A RELATIONAL FRAMEWORK FOR SUSTAINABILITY SCIENCE

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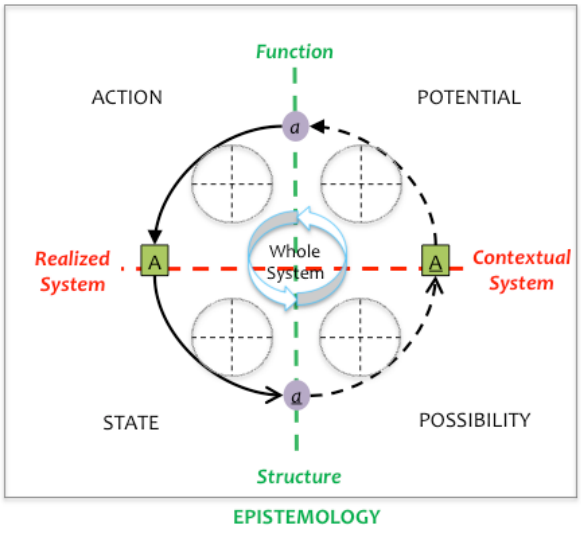
ABSTRACT

Since publication of a synthesis of Robert Rosen's relational theory in 2011, called R-thoery, considerable progress has been made in defining a general system framework that is both causally based and subject to analysis using category theory. This framework is based on hypothesized natural closure of Aristotle's four causes and implicit fifth level unity or organization of causal relations. The framework is based on holon relations described in the earlier work. In this paper I outline various representations of that framework showing that it is general to many known and practiced systems frameworks for understanding or managing complexity. These examples range from modern applications to anchient history. Based on these comparisons I propose that the causal structure of the R-theory holon does indeed represent a "General System Theory" as initially sought by Ludvig von Bertalanffy and implicitly in the work of Robert Rosen. I also suggest that it may be usefully applied in the emerging discipline of "Sustainability Science" which is seeking such a framework for integrating models of human and natural systems.

INTRODUCTION

Robert Rosen was a theoretical biologist who developed a foundational set of interlocking scientific theories, including mathematical models, to account for the difference between living and non-living systems. His scientific work talks about how nature is organized, how living systems are organized, and how life manifests itself within nature. His work suggests that understanding these organizational entailments, which are actually relational entailments, can teach us something new about physics and help us build more accurate models of complex interacting systems like the biosphere. What were his ideas? How could he make such claims? And how can we use this information to further develop science and increase the potential for public benefit and health?

In 2011 Dr. John Kineman, working closely with Judith Rosen, Robert Rosen's daughter, developed a synthesis of Rosen's several lines of reasoning along with basic ideas from Physics and Ecology. The result was a general theory of nature that may realize von Bertalanffy's ideal of a "General System Theory". The synthesis goes by the name "R-theory" after "relational" and "Rosen", and yet to clearly distinguish it as a further development of Rosen's original ideas in Relational Biology.



Since 2011 the theory has been refined and tested in a number of disciplines, and found to reveal startling results. R-theory now provides a clear definition of what it means for a system to be 'whole', and therefore may give important clues about sustainability and resilience. It also extends Rosen's description of life and predicts, from its category mathematics, the three major categories of life we observe. The theory has also been successfully tested for its cosmological implications, and found to correspond to a revolutionary new theory of "scale expansion".

At the recent 'conversation' of the International Federation for Systems Research, the R-theory four-quadrant holon was recognized as corresponding to many empirically and intuitively determined methods in systems research, perhaps underlying them all. The meta-system causal schema shown above transcends mechanistic and hierarchical concepts of causality to include the effect of contexts. In doing so, it accounts for 'bottom-up' causation traditionally associated with the material world and increase in entropy, with 'top-down' causation by which systems become organized. It allows us to relate ontology and epistemology and thereby provides a means of analyzing systems in terms of self-similar wholes. In other words, if we imagine the separate mechanisms and material parts of a system inside some container, R-theory allows us to understand the constraints imposed by the container. Furthermore it allows us to study systems in which the container and the parts determine each other.

That condition turns out to underlie all natural systems, except to the (often considerable) extent that they have formed enduring material elements. We thus can see that relational theory looks at the origin of nature oppositely than mechanistic theory, beginning with complex whole relations and then explaining how systems originate and become reduced to material realizations and elaborated into even more complex living entities. Considerable work remains to be done in rewriting our previous theories and models into this new and more natural worldview, and testing the results. Revolutionary as it is, considerable work is also needed to decide the extent to which Systems Science as a field can embrace it, or perhaps already does.

While these claims are obviously grand and impossible to prove in a single workshop (or perhaps many), we can gain an understanding of the new view through examples, models, analogies, and applications. In contrast to more standard scientific models, the relational view is actually more parsimonious in the sense of being a more elegant description of nature, in fact closer to our natural intuition. In fact, that association with more natural human thinking becomes clear in the study of natural-living modern and ancient societies throughout recorded history. A fascinating study is beginning about the human history of holistic thinking, before the world plunged into an extreme form of dualism.

While R-theory appears to offer a robust explanation of how natural systems of all kinds are organized – thus saying something new about physics as well as biology – confidence in it as a general causal structure or model of the universe can only be gained by considerable application and testing. And to accomplish that, it must be learned and applied correctly. Although a well-developed education program is really needed now to extend the use of R-theory, we are still at beginning stages where teaching methods and tools are being developed and curricula written. Periodically we offer workshops to explain the basic concepts of both Rosen's original ideas and the over-arching, more recently synthesized R-theory. Our strongest desire is to reach a point where we can engage graduate students in significant relational science research, so that they will carry the work forward.

These ideas radically expand our scope and vision in both science and culture. It is as 'out of the box' as any intellectual experience can be (not denying there are other, perhaps more profound,

ways to be 'out of the box'!). We find a solid basis for guided evolution, explanation of organizational patterns in cells, organisms, and ecosystems; a clear characterization of consciousness, Being and identity; an architecture for new informatics; and even a new model for space-time and the cosmos. But in this initial stage of development, perhaps the strongest need and opportunity for applying the theory lies in the human, social, and ecological sciences, where humanity is facing crises clearly attributable to our lack of understanding of whole systems. In fact, one very promising avenue of exploration is into 'crisis science' which shares all the characteristics imagined of holistic science. Thus, in contrast to how difficult it can be to promote systemic thinking otherwise, it emerges instantly during a crisis. Recognizing this important fact, we can then ask how to trigger that thinking earlier, to think in anticipatory modes and perhaps prevent crises.

First I will focus on concepts of relational entailment. Many people have trouble visualizing the difference between the mainstream view of how causality works and the relational view. Specifically, we will make use of a common game called Sudoku, which is actually a useful demonstration of how relations between “things” are not only important but can be as much of a driving force, in terms of outcome, as any material phenomenon.

With a solid foundation in Robert Rosen's system thinking, we can then embark on an amazing journey where we see rather surprising and delightful implications. Releasing many artificial constraints that have been placed on our minds, we will learn to dance with reality, perhaps even to fly. The equipment you will need for this journey is only your mind (regardless of the brain), removed from its present container (not the skull, but its philosophical container). R-theory changes our entire concept of reality into one in which the foundation of all things is not material but relational. Indeed, the complex relational nature of the universe is at the root of both its origin and its interactions. From this relationally complex foundation we can easily see how mechanical systems are fractions of a whole complex system and how living systems are higher order complex wholes. We thus find a means for unification of science as well as a deep understanding of human cognition, intellectual selfhood, and imagination. By providing a theory of whole systems it suggests plausible approaches to understanding sustainability and anticipation, as we move into a new era in human evolution that will likely depend on that understanding. To see our present and that future in proper perspective, we will even take a journey back 5000 years to ancient India and similar concepts of the 'non-dual' whole.