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Operationalizing Self-organization Theory for Social Science Research

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I would like to begin with a short description of some of the general attributes of all systems as such. These are the general characteristics of any system whatever, regardless of the level of emergent order to which it may belong. On the basis of this general theoretical background I would then like to propose criteria for distinguishing between different kinds of systems. This is important, since concepts, models, and methods developed in order to describe and analyse one kind of system cannot without risk of confusion be applied to systems of a different kind. I will propose that there are three distinct levels of emergent order and therefore three different kinds of systems: mechanical, biological, and semiotic. On each level of emergent order the basic concepts of systems theory take on a different meaning and the methods of systems analysis become different. In other words, each level of emergent order and each kind of system hat its own specific science. If the physical and biological sciences are concerned with mechanical and organic systems, then the social sciences are concerned with the description of semiotic or meaning systems.

1. General Characteristics of all Systems

1.1 Every system has a principle of organization that fulfills three functions: selection, relationing, and control.

A System is by definition a composition of elements. A table for example consists of a top and of legs. In order to have a table one has first to select the top and the legs out of all possible things. Secondly, one then has to put these selected elements into certain relations with each other. The top has to sit on the legs and not the other way round. And finally, this relationing of the elements can be considered to control or steer the operation or function of the system such that it fulfills a certain purpose. In the case of the table, the purpose may be said to be the creation of a work space at middle body height. We have a system only when elements are selected, related and controlled or steered in such a way that a function is fulfilled. The principle of organization that selects, relates, and controls or steers may be called a "code". Every code fulfills these three functions.

1.2 Every system is based upon a difference between itself and its environment, that is, the system/environment difference is constitutive for all

systems.

When a code selects and relates certain elements such that a specific function is fulfilled and thus organizes a system, then there is much in the world that is left out or excluded from the system. Selection is inclusive and exclusive. Everything that is excluded may be called the "environment" of the system. And since a system is constituted by selection every system will have its environment. A system can be a system only because it is distinguished from the environment.

1.3 Every system constructs its own elements.

A system is always more than a mere a collection of things which lie about in the environment. The table for example consists of a top and of legs. Before there were tables, there were no such things as "tops" and "legs" lying around in the environment. There was wood, metal, stone, etc, but there were no "tops" and "legs", that is, until the code that organizes the system "table" selected and related certain things for the purpose of this system and constructed them as elements of the system. Anything and everything can function as a tabletop or as the legs of a table. If a person goes down on hands and legs and holds this uncomfortable position long enough, he or she can be used as a table. Even water, as Eskimoes know, can serve the function of table legs. A tabletop and legs are not substances, but functions and functionality is constructed by the code of the system and not by the environment. This is also clearly the case for organic systems. An organism consists of organs as for example skin, bones, stomach, liver, heart, etc. Organs do not lie about in the environment until someone like Dr. Frankenstein comes along and puts them together in order to make a living being. The organic system, that is, the genetic code that constructs its own elements. And finally this is also clearly the case for semiotic or meaning systems, like, for example, a language. The human voice can produce an almost infinite number of sounds, but only very few are words in a language. And just as a table does not need wood or metal, but can be made of almost anything, a language does not need acoustic material, since gestures and written signs can serve the same function as verbal signs. A word in a language, therefore, is not a thing, a substance, but - as Saussure noted - a function of a differential system of relations. It is the system, that is, the semiotic code that constructs the significant elements.

1.4 Every system is in one way or another self-referential, that is, it refers its operations to itself.

If it can be said that every system constructs its own elements, then it can also be said that every system has a certain tendency to maintain itself, that is, to resist changes and transformation. The table, for example, tends to resist attempts to use it as an automobile or a bathtub. In this sense, its operation as a table "refers" to itself. Self-reference derives from the controlling or steering function of the code. Every system is organized by a

principle that may be termed a code since it has the functions of selection, relationing and steering the operations of the system. The analysis and description of the steering function in systemic organization has also been referred to as "cybernetics". Insofar as every system is organized by a code it can be said that every system is a cybernetic system. Although we don't usually think of a table as a cybernetic system it does refer its operations to itself in the minimal sense of resisting change and thus maintaining an "identity" over time. In terms taken from classical philosophy the code is the "essence" of the system, that is, it is that which makes the thing to be what it is. When we speak of cybernetic systems however, we usually are referring to systems that are dynamic in a more obvious way than a table. Such system are dynamic in that it can be observed how their outputs become inputs thus creating a circular causality. For this reason a thermostat is a better example of cybernetic self-reference in a mechanical system than a table. In organic systems self-reference takes the form of "autopoiesis", that is, organic systems operate in order to continue their own operations. The cybernetics of living systems is such that the system is operationally closed in a way that mechanical systems are not. It is not accidental or irrelevant that the output of a thermostatically controlled heating system raises the temperature of a room, but it is so for the heat discharged from the cows in a stall. The cows operate in order to continue their own operation, not in order to effect some change in the environment. And finally in semiotic or meaning systems self-reference is of an altogether different sort. It is self-identification by means of communication. However different self-reference may be for different kinds of system on different levels of emergent order all systems are in one way or another self-referential.

Summary: All systems have certain common characteristics that constitute them as systems, that is, all systems are constituted by a code that by selection, relationing and controlling or steering differentiates the system from an environment in order to fulfill a certain function, which requires the construction of system-specific elements and can only be fulfilled so long as the system in some way refers its operations back to itself. These are not the only characteristics of systems as such, but they may be used as defining characteristics and it is helpful to call them to mind for the purposes of applying systems theory to the social sciences.

2. Criteria for Distinguishing Different Kinds of Systems

If all systems have the above mentioned characteristics in common, then what is it that makes them different from one another. This question is not unimportant, since there has been much confusion caused by the use of concepts, models and methods, which were developed for the analysis and description of one kind of system, but which are then applied to systems of an altogether different nature. The concept of "information" is a case in point. What "information" means when applied to the description of

transmission machines is one thing and what "information" for semiotic systems means is something quite different. If researchers do not specify what kind of system they are talking about, then there is great risk of misunderstanding, not only for others, but also for themselves.

I propose distinguishing different kinds of systems on the basis of distinguishing different levels of emergent order. For the sake of this discussion we may define "emergence" as the non-predictable and non-derivable appearance of codes that are capable of integrating previously existing codes. Living systems appeared non-predictably as integrations of mechanical, i.e. molecular and chemical systems and cannot be derived from these systems. Semiotic systems appeared non-predictably as integrations of living systems and mechanical systems and cannot be derived from them. No amount of mechanics or biology will explain or even adequately describe a semiotic system. No description of recursive patterns or structuring of nerve impulses, no matter how complex, will account for the meaning of a word or explain the structure of a language. For this reason we may consider "emergence" as synonymous with "self-organization" and speak of the evolution of the universe as a self-organizing process. Of course we may also say that God, or the "observer" or anyone or anything at all created the universe and everything within it. In this case we have simply decided to name the "self" that self-organizes in a certain way. This naming is very important, for it decides what world we live in. Throughout history the answer to this question has been given (or found) in many different ways. I suggest for the time being to leave the question open of "who" the self-organizing "self" may be. For it could be that this openness is precisely the way that the answer to the question of what world we are living in is being given to us today.

Let us therefore suppose that there are three distinct levels of emergent order: mechanical, biological, and semiotic. Let us further suppose that to each level of emergent order there corresponds a specific form of cybernetic self-reference which, for the sake of simplicity, we may call 1st, 2nd, and 3rd order cybernetics:
1st Level of Emergent Order - Mechanical Systems - 1st Order Cybernetics
2nd Level of Emergent Order - Organic Systems - 2nd Order Cybernetics
3rd Level of Emergent Order - Semiotic Systems - 3rd Order Cybernetics
If we now use these distinctions as criteria for defining the differences between various kinds of systems, then we must look at the ways in which systems organize themselves, and this can be seen most clearly in the ways in which they refer their operations to themselves.

3. Cybernetic Self-reference and Levels of Emergent Order

3.1. Mechanical systems - 1st order cybernetics

A mechanical system or a 1st order cybernetic system refers its operations to

itself in that it resists transformation, as when a table, for example, resists being used as a bathtub, or, more generally, when outputs become inputs as in the case of a thermostatically controlled heating system. The decisive characteristic of a mechanical system is not that it is self-regulated, for this is typical of organic and semiotic systems as well, but rather that it functions in order to effect a change in the environment and not for its own sake. The heating system functions in order to hold the room temperature constant. 1st order cybernetics therefore describe the way that a mechanical system refers its operations to itself. Mechanical systems are systems whose outputs become inputs for the sake of an other, and not for their own sake.

3.2 Organic systems - 2nd order cybernetics

An organic system refers its operations to itself for its own sake, and not for the sake of an other. For this reason they are not only self-referential, but self-producing, that is, autopoietic. Because organic systems are autopoietic, they are operationally closed in a way that mechanical systems are not. The operations of an organism connect up to further operations of the same organism in order to enable these operations. I don't breath the air in my office in order to reduce the level of oxygen in the room, but in order to continue breathing. 2nd order cybernetics describe autopoietic, operationally closed self-reference. Outputs become inputs for the sake of the system itself.

3.3. Semiotic systems - 3rd order cybernetics

A semiotic system is self-referential in that it gives itself a meaning. The operations of a semiotic system consist in making something meaningful. In order to make something meaningful it must be given a name, a designation, a signification, that is, it must be taken up into semiotic coding. The elements of a semiotic systems are therefore signs (in the full sense of the word that includes pragmatics!). This is why meaning systems are semiotic systems, for semiotics is the science of signs, designations, names. A semiotic system can refer its operations of designating to itself only if it designates itself. When a system designates itself, then it constructs its own identity and becomes "self-conscious". I know myself, when I can say "I", when I can designate myself. Meaning systems therefore are considered to be "psychic" or "mental" or however else "we" designate ourselves.

If a semiotic system designates itself as "psyche," "mind," "spirit," "consciousness," "human being," "person," "observer," or the like, this can become confusing since a meaning system is not a thing. Let us recall the long and futile tradition of philosophical and scientific attempt to find that spiritual or mental thing called the soul or the mind. A semiotic system is not a thing, not even an observing thing. Neither is it a certain kind of organism, for example, a central nervous system. Meaning is no thing at all, but a level of emergent order, that level, wherein things of all sorts become designated and thus are made meaningful. A meaning system therefore does not

consist of things or animals or observers, but of "signs". Signs are the elements of the semiotic system. Things, organisms and observers are signs within the system.

But what is a sign? It is a difference that makes a difference, which is how Bateson defined the concept of "information". No word exists alone, but only as a differential relation, a "value" within a system of such relations. To utter a single word is to speak an entire language. And a language is not a collection of words, not even a formal differential system as we know, after the "pragmatic turn" in linguistics and philosophy, know, but a chain of communications. The elements of a semiotic system are therefore not words, but communications. And the relationing of these elements is not purely formal or logical, but social. This is why Luhmann can say that society does not consist of people, but of communications. What Luhmann doesn't adequately describe, I suggest, is the consequences of this statement for human beings. Instead of supposing that human beings are individual psychological systems that somehow "perceive," "think," "feel," and so on but do not communicate, and that they are therefore part of the environment of the social system, a part that can take up a critical, disrupting position external to society (a thesis which recalls the western liberal mythology of free subjectivity as opposed to social constraint), a more plausible account would be that individuals are constructions of the semiotic system. Individuals do not observe society, that is, unless society constructs them in such a way that they perform this function and play this role - and most societies in the history of humanity have had no need for this function - but instead, society constructs individuals, or rather "actors". We may speak of the meaning system as "self-organized" precisely because there is no one outside the system who could organize it. Actors or observers are constructions of the system.

Why are actors or observers constructed by the system? Actors are constructed by the system as that to which communication can be ascribed. Not only individuals are actors, but any source of communication may be considered an actor. All that is required in order to construct an actor is an identity, a self-reference. Groups have identities, institutions have identities, entire nations, supernatural beings, abstract concepts like "justice" (which "speaks" in every legal decision) and so on, all may have identities. In general it may said that a semiotic system constructs identity upon various levels: ontologically, for the system as a whole, culturally, socially, and finally personally for ever smaller subsystems. The internal differentiation of the system, that is, the "self-organization" of subsystemic communication networks, groups, institutions etc. occurs by means of the construction of identities or actors.

If actors are constructed sources of communication, then a semiotic system refers its operations to itself neither for the sake of an other (1st order

cybernetics) nor for its own sake (2nd order cybernetics), but rather for the sake of communication. This is 3rd order cybernetics. No theology says that God created the world for His own sake. A solipsistic God who only talks to Himself (or a solipsistic observer for that matter) is absurd, as Wittgenstein's argument against the possibility of a "private language" demonstrates. A private speaker, as Wittgenstein pointed out, could not reduce complexity, establish redundance, and ward off entropy, since whatever it says is right would be right. All possibilities become equally probable, which is the definition of entropy or chaos. Without intersubjective corrigibility, that is, without communication, there is no way to reduce entropy, exclude certain possibilities and create order from noise.

When a world comes into being out of chaos, that is, as soon as a meaning system emerges and semiotic coding begins, then the operations of the system become communications that "refer," that is, connect up to further communications. And this requires the construction of actors, who "speak" and thus introduce asymmetry and temporal process into the system so that the elements of the system can be related to each other.
"Only through the construction of action can asymmetry be introduced into the communicative process. Only then does communication receive a direction from a sender to a receiver, a direction that can be reversed so that the receiver may in turn communicate and thus begin to act." (My translation from Luhmann 1984, 227)

And again:
"The elementary process that constitutes the social as a specific reality is the process of communication. This process must however be reduced to action or decomposed into actions in order to steer itself. Social systems therefore are not built up out of actions, as if actions are produced on the basis of the organic and psychological constituents of the human individual and can exist for themselves; rather, social systems are broken down into actions and by means of this reduction they gain the basis for connecting up communications to further communications." (My translation from Luhmann 1984, 193)

Third order cybernetics, as I wish to define the term here, is not merely the description of a recursive application of an operation to itself to the third power. Generally it may be said that recursion, that is, the mere application of the same operation to itself does not necessarily change anything with regard to systemic organization or with regard to the level of emergent order upon which a system is located. Recursion in other words has no necessary relation to emergence, even if after the fact we wish to model the dynamics of emergence in this way. Hegel referred to recursion as a "bad" infinity. The infinite regress of operation upon operation, for example, the observation of observation of observation . . . to the nth degree is still, as Luhmann pointed out, observation of the same kind as the first operation.

Recursive operations of molecules upon molecules do not bring forth life, even though after the fact the emergence of organic systems might be described in this way. And correspondingly, recursive operations of organic processes upon organic processes, for example, of nerve impulses upon nerve impulses do not bring forth meaning (as Krohn/Küppers 1992, 22 rightly note), even if this is how we might want to describe the operations of the brain. The operations of the brain are not the operations of a semiotic system, but the operations of an organic system. Recursion does not create meaning out of non-meaning. Recursion is not semiotic reference, even if the semiotic system at one point wishes to designate itself as a "brain". The only thing meaningful about the brain is the name itself. Specific differences in forms of self-reference and therefore in the emergence and self-organization of systems arise only when the operations we are talking about are already specifically different operations, that is, when the metaphor of recursion is (mis)used to explain how something different comes from something that is the same or how quantitive change somehow produces qualitative transformation.

Once semiotic coding and thus communication has come into being, then absolutely everything, including communication itself can be talked about. The system can designate its own operations as it wishes. Since the system distinguishes itself from the environment by means of self-reference, every semiotic self-reference implies a reference to the other, to the non-self against which the self is identified. For this reason semiotic self-organization occurs by means of constructing basic distinctions. The system can appear to itself in terms of the difference between subject/object, observer/observed, being/non-being, meaning/meaninglessness, culture/nature, true/false, good/evil, order/chaos, beautiful/ugly, living/dead, noble/base, sacred/profane, pure/impure, right/wrong and so on.

What the system at any time appears to be depends on the way in which the system semantically organizes itself, that is, what concrete symbols are taken as starting points for de-tautologising and de-paradoxing operations, that is, the operations whereby differences are produced (historical examples of such symbols are God, the autonomous, rational subject, the citizen, freedom, the law, Tao, Emptiness, the proletariat etc.).

How the system appears, that is the mechanisms by which it constructs self-reference depend upon the way or ways in which the system pragmatically organizes itself. The pragmatic conditions of communication determine how de-tautologising and de-paradoxing operations are applied and thus how actors and what they act upon are constructed.

And finally the media the system uses depend upon the way or ways in which the system syntactically organizes itself.

Semiotic self-organization occurs by means of constructing networks of actors who talk about various things using various media. This construction may be analysed into the three dimensions of syntax, semantics, and pragmatics. The use of these terms within the context of systems theory does not necessarily imply an over-dependence on linguistic models or methods, but rather an attempt to provide systems theory with basic concepts more adequate for the description of meaning systems.

As a concluding remark I would like to suggest that each of these three dimensions of in which the self-organization of a meaning system takes place opens up a potential field of research for the social sciences. The general theoretical framework, which I have briefly sketched out above, I would like to call semiotic constructivism or third order cybernetics in order to distinguish it from cognitive, social or so-called radical constructivism. On the basis of this theoretical background it now remains to pose the question of how self-organization theory can be operationalized for the purposes of analysing and describing actual communication systems, specifically networks of information production, distribution and application.

5. Literature

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