An Analysis of the System Theoretic Perspectives in the Proposals by Klir and Luhmann for the Study of Cross-Area Epistemic Communication

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Abstract

System theory presents multiple approaches that enable a certain understanding of systems given the particularities of each of the various approaches to it. If one were to describe under which conditions there exists the possibility of communication across knowledge areas and one were to use Systems Theory to perform such a description, which of the available system theoretical perspectives would be most adequate? This endeavor requires a choice among these different approaches available within systems theory, and since the analysis is to be made on a set of knowledge-producing areas inscribed in a knowledge validating environment, the need for a cross disciplinary approach such as the one taken by systems theory is deemed appropriate. We have selected two of these systems theoretical positions to describe and ultimately select from. The present article discusses the differences and similarities of the approaches to systems theory proposed by Klir and the one in Luhmann's social systems. The methodology used for this purpose is a summary revision of some key system theoretical proposals for the objective of contextualizing both theories and providing the grounds for analysis. Given the contextualization of the perspectives one is able to better appreciate the implications inherent in taking one or another perspective for the proposed study. The gain in depth, the distinctions, and the qualifications in the resulting characterization of the system to study will strongly depend on the choice of perspective. A clear distinction between methodologies is obtained as a result of this study and the obvious choice for the objective of studying cross-area communication among knowledge areas is presented and justified.

Keywords: Systems, Epistemology, Knowledge Systems

Introduction

System science, systems theory, and general systems theory are but a few of the names for the study of complex systems which usually cross the usual epistemic disciplinary distinctions. Within the study of such systems, there are multiple approaches that enable a certain understanding of systems given the particularities of each one. This variety implies a significant difference in the information obtained from their application. The purpose of analyzing communication across areas that have been epistemically or disciplinarily defined requires a choice among these different methodologies within system science. Having selected two of these methodologies to describe, analyze, and ultimately choose one of. The perspective presented by Klir and the one in Luhmann's social systems are to be contrasted. We will do this through an initial sampling of the topics most relevant for this contrast. This is done mainly in the theoretical considerations, as we look into; systems science as an opportunity provider, modeling reality, communication, ontology, evolution, radical constructivism, Kuhn's paradigms, recursion, functional differentiation, contingency in observation. We take the views of different systems researchers and sociologists into consideration so as to contextualize the proposals under study and give them the proper contrast. Once having obtained this contrast and information regarding the context to which each belongs, an analysis in searching for the gain or loss of knowledge about the system implicit in the choice will be done. What we will ultimately know about the knowledge systems involved and the relevance of this knowledge to our particular problem is contingent upon the selection we make. Therefore we must set out to draw a clear distinction between the two positions, for which an elaboration of the necessary contextualization within systems theory and also science itself is indispensable. The nature of the framework onto which the knowledge system and its disciplinary subsystems are set will be of prime importance in the selection to be made for studying the possibility of cross-area communication among areas differentiated through set epistemic criteria.

Analysis objective

The objective is to find the necessary characteristics for the possibility of epistemic communication across areas in a field of knowledge. These areas have been defined either by their discipline or the epistemic demarcation they adhere to. We are to accomplish this objective through a characterization of the areas themselves as systems or subsystems as they are present under the scope of a greater classification. This characterization is to be done through an analysis using the most pertinent system theoretical perspective available. Depending on the characteristics of the qualifications obtainable by the approaches to systems theory, we will be able to accomplish the goal here stated to a greater or a lesser degree.

Theoretical considerations

Many researchers, including the ones considered to be the founding fathers of the system theory approach, propose definitions of a system with a greater or lesser degree of specificity and take views that complement and contrast with the others'. By these mostly historical notes we intend to contextualize the proposal put forth by Klir in his epistemic hierarchy taxonomy of systems (*Klir, 1985*) and the one by Luhmann in Social Systems (*Luhmann, 1995*). The greater part of the notes here presented were selected from systems researchers in either Klir's book (*Klir, 2001*) or essays on systems science from New German Critique (*Oppenheimer, 1994*). These two very different sources provide us with a restricted view of where these perspectives fit in systems science and a basis thereof for the discussion leading to the making of the decision which is ultimately the purpose of this article. The justification for attempting to achieve such a grand goal given such a reduced view is given in the discussion itself and we shall come back to this point when making the decision itself.

Systems Science as an opportunity provider

To this day Systems theory has not remained in a constant state but is changing, evolving. This evolution has occurred along some research lines that have for the most part kept a few concepts as guiding principles. These principles or goals are pretty much in discussion now as they were when the field originated. System theory as such was born in 1954 on the first meeting of the then "Society for General Systems Research", which later became what it is now known as: "International Society for the Systems Science", as it was held as part of the American Association for the Advancement of Science. Bertalanffy, A. Rapoport, K. Boulding and Ralf Gerard were some of the researchers involved in this society since its conception.

The society's original program highlights these topics:

> "The Society for General Systems Research was organized in 1954 to further the development of theoretical systems which are applicable to more than one of the theoretical divisions of knowledge. Major functions are to (1) investigate the isomorphy of concepts, laws and models in various fields, and to help in useful transfers from one field to another; (2) encourage the development of adequate theoretical models in the fields that lack them; (3) minimize the duplication of theoretical effort in different fields; (4) promote the unity of science through the improving communication among specialists.
>
> "The aims of general systems theory are numbered as follows:

1. There is a general tendency towards integration in the natural sciences, natural and social.
2. Such integration seems to be centered in the general theory of systems.
3. Such theory may be an important means for aiming at exact theories in the non-physical fields of science.
4. Developing unifying principles running "vertically" through the universe of the individual sciences, this theory brings us nearer to the goal of the unity of science.
5. This can lead to a much needed integration in scientific education." (*Bertalanffy, 1969, 38*)

The aims here mentioned suggest the development of a system theory with the purpose of promoting the integration of science and later attempting the application of this theory in fields other than science, with the commentary of the importance of unifying principles. The high goals set for systems theory and its not being placed within any particular disciplinary realm allows for a diversity of applications and perspectives on what systems science is, should be, and has been up to now.

Rosen (*Rosen, 1986*) for instance, sees systems science as a provider of opportunities that have not yet been explored. Based on the fact that systems science incorporates tools from different paradigms, systems science is the "science of alternatives", and precisely because of this privileged position, systems science is also somehow immune to paradigmatic revolution in the Kuhnian (*Kuhn, 1970*) sense. Rosen calls system theory "…the unmoved mover; a revolutionary advance which itself can never be challenged by revolution." (*Rosen, 1986*). This all bodes very well for systems theory, at least in terms of its permanence within the scientific realm but there are some internal differences in the understanding of what systems science should take as its primitives.

Modeling reality

The feeling that science does not have the structure it needs for its unification and that systems science is the answer is supported by various systems theorists i.e. Boulding (*Boulding*, *1956*) treats systems theory as the "skeleton" of science through the making explicit of the complexity levels in the relations dealt with in science. The use of lower, well defined methods for obtaining descriptive regularities at a higher complexity level is encouraged by Boulding in this article. This technique is applied also by Miller (*Miller, 1986*) in a more general sense when talking about cross-level studies in biology and social structures. Later on, the implementation of a differentiation through hierarchy levels through the analysis of complexity is later incorporated by Klir in his GSPS taxonomy of systems (Klir, 1985) of which we give a description below. That science is not structured enough is taken as the problem to solve by some of our system theorists, considering modeling the solution to this lack of complexity and structure. This need for building models can be seen in Conant and Ashby (*Conant and Ashby, 1970*) where they prove the need to model if a system is to be regulated in an attempt at a "change the status of model-making from optional to compulsory" (*Conant and Ashby, 1970, 96*).

Given the stated aim of systems theory of unifying science and also due to the ever present influence the Newtonian paradigm has on the scientific realm, models are commonly linked to the topic of mechanization. In Weinberg (*Weinberg, 1972*) arguments are presented for the detailed analysis of the simplifications made in mechanistic systems that allow for their exact solution. Another theorist critical of the Newtonian paradigm, Rosen (*Rosen, 1985*) analyzes Ashby's (*Ashby, 1964*) views arriving at the impending need for a methodology that takes us beyond the mechanistic view of the world. Still another view in the same general line is the one Ackoff (*Ackoff, 1973*) presents in an article in which he shows the relative lack of importance of scientific disciplines as mirrors of reality. Systems, in his view are defined as interrelated elements, and elements as necessarily forming part of a system as well, just as subsystems are also necessary subgroups of systems. Even the empirical observation modes are critically assessed; Rosen (*Rosen, 1979 b)*) holds that empirical observation is blind to relational characteristics. In this article Rosen explores the incongruity in the modes of observation practiced by empiricists adhering to a reductionist paradigm.

Close to modeling is the comparison of models that describe systems that have elements that are different in nature but have a similar relational structure, the concept most brought up with this distinction is isomorphism. Zadeh (*Zadeh, 1962*) develops the notions of state and system equivalence and the use of policy in the implementation of control in systems. He calls attention to the fact that the mathematical information available in the relational structure of variables describing systems contains information that should be considered important. The nature of the elements has played an important role in differentiating and making the similarities opaque between structurally similar systems. Others are not as sure about the efficiency of the building of models as Ashby notes:

> "Another common aim that will have to be given up is that of attempting to <<understand>> the complex system; for if << understanding>> a system means having available a model that is isomorphic with it, perhaps in one's head, then when the complexity of the system exceeds the capacity of the scientist, the scientist can no longer understand the system…" (Ashby, 1958 a))

Ashby's (Ashby, 1962 a)) preoccupation leads us to the topic of complexity as it is with complex systems that systems theory is mostly faced with. Prigogine (Prigogine, 1985) presents an interesting and optimistic description of the science of dynamic systems in that it describes the emergence of structure over longer than expected distances being due to what he argues as the change of scale of the interactions. A brief description of dimensionality and the possibility of time scales other than the observer's are useful devices presented here by Prigogine. The manner in which relations keep the system together is addressed in the following on the topic of communication.

Communication

Communication is one of the most controversial issues in systems. The question of whether communication is with regards to the relations among elements in the system itself or with regards to the relations held with other systems, whether it consists of structure, energy or merely information. The issue of communication is addressed in a novel way by Conant (*Conant, 1976*) in an article in which he posits a model that generalizes information theory and proposes the N-dimensional statistical analysis of variables that are identified as descriptive of the system. Relations are viewed here as information flows among variables. These information flows are also constitutive of the dependencies among these variables, the strength of the dependency contingent on the amount of information exchanged. The existence of the system itself requires constraints that make the variables non-independent. The applicability of this model is limited to ergodic and stationary systems. Knowledge systems whose communicative possibilities we are investigating are neither ergodic nor stationary. Later in the same article when recognizing the limitations of the proposed model Conant suggests the use of "judicious interpretation and generalization" (*Conant, 1976*) in order to apply this model to non-ergodic, non-stationary systems. The additive nature of the relations amongst variables and the extrapolation method here proposed are in direct opposition to the theses put fourth by Weinberg (*Weinberg, 1972*), Ackoff (*Ackoff, 1973*), and Rosen (*Rosen, 1979 b)*) (*Rosen, 1985*).

Ontology

The topic of modeling however is not free from ontological connotations a problem addressed in an article by Gaines (*Gaines, 1984*) in which the ontological implication of the choice of model for system description is analyzed. For Gaines in this article *Zero* represents the "there is no method of reality" position, *One* the "there is one correct method of reality" and *Many* "there is an indefinite variety of methods of reality" (*Gaines, 1984*). If one were to use models to understand reality, the question of how to model is dependent upon the distinction one makes when choosing what to model. In "Distinction and Indication" a chapter of the article (*Goguen and Varela, 1979*) Goguen and Varela point out that the focus of one's attention when observing is more than a simple observation it is an indication through the imposition of value. Value judgments are not uncommon in systems theory. Acting "in good faith" the researcher makes certain "judicious decisions" that simplify or make the system under study more readily analyzable. What is not usually admitted though is the fact that these decisions skew the results obtained from the study. One such distinction is hierarchy as Goguen and Varela note (*Goguen and Varela, 1979*).

We will be commenting on this hierarchy distinction below as it is an important component to Klir's taxonomy and proposals from some other system theorists. Goguen and Varela continue stating that the choice of treating the system as autonomous or controlled is dependent upon the choice of analysis level. An analogy is made between autonomy/control and recursion/behavior. Recursion sets preference on the internal constituents while behavior does otherwise: focuses on the environment. This is an important point for our purpose of the comparison between the proposal by Klir and the Luhmanian one, as both use the distinction above mentioned and do it in different ways. On the debate between reductionism and holism Goguen and Varela (*Goguen and Varela, 1979*) comment that science has both present in practice but publicly accepts only reductionism. So the complete debate as to which perspective is to be taken as the official one for a proper system theoretic approach is summarized in one line in (*Goguen and Varela, 1979*):

> "reductionism implies attention to a lower level, while holism implies attention to a higher level. These are intertwined in any satisfactory description; and each entails some loss relative to our cognitive preferences as well as some gain."

It is the management of this loss or gain by the researcher that determines his preference for an overly reductive or holist study and as stated above, most proposals are not clearly either. What must not escape us here as a comment, is the awareness that the methodology or theoretical stance taken to study a particular system will be inextricable from that study's results.

Returning to the question of what systems theory is we have Klir in an article in which he quotes from his Systems Science Manifesto in this article he holds;

> "…systems science is not a science in the ordinary sense, but rather a new dimension in science. Each system developed as a model of some phenomenon in any traditional sense represents knowledge pertaining to that science. Knowledge in systems science is not of this kind. Rather, it is knowledge regarding knowledge structures, i.e., certain specific categories of systems. Hence experimental objects in systems science are not objects of the real world, but rather abstractions, which we are able to make real on the computer." (*Klir, 1988*)

Present in this view is the necessary character of the model and a new statement that systems science knowledge is knowledge about the structure scientific knowledge has. Systems science deals with knowledge of the structure systems have. A more explicit statement is made implicitly in another article by Klir (*Klir, 1986*) through the procedures proposed for reconstructability analysis (RA). In this article Klir talks about Reconstructability analysis, there are some main terms that somewhat define the view

> "In general, a system is an abstraction distinguished on an object by an observer, which reflects on the interaction between the observer and the object. In RA this abstraction is conceived as a set of variables together with a characterization of the constraint (relationship, dependency, correlation) among the variables." (*Klir, 1986*)

One term is subsystem, which is defined as a system based on the variables of another system. A structure system is one in which several systems are considered as a unity. Finally an overall system is a system that consists of all the variables in a structure system. The main point in contention here is the constitution of the whole through parts and the identification of the relations which the whole and parts hold. This is not just another working view for the description of systems but an ontological position that defines the epistemology to be worked with. The case here is similar to the one in the article by Barto (*Barto, 1978*), when proposing the changes to the standard conceptions of discrete and continuous timed models of systems. He mentions the possibility of misinterpretation of system theory as science. He also warns of the failure to note the distinction between the knowledge a system is composed of and the knowledge about the systems composition which can lead to false or misdirected statements about either or both. Weaver (*Weaver, 1948*) much earlier, warns about another misinterpretation; the one that attempts to construe science as the sole provider of truth about the world and the all encompassing solution to our problems.

Rosen (*Rosen, 1979 a)*) comments on the fall of vitalism and the understanding of phenomena through personification continuing on to the rise of the Newtonian world view. He notes one of the main disadvantages gained from the Newtonian view of the world is the need for the explicability the possibility of explaining natural phenomena using a limited set of general principles and a symbol-manipulation methodology led to the uniqueness of the Newtonian world. This last approach also led to reductionism as the tools we have for the explicability of the world were for basic interactions, the world itself if it was to be explicable, had to be decomposed into these basic interactions. The observation of a system in order to determine the particles of which it is composed and forces acting upon those particles is an empirical one. Reductionism and empiricism then have a common theoretical framework and can be of wide applicability and much use.

> "…the empiricist-reductionist view can be pursued independently,… measurement and observation are primarily ways for discriminating between systems; that is they necessarily emphasize the idiosyncratic features of systems, rather than what makes them similar." (*Rosen, 1979 a)*)

This comment on physical measurements and later on science itself pervades most of these articles on systems theory. The counter-move or solution to the problems so derived is to be coming from system theory. Therefore, it is to be expected that system theory is said to search for commonalities among systems. For this purpose, the concept of equifinality (*Bertalanffy, 1968*) is analyzed in an article by Rosen (*Rosen, 1979 a)*) as well as the consequences of treating biological systems as open systems in the sense of their being able to exchange energy and matter with their environment. The consequences of the approach here mentioned are: functionalism being more useful than reductionism, and a relation established between the regulatory nature of biological phenomena and the stability of systems. The consequence considered by Rosen to be of great importance in Bertalanffy's proposal is the possibility of learning something of one particular system from the observation of another that presents the same characteristic behavior. Rosen mentions this through the use of the word "metaphor". Klir, for example uses these ideas in his particular way as he classifies systems' levels through hierarchy. Another theorist convinced about the advantages to such studies is Miller (*Miller, 1986*) where he talks about the "…generalizing power of cross-level studies of living systems".

There is great suspicion of those methodologies that do not appear to be scientific. The question of whether General Systems Theory (GST) is scientific or not is addressed and it is ultimately answered in the affirmative by Bunge (*Bunge, 1977*). Bunge starts from a narrow definition of when a given theory is scientific, and throughout the article he keeps making exceptions for theories considered scientific and adjusting the definition so as to allow for such unquestionably scientific exceptions. When at definition number five, he stops and considers the case of GST and we are convinced that GST is to be taken as scientific if most of science is to be so. In the same stroke, though, he claims scientific ontologies (SO) are bound to be scientific under the same definition. He concludes that while there is the possibility of making a distinction between SO and GST they are both scientific for the same reason. This for us is an important point; the scientific character of systems theory is an important one for the validity of its results given the world view in which science is the self-designated keeper of truth.

Evolution

The increase in complexity that permits a system its survival in a changing environment, is explained in terms of evolution in (*Simon, 1962*) especially with regards to the hierarchical forms that appear to be preferred by such systems. Rosen (*Rosen, 1972*) is not in complete agreement with the position put fourth in Simon (*Simon, 1962*). Rosen understands the need for simplification but argues it is to be found in the functional, rather than hierarchical differentiation of systems. A classic paper on the same topic of evolution but with a completely different ontological proposal is the one by Maturana and Varela (*Varela, Maturana and Uribe, 1974*). The concepts and ideas presented here are generalized and used by Luhmann later.

Radical Constructivism and the Structure of Knowledge

Given these previous notes, we can see a general tendency to follow, use, or in general align systems methodology to science. Robert Holub in "Luhmann's Progeny" (*Holub, 1994)* mentions this very idea. The proposal by Luhmann is after the description of complex systems and uses some of the ideas present in the articles mentioned above. Examples of these ideas are Maturana and Varela's (*Varela, Maturana and Uribe, 1974*) concept of autopoiesis, and Spencer's forms (*Spencer-Brown, 1969*) as well as some other ideas related to delimitation and environment recognition ideas present in Rosen (*Rosen, 1977*) and also in Ashby (*Ashby, 1962 b)*). Furthermore Luhmann coincides with Ashby in the need for influence on the system for organization to take place and on the possibility of the system interacting with other systems. Despite these commonalities, Luhmann's systems theory needs a different approach for proper contextualization given the case that some of its foundations are in contrast with most views on science and the epistemology that classifies it.

Some of the foundational elements of the Luhmannian proposal can be seen in the foreword to Luhmann's Social System's book (Luhmann, 1995, xii) in which Eva Knodt gives a description of what Luhmann does as:

> "…Luhmann lays out a theoretical groundwork which subsequently provides a frame for a description of modern society as a complex system of communications that has differentiated itself horizontally into a network of interconnected subsystems. Each of these systems reproduces itself recursively on the basis of its own, system specific operations. Each of them observes itself and its environment, but whatever they observe is marked by their unique perspective, by the selectivity of the particular distinctions they use

for their observations. There is no longer an Archimedian point from which this network could be contained in an all-embracing vision…”

The main shift from the previous system theoretical proposals is summarized by; the loss of an all-encompassing preferential observer, the communications based networks composing the systems, the system/environment distinction as constitutive, the recursive character of the operations a system reproduces itself by, and the necessary contingency of all observations. Each of these will be addressed in what follows and the separation from the heretofore common positions held on these issues is commented upon.

Kuhn’s Paradigms, Modernity and the loss of Reference

On Observation

The theory proposed by Luhmann implies the loss of the privileged observation point ever present in previous proposals. This is a controversial position which gives rise to all sorts of historically framed debates both in science and philosophy and has several consequences of which we will mention some. Rasch and Knodt (*Rasch and Knodt, 1994*) view Luhmann’s proposal as an ontological proposal as it contains a paradigmatic shift form the other proposals available at the time and a different worldview. Rasch and Knodt’s argumentation line suggests the tendency of science in general of moving towards epistemology and second order cybernetics. They argue that the question is no longer “…what is there? – but: how does an observer construct what he constructs in order to connect further observations.” (*Rasch and Knodt, 1994, 3*).

Kuhn’s normal science

In “The Modernity of Science” (*Luhmann, 1992*) Luhmann addresses the issue of science’s self-representation as modern. Society is modern, by stigmatizing the old, and reducing it to mere history. “The modernity of science consisted in the progress of science itself; science was more or less a constant modernity.” (*Luhmann, 1994, 11*) Before the paradigm inconmesurability thesis, there was no challenge to accepted theories and they constituted truth. The status now earned by precursor theories as “paradigms” prevents them from being so readily discarded and historicized. This development undermined the until-then stable foundations of science and its modernity as well. As Luhmann puts it,

> “One could only say: we are dealing with a different paradigm whose claim to superiority can be formulated only by its own means. The constructivism of modern epistemology is grounded only in itself.” (*Luhmann, 1994, 11*)

This quote above leads to at least two different discussion topics; one, the previous and total control that “normal” science held on science and the now relativism that reduces its scope of influence, and what leads into Luhmann’s functional differentiation. We will address the former and then move towards the topic of functional differentiation.

If we concentrate on the term normal in the sense Kuhn uses it to describe “normal science” or the paradigm that currently enjoys the favors that the consensus of the “experts” has bestowed upon it, we are immediately led to denote abnormal science everything that is not the former. Inherent in the statement of abnormality is a negative connotation that pervades “other” theories as not entirely scientific or at least of not enjoying validation to the fullest extent. The notion of truth is then contingent upon both the normal science view and the experiments that make reference to nature itself. On the other hand, if we were to focus on the word normal, as that of the outcome that has the highest probability of occurring. We are led to believe that “normal science” is the most probable outcome of nature, hereby making reinforcing positive aspects of the notion of the hegemonic position. The position held by Luhmann being an empiricist, is not quite the same as Stephan Fuchs puts it:

> “We can distinguish between two different ways of conceptualizing scientific knowledge. Traditional epistemology has been concerned with the epistemic conditions under which science can produce a “valid” and “true” knowledge as accurate accounts of “objective reality.” For empiricist epistemology, “truth” signifies the intrinsic property of sentences that are not selected by a community of knowledge producers and validators but by reality itself. Scientists select hypothesis; reality selects true or sufficiently corroborated propositions. The epistemological notion of science, conceives of “true knowledge” as a relation of correspondence between theory and something else that is not language: reality”(*Fuchs, 1986, 126*)

The system/environment distinction so important to system theory proposed by Luhmann makes the previous point on normality as higher probability an empty one. Because of the high number of possibilities the system has in choosing its distinction from the environment and the small number of those that may be favorable to the systems survival, Luhmann notes to be searching for theories that “…can succeed in explaining the normal as improbable.”(*Luhmann, 1995, 144*) We now move from “normal science” into the Lumannian system theory through one of the most controversial proposals still; the system/environment distinction. This move has earned Luhmann many enemies, accusing him of proposing a social technology, not a system-theoretical descriptive epistemology.

Recursion, Self-reference and System Production

In describing Social Systems, Müller (*Müller, 1994*) explains the lack of a claim to absolute truth in Luhmann’s theory, specifying that social systems are composed of communications as elementary self-constituting elements. The proposed methodological recipe is to look for theories that succeed in explaining the normal as improbable as was quoted above. Müller (*Müller, 1994*) argues that this methodology implies defining the function of function so we can later ask how it affects structure or processes. This last defining of the function of function rids the theory of the association of meaning with intention, as meaning is only to be associated with reduction and not in a relationally closed manner.

The Kantian notion of a knowing subject is replaced by the one of a self-referential system and there is an implicit acceptance of the partial observations this system makes of its environment. “The question of how a subject can have objective knowledge of reality, thus gives way to the question: How is organized complexity possible?” (*Luhmann, 1995, xvii*) This results in a more natural albeit complex rendering of systems in their specific interaction with their environments. A knowledge system, for Luhmann models complexity to explain complexity. Here it is possible for us to relate back to the system theoretical positions in which modeling and simulating systems were the choice methodologies for their understanding (*Conant and Ashby, 1970*). The system/environment distinction constitutes a reduction of complexity, for the environment is always more complex than the system, the system then manages the complexity level of its environment effectively isolating itself from it to a certain extent. The modeling of reality is an example of this process although not necessarily the only one, to model, one must first distinguish and in doing so, one's model is contingent upon that choice. System self-reference is contingent upon the choices the system makes for the reduction of complexity that enables the distinction, therefore the very mechanism that enables system survival may very well end its existence.

> "Once one uses the basic system/environment distinction, then none of the traditional philosophical or sociological distinctions --- transcendental and empirical, subject and object, ideology and science --- can eliminate the contingency of enforced selectivity." (*Rasch and Knodt, 1994, 5*)

These are the premises that set the tone of the ensuing discussion. We have now left the relative safety of historically based positions on science and knowledge and enter the realm of "radical constructivism" in an attempt of enabling the possibility of a description of a system unencumbered by traditional epistemological baggage but still on solid foundations. We here present a receding view of these theories while at the same time a clearer and closer view of the Luhmannian proposal is grasped.

Functional Differentiation

When describing modern society's influence on science Luhmann states:

> "Modern society's form of differentiation makes possible, or even enforces, the autonomy of separate functional areas; this is accomplished by the differentiation of certain operationally closed, autopoietic systems. Functional differentiation thus imposes on systems an obligation to reflect on their own singularity and irreplaceability, but an obligation which must take into account that there are other functional systems of this type in society." (*Luhmann, 1994, 11*)

This quote shows another characteristic of the Luhmannian proposal: functional differentiation based on self-reference and the acknowledgement of other systems in the environment (external-reference). The last necessary characteristic mentioned here relates to the "significance of second order observation" (*Luhmann, 1994, 22*). This feature of the Luhmannian argument poses a striking similarity with the proposal by Klir (*Klir, 1985*).

Contingency in Observation

Observation for Luhmann, is a process which is always done from the particularity of a system. A system makes a distinction and from that distinction it can make observations. The system in question cannot "see" the unity of that distinction and that influence on its observation he calls "blind spot" it is the unavoidable source of the contingency inherent in every observation. Cary Wolfe (*Wolfe, 1994*) explains Luhmann's treatment of observation as "self-reference" as an extension of the process of self-production "autopoiesis" in Maturana and Varela's terms.

Even when Luhmann posits observations as necessarily contingent, self-referential processes that may give information about other observers and their observations, Luhmann's theory makes a claim to universality. Luhmann himself in Social Systems makes a point of this including the same theory he proposes as necessarily part of what is to be analyzed. On the topic of universality and the contingency of observations, this being most controversial for it of one of the main contention points, Rasch quotes Luhmann explaining the necessity of the contingency of observations in the "construction of a visible universe". (*Rasch, 1994, 72*) It is precisely what is contingent of each of the observations that gives way to the visible in the constructed universe.

This notion of letting go of the privileged observer leaves a sense of impending danger of loosing objectivity. The way out of this apparent conundrum, as Cary Wolfe puts it partly using a phrase by Luhman; "is that "everything said is said by someone" – that is, to foreground the contingency of what Luhmann will call *observation*." (*Wolfe, 1994, 112*) Noting the very source of the contingency of observations that has become such a point of contention because it affects what is to be taken as the real. The paradox implicit in the fact that reality is constituted through contingent observations and the very contingency of them is what is real for it is a self-reference to the system making the initial distinction, is a way of making systems dependent upon other systems not for the generation of reality but for its understanding. This is the manner in which second order observation: the observation of observers making observations, becomes necessary in the study of what is especially in the study of society.

Fuchs (*Fuchs, 1986*) analyzes the knowledge generation process in science using Luhmann's systems theory and notes its functioning in terms of functional differentiation and the mediating function of truth that Luhmann (*Luhmann, 1976*)talks about:

> "The mediating function of truth makes it possible to rely to an ever increasing degree upon the experience of others, even without ever knowing them"(*Fuchs, 1986, 138*)

This is noting the manner in which science permits the creation of knowledge *on trust in truth* as the generalized medium of communication.

> "The acceptability of scientific selections does not depend on the individuality of particular researchers or on the specificity of particular contexts of knowledge production but on trust in truth as a generalized medium of scientific communication."(*Fuchs, 1986, 138*)

This proposed for our purpose of elucidating the possibilities of communication across areas disciplinarily set apart may prove useful. The statement that it is only through mutual and contingent observations that we constitute reality, and the comment on the distinctions founded on the blind-spot observable only from second-order operations, gives us the foundation for a methodology capable of doing just what we are after; elucidating the conditions for the possibility of epistemic communication across areas.

The Systems Proposal by Klir

In an article Klir (*Klir, 1985*), proposes a methodology for the study of systems. Before such a methodology can be enforced however, these systems must be classified according to their constituting characteristics, namely the elements or objects that compose it may be characterized by type. The other main constituent of a system is its relations which can be typified as well. There is still another initial limitation on the types of systems to be treated if one is to be at all practical given the extensiveness of the whole universe of possible systems;

> "A pragmatically sound taxonomy of systems, should take into account systems that have proved useful in various traditional disciplines of science." (Klir, 2001, 220)

There remains the question of what type of characterization or classification should be used once the system to be studied has been determined. The taxonomy of systems proposed by Klir is the one now commonly referred to as the GSPS (General System Problem Solver). This taxonomy is based on a hierarchical layout of epistemologically differentiated types of systems. The primitives for such an epistemological differentiation are: an investigator in a given environment, an object to be observed also embedded in an environment that may contain the observer to a certain extent or relevance, and an interaction between the observer and the object of observation. This proposal is similar to the top-down approach to systems theory proposed by Ashby (Ashby, 1958 b)) in the following sense; Klir's taxonomisation of systems has the observer-object relation at the beginning level while for Ashby it is the furthest down. The knowledge obtained from systems in higher levels in Klir's system taxonomy reminds us of what Ashby reportedly states as a possible consequence of the adoption of his top down approach.

Levels in the epistemic hierarchy:

Level 0 which is also called the generative system level is the direct interaction between the observer and the observed. This interaction is presumably not free from interpretative bias in any way. There are to varying degrees, influences deriving from the investigator's capabilities, and interests. The manner in which this interaction is conceived as a system by GSPS is through the investigator's definition of variables to be measured and the possible states that these variables may take. Included in this level is also the interpretation of the state of these variables in reference to the peculiarities of the "real world". This level 0 type system is also called, a generative or source system as these are the sources for the empirical data that is to be studied further. The descriptive variables just mentioned may be further divided into basic or support variables, in dependence of the relevance they have, to the observed phenomenon. Still within this level we can have a further classification which entails the distinction of variables into input or output variables depending on whether the influence measured through the variable is exerted on or by the system respectively. If there is any value in the input / output variable distinction, the system is to be considered as directed, otherwise it is non-directed. Similar distinctions can be drawn upon the variable states; whether they be continuous or discrete, crisp or fuzzy, ordered or any other characterization that validates the distinction.

Higher levels in the hierarchy are distinguished by how much is known about the basic variables. That is level 1 for example can be the case of having a source system and additional data about the states of the basic variables. Level 2 would contain additional information about the "support invariant relational characteristics" of the level one system; this is, the boundary conditions of the set of basic variables or information about the properties of the level 1 system. In the level 2 characterizations may include the introduction of new variables descriptive or needed in the description or modeling of the lower level system.

A system of epistemic hierarchy of level 3 would be a set of generative systems (subsystems) that may be coupled. These level 3 systems are called structure systems. Level 4 systems characterize changes in procedure that maintain structure invariance, these systems are called metasystems. Level 5 and above allow for changes of higher order in the characterization of systems these are now meta-metasystems. Still higher levels follow the same trend as is followed by the ones mentioned before.

The Systems Proposal by Luhmann

The first distinction In Luhmann's proposal as it relates to our objective, is the identification of elements and relations, which are the most basic distinctions possible for they determine the level of analysis to be made in terms of the whole system. There are no universal elements or relations. Their choosing is in fact arbitrary, but once chosen the whole system description is determined. Elements are therefore the smallest constituents of a system, ones without which the system itself would cease to be called one. Relations are what keep elements related and also a part of the system they constitute the structure of the system.

Once the distinction that constitutes the system is made, immediately the one that determines its environment is also made. The differentiation of system and environment or the boundary formation between them is critical for system survival. This last system/environment distinction is also due to the selection of element made. Therefore added importance should be given to the selection of the elements that are to constitute the system.

Also key to distinguish is the process of communication Luhmann states that communication happens when there is structural change within the system, not only through information transfer as is usually theorized. For Luhmann the structural change is of high importance. This structural change, by itself poses an additional restriction to the type of exchanges possible with a given system. The communications the system can perform with its environment will have to be done through the capabilities enabled in its structure. Structural change with each communication, results in changes as to what further communications are possible. This contingency in the communicative process still does not imply meaning transfer; for meaning transfer there is an implicit double contingency. The system that is to transfer meaning has to have the structural components such that communication is possible both to and from the system that is to accept the meaning, therefore both systems have a structural change performed once there is the transfer of meaning.

The structural change performed in the act of communication is not boundless within the system. There are certain structural areas that will accept that communication and therefore change. This is called differentiated information processing. Now because of communication and other internal reference processes, the structure in systems is not static nor is meaning it is always in evolution. There is an actuality of meaning, this is the one enabled by the system's instantaneous structure at a given time. A potentiality of meaning also exists given the structural changes in each system and their communication enabling properties. In the meaning enabling process there is then, both a double contingency and mutualistic constitution to the extent the structure in both systems changes.

Difference has a very important role in this theory, for it is what enables the determination of what a given term is and what it is not. Not only does difference select the meaning but the language realm it belongs to while at the same time excluding those it is not a part of. We have the possibility of further analyzing terms meanings in the factual, temporal and social dimension of meaning giving us the opportunity to include factors that are not generally taken into account on term-meaning description. As another separate distinction useful in the analysis of meaning, we have the distinction between internal and external attribution, between experience and action. The manner through which systems render themselves visible and identifiable by other systems in the environment is through systemic references.

The benefits to be obtained given our objective and Klir's proposal

Directness in the applicability of scientific analysis is one of the most favorable characteristics in the proposal by Klir. This fact is self-evident for he is taking an initial set of systems that are "practical" in the sense that these scientific techniques have already proven themselves efficient in their treatment. Nevertheless, it is worthwhile to note the analysis-enabling power wielded by the scientific techniques here mentioned is not to be taking for granted. One could argue these techniques are the best of what we have as tools for analysis.

The system/observer distinction that the taxonomy bases its generative system level on provides a ground level approach that is common in most scientific endeavors. There is almost no "transition problem" from systems science into or from science into systems science. The epistemic gap does not consist on the obvious differentiation between the epistemic hierarchies used in GSPS taxonomy of systems and the traditional scientific epistemological approaches. It is in the difference in knowledge constructs which is implicit in the added importance given to the relation based classification and to the language used in the description of the systems under study. The results obtained from these studies reflect this gap. This gap is not completely filled and may not ever be.

The methodological gap is practically non-existent, while the epistemic one is significantly reduced. There is virtually no methodological difference for the methodology used for the analysis of systems is mostly the one science has and continues to use. The applicability of the methodology Klir proposes as experimental procedures, computer simulation and methodological comparison are clarified by the use of the taxonomy that exposes the epistemic hierarchy of the system under study. This is an additional benefit of the point of view proposed for we have to look no further than science itself to find these methods being applied as we speak.

The fact that when the problem is subdivided into smaller subsets composing subsystems following controlled changes in the observation perspective is also an asset to the GSPS taxonomy of systems proposed by Klir. This control over the procedures that allow for system-subsystem distinctions at least in the amiability to mathematical expression of the change provides a footing of sorts that may enable a more detailed understanding of the system.

The benefits to be obtained given the selection of Luhmann's perspective for the analysis

Luhmann's perspective presents some drawbacks that turn out to be its greatest benefits; the systems theoretical framework is situated such that it has very little resemblance with currently applied systems theoretical frameworks. This presents a difficulty in that the terminology used for the description of a system and the description itself has to be clarified step by step. On the other hand it has the freshness of innovation, the explicatory potential of a new viewpoint that cuts across the established ones for the very reasons mentioned above.

If the task is to analyze the possibilities for epistemic communication across disciplinary domains, it appears natural to establish the problem to be studied as a knowledge system and then analyze the meaning transference across the areas viewed as knowledge systems. The depth of analysis inherent in this Luhmannian perspective towards meaning briefly described above bodes usefulness for this purpose.

Because of the very contingency Luhmann makes intrinsic to observations and the fact that ours is an undertaking of just that: observation, it seems that separating ourselves from the standard distinctions made with regards to meaning, communication, and the hierarchy implicit in epistemic differentiation could prove of benefit to our task. The instrument used for such a commission, systems theoretical perspective, is also on this same state of affairs so one would think similarly as to its origins and implicit epistemic baggage.

The similarities of both approaches

Both Klir and Luhmann posit a theory that involves second order observation as a key component. If we were to take Luhmann's proposal and Klir's on only level 2 of his proposed taxonomy we would find many similarities. This is the case only if we are to disregard both prior and further levels as proposed by Klir.

Both analyses are likely to yield interesting facts about the possibilities for epistemic communication across disciplines. As they are both instruments with a high potential for descriptive output, we would most certainly obtain information about the systems studied.

The contingency in observations as is described in Luhmann, is also treated in Klir's perspective as the "blind spots", are eliminated through the observation of the structural invariance that moves the analysis to the next meta-level. This is an isolated point, there are many differences not mentioned here that appear, as soon as one moves away or extends from this position in any of the perspectives the similarity ceases to exist.

Klir and Luhmann each take from research available in systems theory a perspective consistent in its own right. They are not the same perspectives and "incommensurable" in Kuhn's terminology seems a light qualification, but both strive to describe systems in a manner consistent to their belief set.

The differences in the foreseen results from one or the other approach

The results to come from using Klir's perspective promise a set of different models for epistemic communication across areas. It may give insights as to the workings within the areas and the manner in which they relate in a broader scheme. The scientific tools available and necessary for the analysis will have been brought to bear. The validity of the results will be furthered given the proper use of these tools and the consistency in the use of both the classification scheme and methodology proposed by Klir.

A description using the Luhmannian perspective may give results that a priori are to be considered contingent on the system making the observations. The resulting descriptions are based and are to be interpreted in a terminology proper to the perspective and not as popular as the scientific one, so they may encounter resistance due to this very fact. The insights to come of a perspective that so readily cuts across the traditional epistemic demarcations and has such a powerful means of investigating the workings of meaning constitution in regards to systemic structure show much promise as a descriptive instrument for the very purpose we are after.

The selection; on the contingency of the distinction to be made when choosing

The problem at hand is not easily dismissed; we set out to compare two perspectives that seem at first hand incomparable. We end up deciding between both the backgrounds each perspective comes from as well as between the perspectives themselves. The quote below contains the essence of our purpose in this study. We set forth to choose the best systems theoretical proposal to study knowledge systems. We have briefly stated some of the ideas and goals that gave rise to the whole system theoretical endeavor and we finally come to the end of a brief description of both a system theory also described as "radical constructivist" and one that finds its foundations in the traditional sciences. Habermas can here be assumed to support the latter for he is described to be one who would further the Enlightenment project and find support for the everlasting "modernity" of science.

> "We are left, it seems, with an uncomfortable choice, not – as Habermas would have it – between "pure historicism and pure transcendentalism," but between two incompatible theories, both of which make strong claims to universality: one that promises to preserve our most cherished utopian hopes, and another that promises to provide a "more adequate" understanding of contemporary society capable of accommodating in a more rigorous fashion many of our "postmodern" intuitions, concerning, for instance, the status of the subject, the experience of radical contingency, and the irreducibility of paradox." (Knodt, 1994, 92)

The choice may already be apparent in the text above for despite the effort for impartiality there is none. As Luhmann mentions, "everything said is said by someone" every observation contingent. The choice for Luhmann's perspective can be seen in the ever present search for justification to each statement of fact above. Contingency is not to be eliminated in the search for absolute truth for it necessarily distances us from reality making the problem into a validation and reference one. There is to be a price to pay for this selection, as there is one for the other, both in the work before us in the description itself and the proper grounding of the terminology to be used in the analysis. But in our opinion the Luhmannian proposal is more worthwhile given the possible insights into the constitution of meaning and its relevance to communication.

Conclusions

The present analysis shows its utility in the contextualization of two quite distinct system theoretical analysis proposals. This is not a general all encompassing analysis but one geared towards the selection of a descriptive mechanism appropriate to a given problem: the problem of the description of the conditions for the possibility of epistemic communication across areas. This analysis ends with a selection and its justification given the contextualization and contrast made possible in the theoretical considerations. The selection is made to depend on an evaluation of the benefits to be obtained from the selection and the costs the selection implies. This selection is no doubt a contingent one in the Luhmannian sense, for we have a limited variety of positions to clarify the context in which it is made and limited space to make them in. We may thereby have introduced and unintended bias in our observations. This is the very "blind spot" we must live with, the same one visible to the reader one expects. We hope this analysis is of use for similar endeavors to ours and extends the scope of research in system theory as the use of the Luhmannian perspective appears to be limited as is mentioned in some system theory introductions.

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