LIVING SYSTEMS THEORY AND ENTITY-SYSTEMS THEORY

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Abstract

The process-structure approach of Living Systems Theory (LST) provides a more robust explanation of life than did the earlier explanations based in the concept of sense-response. Three aspects of LST, however, provide less robust explanations than those that generally characterize the theory. They are the concept of dispersed critical subsystems, the relative neglect of emergence, and the neglect of the pervasive influence of conceptual systems on LST defined information systems. This paper suggests that attempts should be made to strengthen those aspects of the theory of life.

Keywords: Living Systems Theory (LST), critical subsystems, dispersal, emergence, emergents, conceptual systems, information subsystems.

Introduction

Living Systems Theory (LST) (Miller, 1978) provides a much more robust explanation of the process-structure of living systems than the earlier sense-response, action-reaction approach. By adopting an input-throughput-output approach, LST opens up the interior of a system to analysis and synthesis. While acknowledging the whole, LST ventures into the black box to make sense of the actions and characteristics of the whole in terms of matter, energy, and information processes.

Notwithstanding that grand advance, some aspects of the explanation are less robust than others. Three of the less robust general aspects of the theory are the following:

1. The concept of dispersed critical subsystems.
2. The relative neglect of processes by which individual social systems (groups through supranational systems) emerge and the emergent characteristics.
3. The neglect of the pervasive influence of conceptual systems on the information subsystems of living systems at levels of some organisms and higher.

These aspects are not unrelated and any attempt to strengthen the explanation will likely intertwine them with others that characterize LST, both generally and specifically.

Dispersed Critical Subsystems

I have listed the concept of dispersed critical subsystems first because I believe that it has the least general explanatory power of any of the central concepts of LST. That is not to say that it does not have significant explanatory power. The problem is that

LST goes to great detail to explain the critical subsystems and how their interactions bring about function, history, and evolution, but when one is dispersed, or all are dispersed except the decider, it then simply goes into a black box (the other system, prosthesis, or environment). Such a truncated examination betrays the robust explanation that is LST.

A remedy may lie in that which I term entity-systems theory (e-s theory). By that theory, we acknowledge that there exist, in the empirical reality we examine, entities that together form a subclass of the class of all systems (elements standing in interaction). These entities are systems that take on characteristics such as emergence, self-organization, and autonomy (in Miller's (1978,.p. 18) words "actively self-regulating, developing, unitary systems"). Just how we define such entities is a significant question. We may draw from the empirically rich concepts of the entity theory developed in accounting, law, and economics in the nineteenth and twentieth centuries. Or, perhaps, we may define it more abstractly as Strijbos (2006, p. 250), has: "the individual wholes that present themselves in concrete experience." The definition that is adopted should place concreteness as Miller has, in matter, energy, and information."

Fundamentally, a living system defined by LST is an entity that has many internal components and subsystems and by dispersal may have many cross-boundary subsystems as well. Some of the outward dispersion is well-defined by a concept of boundary that allows certain inputs and outputs of matter-energy and information. Some other, however, is better defined by an attractor concept. According to e-s theory, a social entity very well may have subsystems of varying characteristics that reach into its environment under varying degrees of entity control. The elements of such a subsystem are standing in interaction with not only its entity but also with those of other entities. Strijbos terms such systems *interwoven wholes.* Because all such subsystem dispersals do not rise to the characteristics of an entity, the term *system* in its broader meaning may be more descriptive.

One further aspect of e-s theory should be mentioned here. It acknowledges that the subclass *entities* contains at least two major subsubclasses, namely, biological entities and social entities. The two types of entities are distinctly different, although both types require the same or similar critical subsystems.

The Relative Neglect of Emergence

E-s theory acknowledges that social entities are not usually reproduced in a manner directly analogous to that of biological entities. Instead, processes of emergence occur whereby social systems of varying characteristics take on the critical subsystems identified by LST and at some stage of development become "actively self-regulating, developing, unitary systems." Those emergent processes are increasingly influenced by, dependent upon, constrained by information processes and structures in which inhere abstracted or other conceptual systems. Those conceptual systems influence in almost every detail the emergence processes of groups and higher levels of life. Bailey (1990, 1994) developed in Social Entropy Theory (SET) six key social-system variables that I believe are in fact such social life emergents.

The Neglect of Conceptual System Influence

E-s theory expands our attention to include the influence of conceptual systems on living systems at a detail characteristic of LST. By e-s theory, living systems are identified as entities that have the matter-energy and information process-structure postulated by LST but that also include a significant proliferation of conceptual systems. Those conceptual systems determine in some degree the kinds of information that living entities process.

Kvitash's work (2002-2003) in relationships of elements (Relonics) and more recently in relationships or relationships inevitably points to a connection between conceptual and information systems. The number of relationships among the elements of a system explodes as the number of elements increases. Beyond three elements, a hierarchy of relationships among the relationships among elements likewise explodes.

In concrete systems, the cybernetic burden of multiple relationships on a particular element is important. In living systems, both the conceptual and informational relationships are important. The conceptual and informational, however, are different qualities. That difference is captured in a simplified way in the definition of a system as *related* and *interacting* elements. The term *related* captures the abstract quality (the conceptual) while the term *interacting* identifies the cybernetic or concrete quality (the informational). The exploding number of relationships provides a conceptual structure into which all possible cybernetic interactions may be mapped. It is a pattern of possible concrete emergence. In that sense, we can place a certain degree of concreteness in it.

The question then is: What are the concrete limits of relational expansion in such conceptual structures? Kvitash is using the concept of *Euclidity* to calculate the limits of empiricism in some three-element systems of measures of biological processes. In social systems where significant complexity intervenes, it may not be possible to identify certain levels of hierarchical expansion at which relationships of relationships are no longer of significant influence on a certain concrete element or measures thereof.

For example, I enter the financial securities market and choose to invest in a derivative instrument. I select a derivative the value of which is determined by the composite average of the prices of all stocks traded on the New York Stock Exchange. I decide, initially, to invest and continue to manage my investment by receiving information on the changing price of that derivative. In doing so, I have established a direct cybernetic feed (an interaction) between an nth level of relationship of relationship. It is probably not possible to trace all of the indirect relationships of relationships between me and the price of the derivative. It is probably not even possible to determine *n* within reasonable error limits. But if those multiple relationships did not exist, I would be unable to establish the direct feed that makes it possible to manage my investment. The relationships of relationships that I can only consider abstractly (and for complexity, I may not be able to do that exactly) in fact have a certain degree of concreteness.

Bailey (1990, 1994) takes a more traditional science approach to connecting conceptual and information systems. He points out that LST is difficult to quantify because the basic units are objects, such as organs, and he states, "Miller would have needed . . . to focus instead on the attributes or variables of such objects" (2006, p. 296).

Swanson (1993; Swanson and Miller, 1989; Swanson, Bailey, and Miller 1997), expanding Miller's concept of money as a special kind of information flow, has identified the attribute *specific exchange value* that emerges mainly at the societal level. The attributes variable is *price* measured on a ratio monetary scale. The attribute emerges in economic exchange where and when relatively independent parties (agents) vie for their own self-interests. The system of accounting for such exchanges involves a double-entry method of balancing equations. When money-information is identified as the facilitator of goods-services (matter-energy) flows, that system reveals that the total exchanges per period of any entity converges on the measure *net matter-energy* (NME). The recent research of Swanson and Bailey (2008) shows that information concerning communities, societies, and the natural environment is contained in the record of matter-energy flows ─and therefore should be publicly disclosed.

Simms (1971, 1983a, 1983b) builds a science of living systems (including both biological and social) on the observation that "a system's *capacity to direct energy* is a function of a system's structure and organization [and a] system's capacity to direct energy can be measured or calculate" (2006, p. 384). He provides measurement units of that capacity at several hierarchal levels of life. Simms connection of conceptual and informational systems is without doubt rigorous. For complexity, its application is difficult.

Perhaps at the other extreme, Hector Sabelli and his colleagues have identified *bios*, a prototype of natural processes in which life emerges. "Those [c]reative processes are characterized by diversification, episodic pattern, novelty, and nonrandom complexity, measurable features that are present in empirical data, mathematical bios generated mathematically by recursions of bipolar feedback, . . and some stochastic processes," (Sabelli and Carlson-Sabelli, 2006, p. 324). Sabelli and Carlson-Sabelli further state that "[t]hese processes of creativity are absent in random, periodic or chaotic processes, and show that many empirical processes, suspected up to now to be noise, actually are biotic. Similarly, many processes suspected to be chaotic appear to actually be biotic." This observation is particularly interesting in light of my reference to Eriksson's phenomeno-semantic complexity below.

The measures, models, and isomorphics introduced by Kvitash, Bailey, Swanson, Simms, Sabelli and many others are conceptual systems abstracted from empirical concrete systems. They, therefore, may provide some means of expanding our attention in the influence of conceptual systems at the level of detail characteristic of LST.

Quantification of living processes is a significant goal of LST. Such efforts as mentioned above should be integrated into the theory. But that is not enough. Qualitative information is as much a part of living as is quantitative information─and perhaps more a part of it.

Heiskanen (1975; Heiskanen and Arraksinen, 1979) developed a theoretical approach to the analysis of social actions and decisions that includes qualitative communications. They termed it *linguistic-mathematical theory* (L-M theory). The theory combines Klir's (1985) theory of backdrops and hierarchy and network theory with syntactic and semantic analysis to understand and more effectively use social communication. The methods suggested by the theory provide transition between linguistic logical systems, mathematical ones, and computer languages. Swanson and Heiskanen (1992; Swanson, 2001) combine L-M theory with LST to introduce management observation and communication theory. Swanson and Marsh (1991) extend the L-M theory conceptualization to internal auditing, suggesting that measurements and assessments of organizational processes should be made on monetary measurement, monetary assessments, non-monetary measurements, non-monetary quantitative assessments and non-quantitative (qualitative) assessments. Such orderly extensions of logico-mathematical conceptual systems to LST itself may be useful.

Recently, Eriksson (2007) proposed the idea of *phenomeno-semantic complexity.* He derives the idea from a process of semantic and syntactical transformation of message as communicated between sense-making actors. Both transformations are unintended, with the syntactical transformation very close in meaning to the noise in Shannon's theory. The thrust of his idea is that emergent complexity can occur in such processes. The unintended transformations in communications of actors result in unpredictable behavior. When the communication is between humans (sense-making actors), a semantic transformation also occurs and is a source of compounding unpredictable behavior (complexity).

The thing that makes Eriksson's idea so interesting to us is his reliance on the concepts of encoding and decoding to explain how semantic transformation emerges. There, he dips from concept to information. Without speaking of Miller's transducer subsystems, Eriksson involves those processes to explicate the possibility of any transformation, syntactical or semantic, thus further mixing the conceptual and the informational. And, as though that were not enough to signal that his work might offer a means of expanding our attention to the influence of the conceptual in LST, he offers the further idea of *first- and second-order semantic complexity.* There he draws together the contributions to transformation (complexity) of the object system and the subject system (observer). Now, the origin of the concept of the observed system is fused with the origin of information in the observed system as concerns transformations in which unpredicted behavior emerges.

Tracy's (2006) examination of the *motivation complex* exhibits an intermingling of conceptual systems (with both syntactical and semantic elements) and informational or concrete systems. He states, "Elements that may enter into the motivation process include purpose; goals, drives, needs, desires, choice or decision making, ability, communication, perception, outcomes, feedback, learning, resources, rewards, power and influence (p. 396). It seems to me that Tracy's (1984, 1986, 1989, 1995) studies of motivation in the context of LST point up a need for illumination of the connection(s) between conceptual systems (particularly qualitative ones) and the informational systems identified by LST.

The difficulty of making that connection is compounded when we are concerned with design. Eriksson (2007), basing his discussion in Ogden and Richards (1985) and contemporary positions take by the *semiotics* school of thought (Deeley, 1990; Nöth, 1990; Stonier, 1997; Brier, 1998), clarifies that added difficulty. Ogden put forward a *triangle of meaning* consisting of *idea* (private mental concept), *object* (referent or thing that the idea is about), and *symbol* (term or signal representing the idea). In design, the object or thing does not yet exist, compounding the discovery of the private idea.

Cowan, Allen, and Mistree (2006) provide one means of mitigating that difficulty. Emphasizing symbolic representation of the LST defined subsystems, they elevate design from the objective to the functional. They state, "It has been shown that LST provides a convenient, domain-independent, icon-based language that can be used to represent the functional requirements of a system early in its design . . . LST has proven useful for modeling living and nonliving systems from a variety of domains. For these reasons, we assert that LST is well suited for modeling the multitude of diverse functional perspectives encountered in the design of complex engineering systems" (p. 370).

And, finally, I suggest that Samuelson (2006) may provide a starting point for us to consider the several dimensions of the concept-information interface aforementioned. His "deep-insights foundation" (pp. 360-361) concerns this general issue.

Conclusion

Miller purposefully constructed a scientific theory that concerned the material processes of life. E-s theory retains that approach and the generally robust explanations of life that are characteristic of LST. E-s theory, however, seeks a more robust model of the dispersion of critical subsystems, a statement of theory of emergence that includes both concrete and conceptual systems and a definition of the influence of conceptual systems on those processes.

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