
What is Sociocybernetics?

The Research Committee on Sociocybernetics, RC51 ISA ([International Sociological Association](#))

2.1 Introduction:

Those of you more or less accidentally hitting this website while surfing through cyberspace may wonder what sociocybernetics is all about. In the case of objects, the best definition is often by simply pointing. In the case of subject areas, and rather abstracts ones at that, this is more difficult. Nevertheless, if you take some time to explore this website in somewhat more detail, you will get a fair impression of what we are doing, and what our approach is - even without reading the following. Since cybernetics derives from the Greek word for steersman, and "socio" clearly pertains to societies, one might assume that sociocybernetics is the science (or perhaps art!) of steering societies. And indeed it is, to some extent, though without the notion that societies can be steered in a hierarchical, top-down way.

Those interested in a more detailed overview of the developments in first- and especially second-order cybernetics and General Systems Theory that stimulated the emergence of our Research Committee on Sociocybernetics, are advised to read our Newsletters at this website, and download "The Challenge of Sociocybernetics", available at <http://www.unizar.es/sociocybernetics/chen/felix.html>.

In the following, the main innovations produced by first- respectively second-order cybernetics are enumerated first, in order to arrive at a better understanding of what sociocybernetics is all about: applications of first- and especially second-order cybernetics, as well as GST, to the social sciences.

2.2 First-order cybernetics:

First-order or "classical" cybernetics, which originated in the 1940s and led to the construction of the first computer, basically had an engineering approach, and turned out to be extremely useful for solving many practical problems, especially of a technological nature. In spite of having a rather mechanistic and technological engineering approach, it nevertheless gave an impetus for a new approach in the social sciences, by stressing the following innovative concepts:

1. Boundaries: It stressed the importance of clearly defining the boundaries of the system under study, and specifically drew attention to the fact that this is inevitably always done in time-dependent, observer-dependent, and even problem-dependent ways which one has to be aware of when developng a suitable research design.

2. Sub- and supra-systems: Next comes the question what are the supra-systems of which the system under consideration forms part, and what are the relevant subsystems, i.e. the component parts that should especially be looked at.

3. *Circular causality: First-order cybernetics made circular causality respectable, up till then seen as a mistake in logical reasoning, leading to tautologies. Recent research into the origins of life even make it likely that life itself resulted from a number of bootstrap operations, for example the circular chemical reactions between molecules as defined by the "Brusselator" described by Ilya Prigogine. The very idea of circular causality attacked the Newtonian-Laplacean clockwork model of the universe, with its mechanistic rather than organic bias, and its stress on linear causal chains unfolding through time. In spite of the rise of multivariate analysis, much of empirical social science still follows this linear model, although the increasing complexification of modern societies would make a concentration on unraveling circular causal chains more profitable.*

4. *Positive and negative feedback: Examples of circular causality are positive (deviation-amplifying, morphogenetic) and negative (deviation-reducing, morphostatic) feedback loops. They can either occur spontaneously, in nature as well as society, or be engineered. First-order cybernetics was primarily interested in negative feedback loops, as its purpose generally was to steer technological and industrial systems by keeping them on a steady course, fluctuating within specified margins around an equilibrium. In the 1970s this led to a critical attitude among especially liberal US sociologists, who came to associate governmental adoption of first-order cybernetics principles to populations rather than machines with oppression of minorities (CIA, Rand Corporation, etc.), and preferred the highly similar, but seemingly more value-neutral and innocuous General Systems Theory. While first-order cybernetics certainly also recognized positive feedback, it was second-order cybernetics, with its largely biological paradigm, that especially stressed it and thus became more suitable for social science applications.*

5. *Simulation: While originally a technique - or rather a new methodological tool or paradigmatic method - of first-order cybernetics rather than a concept, one can certainly say that simulation has made enormous inroads in the social sciences, and is used in second-order cybernetics to study phenomena of emergence. With the increasing mass scale availability of high-speed computing equipment, even on PC's, it becomes possible to realistically simulate ever more complex problems, with the possibility to incorporate an increasing number of interacting variables in one's models. The obvious advantage of such simulations is that one can investigate the effects of changing some of the variables without actually changing them in reality, i.e., without engaging in policy action. Also, simulations with complex models allow one to discover latent consequences of certain intended actions, and to forecast the emergence and the effects of counter-intuitive behavior.*

6. *Wholism: While perhaps not very innovative, since it was stressed already earlier by several intellectual currents, though often in a rather mystical fashion, wholism should also be mentioned here, and is certainly implicit in the cybernetics and systems approaches.*

2.3 Second-order cybernetics:

Second-order cybernetics originated in the 1970s, mainly within biology and the social sciences. The term was coined by Heinz von Foerster, who defined first-order cybernetics as the cybernetics of observed systems, and second-order cybernetics as the cybernetics of observing systems. The main difference is indeed that the essentially biological paradigm of second-order cybernetics includes the observer(s) in the systems to be studied - which, moreover, are generally living systems rather than inanimate technological or engineering artefacts, like for example in robotics.

Even primitive living systems have a "will of their own" and manifest what Maturana and Varela have termed autopoiesis or self-production. Consequently, they are more difficult to

steer, and their interactions with their environments are impossible to forecast more than a few moves ahead. Second-order cybernetics is thus more interested in morphogenesis and positive feedback loops than in homeostasis and negative feedback loops, while the system - whether an individual or a group - is defined as having the ability to reflect on its own operations on the environment, and even on itself. Such operations generate variety in the environment or in itself, which can reflexively be recognized as being due to systemic variation, which makes them recursive: observations can be observed, communications can be communicated, etc.

Obviously, the concepts of second-order cybernetics are extremely useful for the social sciences; it is perhaps not amazing that they all start with "self", if not in English, then in Greek ("auto"):

1. *Self-reference: Circular causality, discussed above as a first-order cybernetics concept, is present in all forms of self-reference, and could also be viewed as its simplest form. Self-reference can have three meanings: the weakest, neutral one implies merely that change in a system's state at a given moment follows from its state at the previous moment; the biological one requires senses and a memory and here self-reference means that a system contains information and knowledge about itself, i.e. its own state, structure, and processes; the strongest second-order meaning implies that the system - whether an individual or social system - exhibits self-observation, self-reflection and some degree of freedom of action, and thus can collect information about its own functioning, which in turn influences that functioning. In social science, this can give rise to interesting self-fulfilling or self-destroying prophecies, whereby accumulation of knowledge leads to utilization of that knowledge by both researchers and their research objects, which may invalidate that knowledge.*

2. *Self-steering: Since human individuals and groups are self-steering to a large degree, most efforts at hierarchical top-down planning have failed; the more democratic anascopic or "bottom-up" view is therefore to be preferred over the katasopic or "top-down" view. Thus, many cybernetically oriented social scientists have concluded that they should not so much deliver useful knowledge for an improved steering of the behavior of social systems and individuals, but should rather try to improve the competence of actors at grass roots level to steer themselves. As even first-order cybernetics demonstrates, control does not necessarily imply hierarchy: e.g. the thermostat of a central heating system.*

3. *Self-organization: Though a second-order concept, self-organization is clearly linked to circular causality. Recent developments in cognitive science - both in relatively "first-order" cognitivism which led to Artificial Intelligence, and in relatively "second-order" connectionism, with its bottom-up neural networks - have demonstrated the emergence of self-organization as a core concept. In different branches of the social sciences, the concept of self-organization is increasingly used.*

4. *Auto-catalysis and cross-catalysis: In molecular chemistry one distinguishes autocatalytic cycles, whereby the product of a reaction catalyzes its own synthesis, and cross-catalytic cycles where two different (groups of) products catalyze each other's synthesis. In biology, Stuart Kauffman of the Santa Fe Institute used the concept of autocatalytic cycles to explain the origin of life from a "primal soup", while in social science the economist Brian Arthur, also from the Santa Fe Institute, has applied autocatalytic sets to the economy, which bootstraps its own evolution as it grows more complex over time.*

5. *Autopoiesis: The concept of autopoiesis, or self-production, was introduced in the 1970s by Maturana and Varela, in order to differentiate the living from the non-living. An autopoietic system was defined as a network of interrelated component-producing*

processes such that the components in interaction generate the same network that produced them. The German sociologist Niklas Luhmann made an interesting theory transfer, and defined social systems as consisting of communications constituting autopoietic networks, rather than of individuals, or roles, or actions.

2.4 Sociocybernetics: a new paradigm for the social sciences:

Having elucidated the main ideas of first- and second-order cybernetics, sociocybernetics can now be roughly defined as a general term denoting applications of GST and first- and second-order cybernetics to the social sciences. Actually, sociocybernetics is to a large extent based on second-order cybernetics, which was developed precisely because first-order cybernetics had only a limited applicability to the social sciences, where the researcher himself forms part of the subject under investigation, in contrast with the natural sciences. Sociocybernetics, while barely 30 years old, has already developed many offshoots, or perhaps one should say more modestly that there has been and is a co-evolution and intensive interaction between a number of closely related fields which all represent a clearly post-Newtonian paradigm, like autopoiesis studies, complexity studies, neuronal networks, etc.

Since complex modern societies - as compared to simpler ones - are highly dynamic and interactive, and thus change at accelerated rates, they are generally in a far-from-equilibrium situation. According to Prigogine and Stengers⁵⁹) - who distinguish systems in equilibrium, systems fluctuating near equilibrium through feedback, and systems far from equilibrium - non-linear relationships obtain in systems that are far from equilibrium, where relatively small inputs can trigger massive consequences. At such "revolutionary moments" or bifurcation points, chance influences, but does not take over from determinism and the direction of change is inherently impossible to predict: a desintegration into chaos, or a "spontaneous" leap to a higher level of order or organization - a so-called "dissipative structure", because it requires more energy to sustain it, compared with the simpler structure it replaces.

In stressing this possibility for self-organization, for "order out of chaos", Prigogine comes close to the concept of autopoiesis. In modern societies, the mechanistic and deterministic Newtonian world view - emphasizing stability, order, uniformity, equilibrium, and linear relationships between or within closed systems - is being replaced by a new paradigm. This new paradigm is more in line with today's accelerated social change, and stresses disorder, instability, diversity, disequilibrium, non-linear relationships between open systems, morphogenesis and temporality. Prigogine indeed calls it the science of complexity.⁶⁰) It is exemplified amongst others by Prigogine himself, Maturana and Varela,⁴⁷) Laszlo,⁴³) and "second-order cybernetics" in general: i.e. the (non-mechanistic) study of open systems in interaction with their observers.

Social scientists, often still thinking in terms of linear causality, would be well-advised to really study Prigogine's theoretical approach and try out the explanatory powers of his conceptual vocabulary on the phenomena they study: fluctuations, feedback amplification, dissipative structures, (ir)reversibility, bifurcations, auto- and cross-catalysis, self-organization, etc. This holds true as well for the concepts and methods of second-order cybernetics in general, as discussed in the foregoing. However, it is already quite difficult to apply first-order cybernetics - which also fully recognizes non-linearities - to social science data sets, and it may seem virtually impossible to do the same with second-order cybernetics. Nevertheless, second-order cybernetics is a paradigm that does more justice to the constantly emerging novel complexities of ongoing human interaction, and does not postulate simplistic assumptions about the constancy of human behavior.

What name one gives to this paradigm, or rather this convergence of paradigms over the last two decades, is a matter of secondary importance. What is reassuring in this novel and therefore risky field of research is that there seems to be indeed a convergence of paradigms: all the blind men seem to have their hands on the same elephant. We have generally called this field here second-order cybernetics; but it might also be designated by other names like cognitive science, general systems theory, complexity studies, or perhaps indeed most aptly the science of complexity.

2.5 Methodological problems inherent in empirical sociocybernetic research:

If one realizes that the social sciences indeed mainly study self-organizing, self-referential, autopoietic systems, which thus have their own strategies and expectations, with intertwining processes of emergence and adaptation - then one is confronted with one of the as yet unsolved core problems of sociology, economics, and other social sciences: how to make a science out of studying a bunch of imperfectly smart agents exploring their way into an essentially infinite space of possibilities which they - let alone the social scientists researching them - are not even fully aware of.

There is indeed quite a methodological problem here. It is already very difficult to apply the principles and methods (e.g., feedbacks and non-linearities) of first-order cybernetics to empirical social research, much more so than to sociological theory, and nearly impossible to incorporate a second-order cybernetics approach in one's research design. Indeed, as far as empirical research is concerned, second-order cybernetics may be a bridge too far, given the research methodology and the mathematics presently available.

Applying the principles of first-order cybernetics in empirical research already poses heavy demands on the data sets and the methods of analysis: every feedback ($X_t \rightleftharpoons Y \rightleftharpoons X_{t+1}$), every interaction between variables [$Z \rightleftharpoons (X \rightleftharpoons Y)$], and every non-linear equation ($Y = cX^2 + bX + a$), let alone non-linear differential equation ($Y' = cY^2 + bY + a$), demands extra parameters to be estimated, and quickly exhausts the information embedded in the data set. Admitting on top of that the second-order notions that the research subjects can change by investigating them, let alone being aware of the fact that these subjects may reorganize themselves on the basis of knowledge acquired by them during the research, exceeds the powers of analysis and imagination of even the most sophisticated methodologists: it equals the effort to solve an equation with at least three unknowns.

In the case of second-order cybernetics these problems indeed multiply: how does one obtain reliable data within such a framework, where nothing is constant and everything is on the move, let alone base policy-relevant decisions on such data? How can one still forecast developments when at best retrospective analysis of how a new level of complexity has emerged seems possible? Certainly, these are problems that are far from solved, and a lot of work lies ahead before hypotheses derivable from second-order cybernetics will be fully testable. Nevertheless, the opportunities offered by this paradigm to present a truly realistic analysis of the complex adaptive behavior of interacting groups of agents seems to good to pass up.

However, one may in turn make objections against these objections, since they are still based on the classical Popperian expectations about empirical research re falsifiability, etc., while the proposed change to a radically new paradigm, the systems paradigm, may force us to revise our expectations of what empirical research is, and of what it can and should achieve. For example, it might be desirable:

- to investigate limitations and limits of what can happen, rather than what will happen;
- to investigate (im)possibilities rather than certainties;

- to work with alternative scenarios rather than with "predictions";
- to analyze facilitating conditions rather than strictly causal determinants;
- to take seriously the notion of "feed-forward" in order to cope with some of the uncertainties in a generally uncertain world, instead of clinging to "central planning";
- to emphasize "strategy", in its original military meaning of having a plan for an uncertain environment which will be modified when required, instead of "sticking to the plan, whatever happens";
- to emphasize "navigation" in its original naval meaning, reaching the port intended by flexibly adapting the course and the rigging to the winds and currents, instead of going stubbornly against the seas, ruining the ship.

For the time being, in other words, sociology should perhaps model itself more on meteorology than on the natural sciences, and force itself to give up the ambition to make accurate medium- and long-term predictions, except in delimited areas of research where complexity is still manageable or can be more or less contained. Ex post facto explanation of how things have come to be as they are is already difficult enough for social scientists nowadays. The best they may do at the turn of the millennium is to get a grip on the underlying laws of change, perhaps by a theory transfer from those subfields within biology where second-order cybernetics was developed, and consequently to further develop the theories, the non-linear mathematics and the simulation techniques required to investigate the growth of complexity of human society.

This might ultimately result in adequate and hopefully also empirically testable, if not falsifiable, models of self-referential, self-steering and self-organizing actors on individual and supra-individual levels, interacting with each other in ever more intricate networks to develop new and unforeseen higher levels of complexity, with new actors engaging in new activities, speeding up the growth of complexity even more. The best one can do as sociologists under these circumstances seems to accept that there is not any one desirable and sustainable state for society - only near-continuous transition, often coupled with the impossibility to forecast even the near future - and that consequently one can engage at best in some degree of damage control, by pointing out the probability of future catastrophes to those who might be able to help averting them.

But the inherent problem remains: the more realistic - and therefore less parsimonious - a theory, the more complex it becomes, and the more difficult it also becomes to test the hypotheses and subhypotheses derived from it which are used in collecting and interpreting the data. If one accepts that social systems have a high degree of complexity, cybernetic theories become more relevant and fitting, but less testable as they grow more complex and abstract themselves, as is the case with second-order cybernetics as compared to first-order cybernetics. There is certainly a challenge here, for theorists and methodologists alike, and we herewith invite you to join our efforts by becoming an active member of RC51.

by Felix Geyer, Honorary President

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