First Order Observations on Second Order Cybernetics[1]

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Abstract

The general structure of multilevel cybernetic explanation is described in the contexts of the functional and the genetic modes of explanation of systems. Dual interpretation of this structure yields 1st order cybernetics (classical cybernetics) and 2nd order cybernetics (cybernetics of cybernetics). The 1st is recognized as a part of a substantive theory of objects, the 2nd as part of a substantive theory of subjects.

Foreword

Whatever IT may be or do (e.g., to disguise ITself from us as Maya or to play dice), IT does not seem to resist multiple description, interpretation or construction of ITself by us. This has been noticed through history; recently by the founder of the Vienna positivist circle Moritz Schlick. Earlier the prophet Baruch Spinoza in his treaties *"Deus sive Natura"* on human possibilities to experience IT created i.a. a masterpiece of dual construction. It is Spinoza's *sive — or* and *and/or —* that I shall invoke several times in this text.

Into the discussion about 1st and 2nd order cybernetics, I wish to introduce the proposition that alleged differences between them are not a matter of a different formal structure, but of alternative interpretations. While I endeavor to represent properly the current views of the issues involved, I strive at the same time for consistency with my general views on science and system theory.

Things

Entities that are extended in spacetime (*i.e.,* occupy some of it) are called things and are regarded as concrete. In our perception, imagination or thought they are captured into fictional bags (which as if seamlessly adhere and are invisible, transparent, but impermeable). The bags are provided with tags (labels, indexes), by which they are identified and differentiated. The tags enable us to distinguish one bag from another. A tag contains no other properties. Any additional information — concrete, abstract or formal — must be associated with a tag by correspondence rules. Concrete information, customarily called data and referred to the things themselves, I call capta and refer it to the tag (index). Things have histories of transformations which are irreversible in time.

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Systems

Here, I am not concerned with things, but with systems.

Systems are formal entities that exist in the mind as relations on n variables, *i.e.,* as v_iRv_n. They have no extensions in space time. Rather they have intentional inexistence as an *"ens rationis"*. As complex symbols, they can be enscribed as signals and communicated. They have no history. Systems may be reversible in time unless they undergo development and acquire historicity.

Things and systems do not have abstract properties. These are associated with them by correspondence rules with entities of a conceptual scheme, ultimately of a metaphor.

We can distinguish systems by the relations that we wish to consider (their structures), by the variables we intend to relate (their fields) and by the values we assign to the variables (their states). In a very general way we can classify systems into four types of structure, or types of explanation.

In a *deterministic* system we consider the reciprocal relations between all its variables. The most appropriate and powerful deterministic explanatory method is differential calculus. The system may be interpreted as formalizing interplay.

If some or all of the values of the variables or some or all of the values (coefficients) of the relations, can only be given as a probability, then the system becomes *stochastic*. The most appropriate and powerful stochastic explanatory method is probabilistic calculus. The system may be interpreted as formalizing the play of chance.

A *functional* system is constructed by partitioning all or some of the variables of a deterministic or a stochastic system into three classes. The variables in the first class are by convention called independent, in the second intervening and in the third dependent. Only non-reciprocal relations between the classes are considered, from the first to the second and from the second to the third class. The most appropriate and powerful functional explanatory method is the calculus of variations. The system may be interpreted as formalizing action.

If some or all of the values of the variables or some or all of the values (coefficients) of the relations in a functional system can only be given as a function of time, then the system becomes *genetic*. The most appropriate and powerful genetic explanatory method is the integro-differential calculus. The system may be interpreted as formalizing the development of continuous identity.

Causality

In functional (hence also in genetic) systems we may differentiate the three classes of variables by different moments of time. The initial moment is assigned to the independent variable(s), a subsequent moment to the intervening variable(s) and the final moment to the dependent variable(s). In this way we transform deterministic explanation into *causal* explanation.

Significance

In functional and genetic systems we may attribute *significance* to a class of variables that constitute the third class, above called dependent. Once this is done, we consider that the classes contain boundary conditions, a functional subsystem and essential variable(s).

A variable or a set of variables is designated as *essential* primarily for formal reasons. (When the system is interpreted, we may speak of essentiality also in conceptual or empirical terms.) An independent variable in a functional system is formally essential if it is posited as having its value at an extremum. By an extremum we mean that it assumes a constant, a minimum possible or a maximum possible value in a range. In functional analysis we may also consider values of the essential variable(s) that are optimum or satisficing.

We can then ask the fundamental question empowered by the logic of variational analysis. How, under various boundary conditions does the functional subsystem maintain, or fail to maintain, the essential variable(s) at extremum?

Cybernetics

A functional system that exhibits both causality and significance is a necessary prerequisite of any homeostatic system and also more generally of any *cybernetic* system. A cybernetic system is constructed by extending the string of causality. The essential variable(s) are no longer assigned a final time moment. Instead, after the boundary conditions and the functional subsystem, the essential variable(s) assume(s) a next moment in the time sequence. The causal sequence is then extended by placing again the functional subsystem and/or the boundary conditions into the causal sequence after the essential variable(s), with a subsequent time moment assigned to it or them. This establishes a feedback loop.

The procedure can be repeated. The set of classes of variables involved in the causal sequence can also be enlarged. We can imagine a master causal sequence of classes: *vis major,* a niche, boundary conditions, a functional subsystem and essential variable(s). The distinctions between *vis major,* niche and boundary conditions are not given, but made depending on our interest, on formal, conceptual or empirical grounds. Depending on with which class we extend the causal time sequence forward in time, we obtain different kinds of feedback loops.

The causal structure of these time sequences, and therefore of feedbacks and feedback loops, can be subject to a dual description, *i.e.,* interpretation, *i.e.,* construction. It consists of associating the formal structure with a conceptual scheme that is a further elaboration (in practice often misleadingly mixed), of metaphors such as organism, machine, mind or template (script). Ultimately such schemes are reducible to construction of entities and the fields of their interplay as thermodynamic systems of transformations of energy sive semantic systems of transformations of meaning (or perhaps information).

Cybernetics of thermodynamic systems

A causal chain interpreted as a sequence of transformations of energy we may call *action* (or force or momentum). Let us call its effect a translation, vibration or deformation of an object.

The basic feedback loop from the essential variable(s) on the functional subsystem we may call *regulation*. Let us call its effect the management of norms (i.e., their maintenance or failure of their maintenance at some extremum).

A feedback loop from the essential variable(s) on the boundary conditions we may call *control*. Let us call its effect the management of values.

A feedback loop from the essential variable(s) on the niche of the system we may call *domination (Herrschaft)*. Let us call its effect the management of boundary conditions (by design or engineering).

A feedback loop from the essential variable(s) on the *vis major* of the system we may call *intrusion*. Let us call its effect the management of the niche.

Cybernetics of semantic systems

A causal chain interpreted as a sequence of transformations of meaning (perhaps information) we may call *communication* (or a code transfer or a message). Let us call its effect an arousal (or capturing the attention) of a subject.

The basic feedback loop from the essential variable(s) on the functional subsystem we may call *perception (sensing)*. Let us call its effect the management of disposition or propensities (a change in the orientation, motivation or decision) of a subject.

A feedback loop from the essential variable(s) on the boundary conditions we may call *observation*. Let us call its effect the management of interpretation of the situation by the subject.

A feedback loop from the essential variable(s) on the niche of the system we may call *participation*. Let us call its effect the management of boundary conditions (expectations or commitment).

A feedback loop from the essential variable(s) on the *vis major* of the system we may call *legislation*. Let us call its effect the management of the existential condition of the subject.

Dual construction

The difference between 1st order cybernetics and 2nd order cybernetics thus appears to be an instance of a dual interpretation of an identical formal structure. This gives rise to two different abstract constructions.

1st order cybernetics present to us an understandable or a mysterious world of objects (not of things). In an epistemological conversion of Cartesian dualism, it portrays to our imagination or thought a spacetime populated with *ens movens* colliding with each other. Their interaction produces a kaleidoscope of vibrations, deformations and translations. These at times appear regulated, controlled, dominated or intruded upon in the manner described above. We understand these transforma-

tions with the help of the metaphors machine and organism. In discussing our constructions of objects, we engage in epistemic discourse and employ concepts drawn from the physical and biological sciences. We are mostly not aware that we ponder the underlying thermodynamic transformations.

2nd order cybernetics presents us equally with an understandable or mysterious world of subjects (Selves and Others). In an epistemological conversion of Cartesian dualism, it portrays to our imagination or thought a spacetime populated with *ens comunicans* confronting on each other. Their conversation produces a kaleidoscope of motivations, orientations and decisions. These at times appear to be perceived, observed, participated in or legislated as described above. We understand these transformations with the help of the metaphors template (script) and mind. In discussing our constructions of subjects, we engage in telic discourse and employ concepts drawn from information theory, linguistics, psychology and the social sciences. We are mostly not aware that we ponder the underlying semantic transformations.

The content of epistemic as well as of telic statements is influenced by prevailing (adhered to) metaphysics, i.e., by epistemology in epistemic discourse and by axiology in telic discourse. Very often the discourses are mixed together and so are the metaphors employed. This necessarily leads to misunderstandings. In the present context it is therefore necessary to emphasize that moral and ethical statements are standard parts of telic discourse.

Janus face of cybernetics

Any cybernetic system has a Janus face. It is a formal structure of functional strings with time sequence and significance assigned, resulting in various feedbacks. It allows a dual construction of partially comprehensible worlds. We may thus experience a world of objects *sive* — that is *or* and *and/or* — a world of subjects. The formal order we represent abstractly we may call in one case, if we so wish, 1st order cybernetics, while its abstract representation in the second case we may call, if we so wish, 2nd order cybernetics.

Thus, in the abstract realm of metaphors and concepts, we may enthuse *Vive la différence!* But formally, 1st order *sive* 2nd order cybernetics — *c'est la même chose.*

Afterword

Above I have tried to present for discussion the thesis that so-called 1st order cybernetics and so-called 2nd order cybernetics are formally identical and differ only in the terms in which they are interpreted.

I regret some shortcomings of the text. It is my first effort to address the question whether there are different kinds of cybernetics. The arguments I have presented are sketchy a not entirely terminologically consistent. Many concepts are employed with a slightly different meaning than conventional. I advance statements without elaborating them. Such is especially the case regarding dual construction, metaphors, orientation, objects and subjects, epistemic and telic discourse. These themes were treated more fully in my earlier texts and are available on www.RichardJung.cz .