richest countries in the world, whose populations are rapidly ageing, face ever more serious problems in providing for our old-age pensions.

Friedrich von Hayek is one of the earliest Nobel laureates in economics. In his after-dinner acceptance speech of 11 December 1974, he argued, no doubt to the surprise of the audience, that economics is not the sort of discipline for which a Nobel prize ought to be awarded[4]. He accused economists, and in particular, Keynesian macroeconomists, of applying the methods and analytical instruments of physics to economics. They thus commit what we may call a category mistake:

> The domain of the social sciences, like much of biology but unlike most fields of the physical sciences, have to deal with structures of *essential* complexity, i.e. with structures whose characteristic properties can be exhibited only by models made up of relatively large numbers of variables. (Hayek, 1974, eighth paragraph).

Hayek's criticism derives directly from Weaver's (1948) "Science and Complexity" of, one of the classics of the sciences of complexity, to which he refers in his address. Hayek had already elaborated his ideas on the correct methods for disciplines that deal with complex phenomena in "*Degrees of Explanation*" of 1955 and "*The Theory of Complex Phenomena*" of 1964[5].

A similar approach to complex systems is that proposed by Herbert Simon[6]. He argues that complex systems often have structural properties in common, such as a hierarchical organization. Charting these abstract regularities (for instance, that a system has fractal properties) is an important tool in coming to grips with problems of complexity. This gain in understanding, however, is often acquired at the cost of increased difficulties in applying it to reality (it is not straightforward what the practical implications of fractality are). A vast domain of research remains to be explored.

3.2 Applying knowledge to complex systems: constructing models

In much of what travels under the banner of social forecasting, the emphasis lies on mega- or macrotrends, the collection of data and the construction of indicators. For instance, the Italian project of BES, benessere equo e sostenibile or egalitarian and sustainable well-being, relies on extrapolations far into the future of demographic, economic, technological and environmental trends[7]. All of these trends are correlated, and it is a waste of resources to gather data on each of them separately without knowing what the causal connections between the trends are. In other words, to assess the influence on well-being of demographic, economic factors, etc., we first have to construct a model that shows how these factors influence one another. Only then do we know what data to collect. Such a model is constructed out of the laws of the various disciplines involved. But it is not a simple combination of these laws as if they were bricks that go into the construction of a house. A model is a representation of a set of causes and effects, of laws, initial conditions and explanantia. For instance, demographic developments both influence and are influenced by economic development. So some of the initial conditions of economic predictions are explained by the laws or regularities of demography and some of the initial conditions of demographic predictions are explained by economic laws and regularities. The construction of such a model is not a trivial exercise, and the necessary resources should be allocated to it before it can be used for forecasting. The model, once constructed, must also be adapted in the light of the failure of the predictions it produces and the actions that are based on these predictions. Often, the most that we can hope to produce will be "negative predictions" that state the incompatibility of two states of the world[8].

3.3 Constructing virtual realities

Weaver in his classical article makes two long-term prophecies. He foresees that computers will play an important role in coping with complexity and that working in teams will be an instrument, too. As to the computers, he has been proved right; the interdisciplinary approach, which is what he intended by working in teams, is still underdeveloped. A development that he probably had not thought of is the recent diffused use of computer simulations in the social sciences. Agent-based simulations have been used for creating and comparing alternative scenarios, studying emergent phenomena and putting to the test alternative behavioural hypotheses. One of the directions in which they might be further developed is the exploration of what Hayek has called negative predictions: showing the incompatibility of certain states of affairs or mechanisms. Computer simulations are an important instrument for suggesting and testing hypotheses and for studying problems of application. They may help narrow somewhat the asymmetry between explanations and predictions and are certainly important for piecemeal engineering. Perhaps the greatest strength of computer simulations lies in their capacity to stimulate and guide human creativity, especially when used in an interdisciplinary setting.

3.4 Intervening in the complex world of the social: from individual to collective preferences

To shape the future, we need to agree on goal or objectives. In any political system except for a dictatorship this involves the aggregation of individual preferences. There are two aggregation mechanisms, the market and politics. In political elections, we vote with a pencil, on the market, we vote with our money. In reality, we always find a combination of the two; according to (usually national) tradition, a particular mix between market and politics transforms individual preferences into collective ones. These mechanisms are subject to limitations: market failures, which are studied by economics, and problems with voting systems, which are the subject of the theory of social choice. As to the latter, voters' paradoxes have been known at least since the times of Montesquieu, but social choice theory did not become a scientific discipline until the publication of Kenneth Arrow's impossibility theorem in 1951. Arrow proved mathematically that a voting system that satisfies three reasonable criteria cannot exist. One criterion is the conservation of the preference ordering between alternatives. If every voter prefers X over Y, then the collectivity of voters should prefer X over Y. The second criterion is known as the independence of irrelevant alternatives. If the preference between X and Y remains the same for all voters, then the collective preference between X and Y should remain the same even in case individuals' preferences between X and Z, Y and Z or Z and Z' change. The final criterion, non-dictatorship, says that no single voter should be capable of determining the collective preference ordering.

One of the implications of Arrow's theorem for social forecasting is that it is impossible in a democracy to come to a full agreement as to what the future should look like. Citizens whose preferences are not reflected in a particular design of the society of the future may rebel and try to sabotage that goal and the procedures chosen to reach it. So even if we could have a full and reliable knowledge of the future and the mechanisms for bringing it about, there are limitations of a political and social character that keep us from realizing it.

3.5 Intervening in the complex world of the social: unintended consequences of individual actions

Both Popper and Hayek emphasize that in a social setting individual actions rarely fail to produce unintended consequences[9]. Let me add that the presence of emergent phenomena and unintended consequences is the main justification for the existence of the social sciences as disciplines in their own right; if all collective phenomena were the perfectly foreseeable consequences of individual actions, all we would need to explain them would be psychology and arithmetic[10]. The consequence that they draw from the omnipresence of unintended consequences in social reality is that we should be very careful when trying to change that reality: our interventions will have unintended consequences, too. What they do not agree on, however, is the extent to which we can intervene. Hayek takes the conservative stance that by interfering with social reality, we risk destroying the mechanisms that make the institutions that constitute it function. That is because we only have a very partial understanding of these mechanisms, which have evolved in a long evolutionary process. Popper, on the other hand, believes in the possibility of "piecemeal social engineering:" despite our incomplete understanding of the complex social world, we may introduce small changes, one at a time, so that we may observe their consequences and suspend our intervention in case they are undesired. For Popper, social reality is a large-scale laboratory. The differences in the views of Poppers and Hayek as to the possibility of shaping complex reality can be traced back to their different stances *vis-à-vis* rationality and their contrasting theories of mind[11].

4. Understanding and shaping complex social reality

The conclusion of the preceding considerations is that the possibilities to predict and shape the future are subject to a variety of epistemic and practical constraints. Ignoring these is not only imprudent and dangerous, it is also irresponsible towards future generations. Within the boundaries of these constraints, however, there is much room for manoeuvring. Social forecasting can benefit more from scientific disciplines by a more diffused use of the working in teams that Warren Weaver mentions as one of the two possible solutions for coming to grips with problems of complexity. For that purpose, it is necessary to educate future scientists for a truly and thorough interdisciplinary approach. That in its turn will nurture and stimulate the only inexhaustible resource known to man: creativity[12].

Notes

1. In the deductive-nomological model of scientific explanation (see paragraph 2.2 below) this is known as the symmetry thesis.
2. F.A. Hayek speaks of the fatal conceit, which is the title of his last book.
3. This type of progress is similar to a type of progress that is made in the sciences. It consists in discovering that what is thought to be a general theory is a special case of a more general theory and under what conditions the special case gives an accurate description and explanation of empirical reality. Cp., for instance, Birner (2002), where this procedure is described under the name of the correspondence principle.
4. Hayek (1974).
5. Both in Hayek (1967).
6. Cp. Simon (1962).
7. Cp. Gazzelloni *et al.* (2011).
8. Cp. Hayek (1955 and 1964).
9. Cp. for instance, Popper (1945) and Hayek (1944).
10. Lindenberg has coined the term “Aggregatspsychologie” for this. Cp. Lindenberg (1992), p. 7.
11. For a discussion of the differences between Popper and Hayek and their background, cp. Birner (2014).
12. Cp. Ostrom (2006).

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