

# PEIRCEAN APPROACHES TO EMERGENT SYSTEMS IN COGNITIVE SCIENCE AND RELIGION

*by Mark Graves*

*Abstract.* Cognitive science and religion provides perspectives on human cognition and spirituality. Emergent systems theory captures the subatomic, physical, biological, psychological, cultural, and transcendent relationships that constitute the human person. C. S. Peirce's metaphysical categories and existential graphs enrich traditional cognitive science modeling tools to capture emergent phenomena. From this richer perspective, one can reinterpret the traditional doctrine of soul as form of the body in terms of information as the constellation of constitutive relationships that enables real possibility.

*Keywords:* Aristotelian form; cognitive science; cognitive science and religion; constitutive relationship; emergence; emergent systems theory; existential graphs; information theory; informative soul; C. S. Peirce; pragmatism; soul; systems theory; theological anthropology

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Cognitive science, the interdisciplinary study of mind that draws upon psychology, computer science, neuroscience, philosophy, linguistics, and anthropology, explores the relationship between a person's mind and brain in its embodied, biological, and cultural context. Cognitive scientists study the mind in the area where these academic disciplines overlap. However, religion already interacts with four of these disciplines—philosophy, anthropology, linguistics, and psychology—and currently those interactions are expanding to develop critical models of a person's mind, brain, and spirit incorporating neuroscience and computer science, in particular artificial intelligence.

Cognitive science and religion, as an interdisciplinary area of study, recognizes that one cannot completely understand cognition without religion,

Mark Graves is visiting faculty at the Center for Theology and the Natural Sciences, Graduate Theological Union, 2400 Ridge Road, Berkeley, CA 94709; e-mail [mgraves@ctns.org](mailto:mgraves@ctns.org).

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either from a weak claim that one cannot understand cognitive aspects of faith, ethical reasoning, religious experience, and so forth without incorporating religious understanding or from the strong claim, as many theologians such as Hans Küng, Søren Kierkegaard, and Paul Tillich have argued, that one cannot understand the human person without understanding the person in relationship to God. Rather than just adding one more discipline to the cognitive science mix, cognitive science and religion forms a more coherent field of study than the attempt to understand how one thinks while excluding what one believes.

#### EMERGENT SYSTEMS

In cognitive science and religion, one approach to understanding the human mind is through emergent systems. Emergence explains how simple objects interacting in simple ways give rise to the complexity and apparent novelty in the world where the whole appears greater than the sum of its parts. The atoms and molecules within one's skull organize into biological processes that give rise to mental phenomena including the ability to communicate with others via symbolic language to create religious traditions. Systems theory provides tools to model those physical, biological, psychological, and cultural systems that occur in emergent relationship.

Systems theory examines the complexity and interdependence of relationships between the regularly interacting parts or activities that form a whole. Although a popular metaphor today is "the person as computer," when computer scientists talk about computers they do not refer to input, output, memory, programs, or operating systems in the concrete. They use the language of systems. Systems theory focuses on the complexity and interdependence of relationships often using information and decision-making/control concepts. It was developed beginning in the 1940s with the work of Ludwig von Bertalanffy alongside Norbert Wiener's cybernetics, Claude Shannon's information theory, and von Neumann's game theory—all of which influenced the development of computer science. Systems theory focuses on the relationships of entities. The original developers of systems theory hoped that mathematics might provide a common language to model the domain-independent laws, concepts, and principles across disciplines, but even von Bertalanffy speculated that other theories, such as graph theory or information theory, might provide alternate approaches to classical mathematics. Systems theory has application in biology, computer science, family systems theory in psychology, engineering systems, organization theory in business, and so on.

We may use it also to describe the relationships that define the human person, to understand the person as embodied physically and biologically and in a cultural and religious context. A first step is to characterize the types of relationships that constitute the person and appear to emerge from each other. Traditionally, different areas of science focus on different parts

of the relationship hierarchy. Karl Popper (1974), Arthur Peacocke (1993), von Bertalanffy (1975), and numerous other scholars have organized scientific inquiry into levels that, for simplicity, I synthesize as physical, biological, psychological, and cultural.<sup>1</sup> The physical level includes study of atoms and molecules—from physics to organic chemistry. The biological level includes systematic study of biological processes and organisms—from biochemistry to neuroscience. The boundaries of these levels are as fuzzy as the boundaries of the scientific disciplines that study them. For the psychological level, I include mental constructs of humans and other animals. Historically, one might have supposed a uniquely human mental level of intellect and will, such as Thomas Aquinas's rational animal, but considerable scientific evidence suggests no significant intellectual quality to distinguish humans from other animals. Individuals interact, leading to the social or cultural level, with its apparently unique emergence of culture among humans, including religion. Terrence Deacon suggests in *The Symbolic Species* (1997) that (within this abbreviated model) culture begins with symbolic language.<sup>2</sup> Philip Clayton hypothesizes in *Mind & Emergence* (2004) a possible higher level of "transcendence" within an emergent, immanent theology of Spirit. Transcendent or spiritual relationships may also be described in this framework, perhaps beginning with ethics and including norms of cross-cultural relationships, such as Josiah Royce's Loyalty to Loyalty (1908) or the Greek ideals of Truth, Beauty, and Goodness, thus modeling systems in C. S. Peirce's normative sciences. Similarly, the apparent inapplicability of efficient causation to subatomic constructs suggests a lower "boundary" level of subatomic relationships, as efficient causation reflects a mechanistic understanding of reality most appropriate at the physical (or atomic) level but not lower.

These four scientific levels and two boundary levels organize systems for science-and-religion dialogue on the human person. But how do these levels relate? As cognitive scientists follow the lead of Eleanor Rosch, George Lakoff, Mark Johnson, and others who study the embodied mind, and incorporate the complex, interconnected systems studied by systems biology and human cognitive neuroscience, cognitive science will continue to shift away from reductionist and toward emergentist perspectives (Varela, Thompson, and Rosch 1991; Lakoff and Johnson 1999; Gazzaniga, Ivry, and Mangun 2002). Ontological emergence describes the irreducible, unpredictable, and otherwise unexplainable properties that appear from the interacting models. Strong and weak emergentists differentiate the ontological status of the distinct, emergent levels, with strong emergentists attributing laws or regularities and causal power to a level, and weak emergentists attributing constraining relationships and explanatory utility. Distinctions in emergent theories depend upon the theory of causation used to describe the relationships between the emergent property of a system and its constituent parts. From an Aristotelian perspective, formal causation appears

more appropriate to describe the relationship of the whole to its interacting parts than efficient downward causation does, and the tendency of that whole within a larger system has a teleonomic aspect one may describe using final causation. A “focal” system consists of an organization of lower-level systems and participates in a higher-level system that provides its function or purpose.<sup>3</sup>

Systems theory, as a foundational approach to computer science, organizes the relationships constituting cognition by modeling the systems occurring at each emergent level. Although scientists currently model systems of atoms and molecules (of the physical level), biological process and neuron networks (of the biological level), and biochemical interactions where biological phenomena emerge from physical ones, we do not yet understand the emergence of psychological relationships from biological systems, cultural relationships from psychological systems, or transcendent from cultural ones with comparable scientific precision. A systems analysis requires a clear hierarchy of the information in the systems to be modeled and the relationships between them, and Peirce’s pragmatism within philosophy, and the construct of *soul* within religion, supports an emergent systems model of the human person in cognitive science and religion.

#### PEIRCE’S PRAGMATIC PHILOSOPHY

In investigating a logical foundation for metaphysics, Peirce settled on three metaphysical categories, which he called Firstness, Secondness, and Thirdness, which categorize relationships and refer to one, two, or many other entities, respectively. Firstness characterizes the quality of something or its possibility for existence; Secondness, the fact of something or its actuality; Thirdness, the habit or regularity of something or its generality. Peirce’s logic and these categories illuminate an understanding of the contemporary mind-brain problem of philosophy of mind in cognitive science and how contemporary perspectives on mind from cognitive psychology and artificial intelligence are conflictually colored by an inadequate appreciation of his metaphysics. His logic of existential graphs, described further below, can diagram systems of relationships and characterize the emergent relationship as the transition of Thirdness to Firstness, described in Peirce’s semiotics as the dynamic and immediate objects. In emergence, the actuality of the interacting systems gives rise to the real possibility of emergent properties that become real as they habituate in the processing of a higher-level system. Although the categories occur in all phenomena, one may characterize some phenomena as typifying one category more than others, such as (I) the quality of “redness”; (II) the uninterpreted and unexpected experience of bumping into a piece of furniture in the dark; and (III) the tendency for an object to fall to Earth when one drops it. With Peirce, one could *prescind*, or abstract, emerging systems: first, the quality of a system as a whole; second, the actuality of acting and reacting systems; and

third, the habituation of those interacting systems into regularities, which then form new systems.

Peirce's pragmatic approach to emergent systems has relevance to cognitive science, which has been limited by its prior philosophical foundations. His metaphysics helps explain philosophical limitations of contemporary cognitive science and demonstrates one way that religion can facilitate the study of mind through the language of *soul*. Peirce used his three categories to categorize everything, including other philosophical systems, as in his 1903 Harvard lecture on "The Seven Systems of Metaphysics":

- I Nihilism
- II Strict individualism (Lutoslawski)
- III Hegel
- II III Descartes, Leibniz, Spinoza and the metaphysics of the physicists of today [1903]
- I III Berkeley
- I II Ordinary nominalism
- I II III Kant,—Reid's philosophy and the Platonic philosophy of which Aristotle is a special development. (Peirce and Moore 1998, 180 [CP5.77n])

I focus here only on the philosophical systems that he saw as having two of the three categories—those of Descartes (Secondness and Thirdness), Berkeley (Firstness and Thirdness), and ordinary nominalism (Firstness and Secondness). In particular, Cartesian and nominalist philosophy currently impact cognitive science.

Cognitive science struggles from an overemphasis in cognitive psychology of nominalism—or a lack of real generality where general ideas are mere names (or concepts) without any corresponding reality—and from an overemphasis in artificial intelligence of Cartesian or mechanistic approaches to the mind. Although both approaches emphasize Secondness, they relatively neglect Thirdness and Firstness, respectively, as indicated by the fact that no one would likely argue that contemporary cognitive science has too much Berkeley idealism, that is, not enough Secondness. For cognitive science to mature, it needs to deemphasize its action/reaction approach of empiricism and mechanism and capture the real possibility inherent in the regularities (or habits) of mind.

Stuart Kauffman makes a similar claim about self-organizing systems needing to balance order and possibility at what he calls the "edge of chaos" (Kauffman 1995, 26). He distinguishes between systems moving toward too much possibility and drifting into chaos and other systems moving toward too much order and shifting into rigidity. Neither direction can support life (or emergence). As Kauffman refers to actual systems, his chaos and order both include Peirce's metaphysical category of Secondness but have parallel limitations with cognitive science's incompatible digressions into nominalism and Cartesian materialism. To model the range of human emergent relationships, systems must capture the real possibility in the midst of habituated, regular processes.

Systems theory models the informative relationships constituting the human person in a scientific framework, and Peirce's existential graphs provide a logical foundation for defining the person as the conceivable practical effects of those constitutive relationships. Each emergent level has systems that one can model using graphs. Peirce's graphs come in three flavors, alpha, beta, and gamma, each of which builds upon the other (Roberts 1973). Alpha graphs capture propositional statements, such as syllogisms, and define basic inference rules comparable to propositional logic. Beta graphs add individuals with lines of identity and are equivalent to predicate logic, as one may predicate a statement about some or all individuals without specifying which individuals. Gamma graphs provide one the ability both to reason with the predicates themselves, not just individuals, and to reason in additional modes, such as possible, impossible, contingent, and necessary. Although Peirce continued to refine Gamma graphs, the logical power of reasoning with possible or contingent higher-order predicates allows one to specify how the habitually interacting systems of one level relate to the emergent property or quality of the higher level.

In summary, Peirce's relational logic describes the constitutive relationships occurring within a system, and his metaphysics categorizes the possible, actual, and general relationships of those emergent systems. By providing a framework that escapes conceptual nominalism and reductive materialism, Peirce's philosophy captures the possibilities of emergent phenomena within a habituated system, enriching investigations of human cognition and spirituality.

#### INFORMATIVE SOUL

The real possibility in the midst of habits characterizes what typically is termed the *soul*. Although Aristotle's form abstracts from actuality, substantial form cannot evolve. Rather than a Thomistic essential soul informing the body, the constellation of the physical, biological, psychological, and cultural relations captures the information content of the emerging human person. However, by examining the constitutive relationships that habitually form the person, one can model not only actual relationships but also relationships that could become part of the systems but are absent. Some of these absences may be constitutive: the spokes of a wheel supporting an empty space at the hub around which the wheel turns; the space for iron and oxygen at the center of hemoglobin; the juxtaposition of wood and empty space that form the open window of a house.

In cognitive science and religion, the concept of soul refers to the emergent transformation of habituated processes into new qualities of possibility capturing the deemphasized Firstness and Thirdness in contemporary cognitive science. One way to articulate the relationships obscured by the actuality of Secondness is to describe them virtually, using the language of information rather than matter or energy, that is, the language of emergent

systems and graphs. From an information perspective, one can model the absent matter or energy constitutive to higher-order systems. These constitutive absences in lower-level relations may constitute what appears as an emergent property from the higher level. From an information perspective, one may define soul as the constellation of constitutive relationships that enable real possibility.

The definition has practical application. A person's real possibility in habituated constitutive relationships opens up the person to participate in relations in higher-level emergent systems. For a physical body lying dormant or lifeless, soul would open one up to biological processes of life such as oxygenation and movement. For a biological body with a brain, soul would open one up to learning novel modes of thinking, feeling, and behaving, that is, creativity. For an individual in isolation, soul would open one up to participating in cultural activities that depend on human interaction. For a person participating in religious culture, soul would open one up to participating in transcendent, spiritual relationships.

In terms of Peirce's categories, the soul relates to the Firstness that occurs in Thirdness. Thirdness highlights the laws and general regularities of a system. Secondness, in its action-reaction, prescinds clear, distinct decisions within the process of a system. Firstness opens up the space in what would otherwise be a rigid, mechanistic process. A functioning, organic system requires all three categories. In terms of a person's soul, one can make decisions that increase the order and rigidity of one's life, and close in on one's self through creation of self-serving constraints; or one can deny one's needs for regularity and open one's self up to chaotic existence in an overly ascetic life. Both approaches lead to what Thomas Merton (1962) has called a "false self." However, Gautama Buddha suggests a Third Way (Merton's "true self"), between the two extremes of self-service and denial, where one lives open to habits of real possibility. Thus, the soul has no "substance" as typically understood in a materialistic (or Aristotelian) way, yet the soul does inform the body—both classically, as the form of the body, and also in an information-theoretic sense. Unlike the one-dimensional information of Shannon's classical information theory (as described in the decisions encoded by a bit string), the soul captures the general regularities of tendencies, enriching the Aristotelian form with emergent possibilities.

## CONCLUSION

Cognitive science and religion provides perspectives on human cognition and spirituality, and this essay has explored perspectives on the apparent mind-brain dichotomy from systems theory in computer science; Peirce's pragmatism in philosophy; and theological anthropology in religion. Rather than disjoint or conflicting perspectives, the tools of each perspective—emergent systems theory, Peirce's three categories and existential graphs,

and soul as form of the body—complement and illuminate each other. Emergent systems theory describes the subatomic, physical, biological, psychological, cultural, and transcendent relationships constituting the human person. Modeling the information in those constitutive relationships using a method such as Peirce's existential graphs can show how the habitual generality of actual constitutive relationships can give rise to possible qualities of emergent properties to constitute higher-level systems. By abstracting from the actual human systems, one can define the human soul as the constellation of constitutive relations that enable real possibility.

## NOTES

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1. One may visualize the levels hierarchically or as concentric circles of inclusion, with the physical as the outermost circle.

2. The hierarchy refers only to humans—and thus for C. S. Peirce would be part of idioscopic science. In other species, such as social insects, social interaction, and thus a "social" level, emerges directly from the biology and any emergent "psychological" characteristics would occur with respect to the ant hill or bee hive.

3. From a pragmatic perspective, the interacting systems at one level give rise to conceivable practical effects that include emergent properties, because of the intelligible nature of reality, even though we may not have predicted them.

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