KNOWERS AND PHENOMENA:
Two Different Approaches to Interdisciplinarity and Interprofessionalism

by

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Abstract: This paper describes two influential but quite different perspectives on disciplinary knowledge and interdisciplinary integration. One conceives of these issues in terms of irreducible differences in the world, among the varying sorts of phenomena studied. The other perspective explains them primarily in terms of sociocultural dynamics within and among the "knowers" (i.e., disciplinary groups) doing the studying. Both perspectives can be productively understood through the lens of complexity science. Unfortunately, interdisciplinary theorists tend to adopt only one of these perspectives and neglect the other. There is thus a need for an integration of perspectives, in order that a more robust theory of interdisciplinarity might emerge. The final section the paper speculates on what such an integrative approach might look like, drawing upon pragmatism, enactivism and several other strands of non-representationist epistemological thinking.

Introduction

I came to the world of interdisciplinary theorizing through an atypical route: The education of interprofessional health-care teams. The study of such teams, their knowledge, and how best to nurture teamwork, is a topic of growing concern in Canadian academic and health-care circles. Current thinking in these circles draws upon some major strands of interdisciplinary

theorizing. As a doctoral student, my desire to question, broaden and deepen this theorizing in the health-care education context pulled me deep into the theoretical literature on interdisciplinarity, including that found in *Issues in Integrative Studies*.

What stands out most in my exploration of this literature is the existence of two very different ways of thinking about disciplinary knowledge and the challenges of integration. One perspective conceives these issues in terms of irreducible differences in "the real world," among the sorts of phenomena studied. The other perspective explains them primarily in terms of sociocultural dynamics within and among the "knowers" (i.e., disciplinary groups) doing the studying. Both perspectives, I believe, can be productively understood through the lens of complexity science.

Unfortunately (at least from an integrative perspective), authors generally tend to adopt only one of these perspectives and neglect the other. There is thus a need for an integration of perspectives, in order that a more robust theory of interdisciplinarity might emerge. In this paper I review each of these positions. In the conclusion, I speculate on what such an integrative approach might look like, drawing upon several strands of non-representationist epistemological thinking. In other words, I attempt to move beyond the view that knowledge consists in the accurate representation of some aspect of objective reality in the mind of a subject.

Definitions

In this paper, I will adhere to a widely accepted definition of *interdisciplinarity*. I will define it as not only *drawing upon* two or more disciplinary perspectives in order to better understand or address a certain issue or problem—mere *multidisciplinary*—but also attempting to *integrate* insights from these perspectives in a way that may lead to the emergence of transcendent perspectives (Klein & Newell, 1998; Augsburg, 2005; Repko, 2008). A few of the authors I will refer to use the term *transdisciplinary* to describe much the same sort of integrative process (although it is worth noting that this term is used differently in other contexts[1]).

The term *interprofessionalism* parallels interdisciplinarity, in the sense that interprofessional activities seek to draw upon and integrate diverse professional perspectives. However, the focus of interprofessionalism is more practical: Better collaboration among professional practitioners (e.g., in health care) rather than the development of new domains of knowledge (D'Amour & Onadasan, 2005). As I implied above, however, many of the

same theoretical issues are at stake, and so I will discuss several contributions from the interprofessional literature.

On the Complexity of Phenomena

One major stream of thinking that I identified in the interdisciplinary and interprofessional literature is often associated with thinkers in the physical and health sciences, as well as some social sciences. It frames disciplinarity and interdisciplinary integration primarily in terms of the various phenomena researchers study—specifically the irreducibility or incommensurability among different sorts of phenomena and consequent need for both disciplinary diversity and some sort of integrative process. In recent years, many thinkers have turned to complexity science as a framework for making sense of the relationships between such phenomena.

In his classic 1972 paper, "More is Different: Broken Symmetry and the Nature of the Hierarchical Structure of Science," Nobel laureate Phillip Anderson writes that no field of science is necessarily more fundamental than another. Disciplines concerned with larger scale phenomena, such as chemistry, molecular biology, and medical sciences, have unique "complications" and new types of behavior that cannot be entirely reduced to particle physics or other rules originating at a more "fundamental" level (Anderson, 1972, p. 396). A similar point can be made in the context of the social sciences. Sociology, for instance, cannot be reduced to the behavior of the individuals, personalities or cognitive processes explored by psychology. Nor are these latter psychological phenomena simply aggregates of the micro-level processes studied by medical and biological sciences.

Within the Association for Integrative Studies and interdisciplinary literature more generally, this perspective is perhaps best articulated by William Newell (2001a). He echoes Anderson's point concerning the irreducibility of discourses concerned with different phenomena, but focuses more on the implications for interdisciplinary integration. He also explicitly invokes complexity science as offering "a comprehensive and long overdue rationale" for interdisciplinary study (p. 6).

Newell (2001a) writes that each discipline focuses on one facet of reality, that is, a set of variables observable from its perspective that are closely and linearly related. For instance, chemistry focuses on the structure and interaction of matter, especially at the atomic and molecular levels, while sociology studies human social behavior and society's institutions and organization. However, most real-world problems or issues are *multifaceted*, incorporating

multiple sets of variables that interact in non-linear ways. Newell himself uses the problem of acid rain, which emerges through the interaction of chemical reactions, biological processes, hydrological cycles, global economic trends, and cultural and political developments (p. 16). Such multifaceted phenomena can be seen, he writes, as complex systems and their relatively simple, linearly-related facets can be seen as component parts (p. 3).

Interdisciplinary research is, therefore, about integrating disciplinary insights concerning various components in order to better identify and make sense of a particular complex system (Newell, 2001a, p. 16). Since a complex system and its behavior cannot, by definition, be reduced to "the-sum-of-its-parts," integration involves more than simply "adding up" disciplinary insights. Integrative theories are judged good, Newell writes, to the extent that they respect both the complex phenomenon under study and the contributing disciplinary perspectives; indeed, researchers will typically "tack" back and forth from disciplinary components to an emerging integrative whole (often an overarching concept, theme, or metaphor) until a satisfactory result is achieved (Newell, 2001a, p. 20).

This approach of focusing on the complexity of the phenomena studied in order to explain disciplinarity and interdisciplinary integration has also appeared in educational literature. In the lead editorial of the 2005 issue of *Complicity: An International Journal of Complexity and Education*, Phelps and Davis suggest that education ought to be understood as a *transphenomenal* enterprise, since even

> something as "simple" as a personal understanding of a physical event [is] likely rooted in biological structure (genetic predisposition), framed by bodily activity (personal experience), elaborated within social interactions (symbolic tools), enabled by cultural tools (societal usages), and part of an ever-unfolding conversation of humans and the biosphere. (p. 2)

Because education involves so many levels of interconnected phenomena, Phelps and Davis (2005) write, researchers studying these phenomena ought to adopt a *transdisciplinary*[2] attitude. To understand personal learning, for example, one might draw productively upon the insights of neurology, psychology, sociology, anthropology, and evolutionary discourses. Furthermore, they argue, complexity thinking offers a means to conceptually bridge such seemingly incompatible disciplinary perspectives. It does so by emphasizing that different sorts or levels of phenomena embody emergent qualities

that transcend their parts and reflect their unique histories; they therefore need to be studied "at the levels of their emergence" (p. 2). Complexity can thus act as an "interdiscourse," negotiating the relationships between disciplinary discourses—while never reducing or conflating them.[3]

The phenomena-focused approach can also be seen in some of the literature on crime and other forms of anti-social and violent behavior. Barak (1998), for instance, has argued that current analyses of crime are fragmented and isolated; what is needed are accounts that integrate the dynamic and interactive processes occurring at multiple interpersonal, institutional, and structural levels. Robinson and Beaver (2009) seek to transcend the disciplinary myopia that characterizes much criminological theory, taking a "cells-to-society" approach that draws upon disciplines as diverse as biology, sociology, psychology, anthropology, and economics. Henry (2009) has made use of these and other theorists to articulate an interdisciplinary understanding of school violence, one that acknowledges the complex, multilevel processes that underlie seemingly isolated events.

A growing portion of the literature on interprofessional health care takes a very similar phenomena-focused approach. Most typically, it takes the form of holistic, multileveled, "cells-to-society" conceptions of health and health care. That is, the health of an individual human being is understood as depending crucially on—and nesting ecologically among—a number of living systems, ranging from the cells and organs within his or her own body, to the social, cultural, and ecological collectives in which he or she participates. Again, complexity science is used by many of these thinkers as a framework for relating—without reducing or conflating—knowledge concerned with these differing sorts of living systems.

Researchers associated with the Plexus Institute (http://plexusinstitute.org), for instance, have produced an enormous amount of research oriented by a multilevel, explicitly complexivist understanding of human health and health-care organizations.[4] A similar sensibility is shown in the work of Bell et al. (2002), associated with the University of Arizona's Program in Integrative Medicine.

> The person is the clinical focus, but the research examines the person as an intact, complex, dynamic system, composed of lower-order systems and existing within higher-order systems. Integrative research includes multiple variables in interaction and emphasizes that evolving context (higher-order systems and dynamics) in which the person as a system functions. This approach permits optimal understanding of the person as a living system within larger systems. (p. 135)

In 2008, the *American Journal of Preventive Medicine* published a special supplement on transdisciplinary[5] team science research ("The Science of Team Science: Assessing the Value of Transdisciplinary Research"). The focus was large-scale collaborative research projects on topics like cancer, diabetes, and addiction that involved a wide variety of disciplines (including pharmacologists, microbiologists, medical doctors, laboratory psychologists, epidemiologists, and so on). As above, the relationships between these disciplines were explained in terms of the varying, health-related phenomena they studied (biological, psychological, sociological, ecological, etc.). For a theoretical framework, most of the authors chose to adopt "socio-ecological" and "systems" perspectives that sought to encompass (but not conflate) these various phenomena. (See, for example, articles in this supplement by Hiatt & Breen, 2008; Mabry et al., 2008; and for an explicitly complexivist account, Leischow et al., 2008).

In sum, there is a well-developed stream of thought in the interdisciplinary and interprofessional literature which seeks to explain disciplinary differences and interdisciplinary integration based on the irreducibility or incommensurability of the phenomena under study. Many of these accounts are either compatible with, or explicitly invoke, complexity science. There is, however, something lacking in this stream of thought, something that becomes clear as one surveys other interdisciplinary literature. What is lacking is the disciplinary (and interdisciplinary) "knowers" themselves. The influence of history, politics, economics, and other sociocultural factors on their knowledge is absent from the picture. This realization takes us to the other major perspective on disciplinary knowledge and interdisciplinary integration.

On Sociocultural Dynamics

The other stream of thought is typically linked to thinkers in the humanities, sociology, social psychology, and some health-care areas. It explains disciplinary boundaries and interdisciplinarity in terms of the sociocultural dynamics among the "knowers" doing the studying, concentrating on issues such as class, gender, history, economic interests, and professional socialization.

Julie Thompson Klein (1986), probably the best known interdisciplinary theorist internationally, explains disciplinarity and interdisciplinarity almost entirely in terms of the dynamic tensions that arise within and among disciplines as they co-evolve, often splitting, joining, or giving birth to new "hybrid" disciplines such as "immunopharmacology" (p. 86). Backing up her ideas with innumerable examples from interdisciplinary research in a

wide variety of fields, she demonstrates how issues of discourse, power, status, history, and context continually shape both disciplinary and interdisciplinary knowers and knowledge. Of particular interest to Klein (1986) are the often-unexamined metaphors that structure interdisciplinary thinking. Two prominent metaphors in the past have been architecture (e.g., "building bridges between disciplines"), and geopolitics (e.g., "fields," "domains," and "turf wars") (p. 91). More recently, she describes how organic and network-oriented metaphors—such as "fractals," jungles," "cross-fertilization," "systems," and "complexity"—have begun to predominate (Klein, 2004, 3).

What is most striking about Klein's sophisticated accounts is that she makes virtually no reference to the world or phenomena themselves. That is, the world seems not to have any sort of structure or integrity beyond how it is construed by human beings. "Life," she writes, "is a neutral assortment of phenomena that are ordered through human thought and action" (Klein, 1996, p. 12).

This focus on sociocultural dynamics is also manifested in literature on professionalism and interprofessionalism. In *The System of Professions: An Essay on the Division of Expert Labor*, sociologist Andrew Abbott (1988) argues that the modern professions constitute an interdependent system. To understand them, one should look less at specific professions in isolation and more at the dynamic interactions that go on among them. His characterization of professionalism is almost ecological: One must attend to competition and cooperation both *within* professional bodies (between, for example, various sub-specialties) and *among* professions, as well as to the influence of external forces like changes in laws and the marketplace (p. 143). The power of a profession, in Abbott's account, is equated with its ability to defend and expand its jurisdiction (i.e., turf) in the face of various systemic forces (p. 136).

In the context of interprofessional health-care teams, Beattie (1995) uses the anthropological metaphor of tribes to analyze health profession boundaries, arguing that each profession has its own explanatory framework or "cultural bias" (p. 20). Each of these professional frameworks finds its justification through differing sets of interests, relationships, and social and institutional values (p. 20). That professional differences might result from something other than these sociocultural dynamics—say, because of differences in the phenomena with which health professionals engage (cells, organs, whole person, and so on)—is not addressed.

Hall (2005) writes that, due to their education and socialization, profes-

sions develop differing "cognitive maps"; as a result, they can look at the same information and yet see very different things. According to Hall, these differences arise as a result of social and political tensions. Based on the work of several well-known social theorists, including Ivan Illich, she describes how professional expertise has long been used as an ideological tool for power and control; for instance, one profession may seek to heighten the contrast between itself and other rival professions in order to expand its authority. Given this focus on sociocultural factors, it is not surprising that Hall's (2005) suggestions for fostering effective interprofessional teamwork center on issues such as communication (team members making their cognitive maps and values clear to one another) and power (fostering equal status among team members) (pp. 190-192).

From the illustrations provided above, then, it should be apparent that literature oriented towards the sociocultural dynamics of disciplinary and interdisciplinary "knowers" (as well as professional and interprofessional "knowers") has its own rich tradition of thought. As with the previous stream of thought, however, one gets the sense that something is missing. A persuasive story concerning disciplinary knowledge and interdisciplinary integration is offered strictly within the bounds of human knowing and culture; the "more-than-human" world that many disciplinarians and interdisciplinarians (e.g., those working in the natural and health sciences) arguably engage with is little more than an inert and neutral background.

Before turning to the issue of how to reconcile, or at least negotiate between, the phenomenon-focused and the knower-focused perspectives, I would like to address one issue: A reader might assume that the sociocultural, knower-focused perspective conflicts with complexity science. In fact, it is quite compatible with complexity—at least how it has been developed by complexivist educators such as Doll (1993) and Davis and Sumara (2006), who are concerned with the phenomenon of learning and knowing.

As described above, complexity science is concerned with living, learning systems at multiple levels—from cells and organs, to persons, social groups, societies and the biosphere. Complex systems at each of these levels are characterized by similar processes of self-organization and adaptation—that is systems adapt to their changing environments, but in ways that are determined by their own emerging structure rather than direct external causation (Capra, 2002, p. 35). From the perspective of educators and others concerned with cognition, these processes can be understood as *learning* processes (Davis & Sumara, 2006). Learning in this case is understood in terms of local coherence or fit, rather than representation or correspondence

with an "objective" reality—a point that will be revisited in the final section of this paper (Davis, Sumara & Luce-Kapler, 2008, p. 99).

At the level of the individual, constructivists such as Piaget and Von Glassersfeld have articulated these processes of self-organization and adaptation; individuals reorganize the structure of their beliefs as they adapt to new experiences (Doll, 1993; Proulx, 2006). At the level of social collectives, social constructivists and constructionists have observed similar "learning" processes (Davis, Sumara & Luce-Kapler, 2008, pp. 102-105). For instance, activity theorists assert that how a social collective responds to external influences is always governed by its own internal dynamics and contradictions (*Cultural Historical Activity Theory*, 2004, para 8).

From a complexivist perspective, then, the sort of sociocultural dynamics described by interdisciplinary theorists—the competition, cooperation, power games and other tensions both within and between collective disciplinary and interdisciplinary "knowers"—can be seen as particular instances of the emergent, self-organizing and adaptive behavior of complex systems (Davis, Sumara & Luce-Kapler, 2008, pp. 102-105; McMurtry, 2006).

Complexity science can, therefore, help to frame not only the phenomena "known" or studied by disciplines, but also the disciplinary "knowers" doing the studying. In line with sociocultural perspective, the complexivist thinkers I have referenced emphasize that knowledge is never simply a matter of objectively representing an external world. Rather, knowledge, or knowing, is always a construction based on knowers' own personal, social, and cultural history.

Whether or not framing in complexivist terms helps enhance the sociocultural perspectives is, of course, another matter. One thing complexity can be said to add to these perspectives, I believe, is a conceptual bridge to (non-mechanistic) physical and biological perspectives on learning that are typically ignored by sociocultural theorists. These include Lakoff and Johnson's (1999) assertion that even our most abstract concepts are ultimately rooted in and dependent upon our physical embodiment, as well as Maturana and Varela's (1992) enactivist view of the biological roots of human understanding (sometimes called the "Santiago theory of cognition").

Two Solitudes or Complementary Perspectives?

The preceding sections show that there are two important, but quite different, stories being told about the nature of disciplinarity and interdisciplinar-

ity. One story emphasizes the complexity of the phenomena "known," engaging them as something "real," with an objective existence and structure that is not simply a function of "knowers'" constructions. The other story focuses on the sociocultural dynamics within and among the various "knowers." Unfortunately, these two perspectives largely ignore one another's existence. That is, thinkers in each strand generally fail to engage with the sort of complexity described by the other.

A few of the more sophisticated thinkers do offer some acknowledgment to the other side. Among those who emphasize the complexity of phenomena, Newell admits a role for sociocultural factors in shaping knowledge; he is certainly no naïve realist. But he only really brings up this point in reply to sociocultural-oriented critics who deny any sort of interface between human knowledge and reality:

> I am increasingly frustrated by either/or ontological thinking that presumes we either have full, direct access to reality or no knowledge of reality at all. As interdisciplinarians, we need to get past such dichotomies. (Newell, 2001b, p. 141)[6]

Unfortunately, he appears not to pursue these ideas, and what might lie beyond this dichotomy, any further.

Among those who concentrate on the complexity knowers and sociocultural dynamics, Klein (2004), in a more recent paper, mentions reality as a "nexus of interrelated phenomena that are not reducible to a single dimension" (p. 4). The structure of the more-than-human world, however, plays very little role in her actual theorizing. Abbott (1988) goes into a little more detail. He recognizes that the human problems that structure professional tasks, identifications and boundaries may have at least some "objective" aspects. These objective aspects range from the technological and organizational—which seem merely to be relatively slow-changing human constructions—to "natural objects and facts" (p. 39). Abbott treats all three as "fixed" in comparison to faster moving cultural developments (pp. 38-39). However, his discussion of such objective factors is quite brief and his depiction of the more-than-human world is homogenous and simplistic in comparison to the phenomena-focused, complexivist thinkers described above.[7]

Each of the perspectives I have described—the phenomena-focused and the socioculturally-oriented knower-focused—therefore tends to give the impression that it alone is telling "the whole story" and that the other perspective, if acknowledged at all, is of marginal or background importance.

There is little productive intercourse between the streams; no one, it seems, wants to engage with both sorts of complexity.

On a practical level, this polarization of perspectives leads to frustration on the part of researchers and practitioners working in interdisciplinary and interprofessional contexts. I have met many natural scientists who attend diligently to the phenomena they study and "get their backs up" when told that knowledge is just a social construction. Similarly, those with a background in the social sciences get understandably frustrated when told that knowledge is simply a reflection of "the way the world is."

Not surprisingly, given how I have framed these issues, I believe that a robust and generative understanding of interdisciplinarity (and interprofessionalism) should acknowledge both strands: that they exist, that they are different, and that each offers valuable insights. Furthermore, I think that interdisciplinary theorists need to start thinking about integrating these perspectives—that is, about the relationship between these perspectives and what it means for conceptions of disciplinary and interdisciplinary (as well as professional and interprofessional) knowledge.

Towards More Integrated, Complex Understandings of Disciplinary and Interdisciplinary Knowledge

There is thus a need for conceptions of disciplinary and interdisciplinary knowledge that integrate these perspectives and avoid the extremes of both naïve realism and naïve social constructivist relativism—views that, as Phelps and Davis (2005) write, refuse to "collapse phenomena with knowledge of phenomena. These are inextricably entangled, but not coterminous" (p. 3). Where might we find such views?

I do not have the space to present such views in a comprehensive form in this paper. However, I would like to make two suggestions, which I believe may help lead us to a more productive and integrated epistemology of interdisciplinarity.

The first suggestion is to dispense with representationist, or correspondence, views of knowledge; that is, the notion that knowledge consists in the accurate representation of some aspect of objective reality in the mind of a subject. It is a notion that is deeply entrenched in Western culture and underpins most traditional scientific research. However, it is also an epistemological trap, since it implies that there is only one truth and that this truth can only be achieved by eliminating the subjectivity of the knower—something that has been thoroughly and convincingly critiqued by structuralist and

poststructuralist thought; we cannot access the world—as it is, in itself—apart from our own personal history, language and cultural context (Belsey, 2002). Moreover, the trend in cognitive science and educational philosophy is away from representational epistemologies, towards understandings of knowledge as distributed, relational, and emergent (Osberg, Biesta & Cilliers, 2008; Star, 2005, p. 168).

The second suggestion is to explore alternative, non-representationist epistemologies. From radical constructivism and pragmatism, for example, one might take the idea of knowledge as something that fits local and temporary exigencies or constraints faced by the knower, rather than a reflection—however imperfect—of some ultimate, unchanging truth (Proulx, 2006; Biesta & Burbules, 2003). From the literature on situated learning and distributed cognition, one might draw upon descriptions of how knowledge is embodied not only "in heads" but in networks of human and non-human activities (Lave & Wenger, 1991; Pea, 1993).

Perhaps most promising are perspectives on how knowledge is enacted in dynamic and evolving couplings between knowers and the more-than-human world—rather than something isolatable in *either* the knowers *or* the world. Such perspectives feature prominently in the following accounts:

> 1) Dewey's theory of transactional realism, which takes as its starting point not traditional Western philosophy's assumed separation of mind and world, but rather the ongoing lived experience of human organisms in their environments. Knowledge, from this perspective, is never simply a human construction or an objective representation of the "real" world; instead, it is located in the *transactions* between the knower and the world (Biesta & Burbules, 2003).
> 2) The phenomenology of Merleau-Ponty (1962), which depicts perception not as passive "mental" observation, but rather as active and embodied engagement with the rest of the world. Meaning, he asserts, emerges through these mutually-affective interactions; it cannot be isolated in either the knower or the world.
> 3) Maturana and Varela's (1992) ecologically-rooted theory of enactivism. These theorists understand cognition in terms of the ongoing processes of mutual adaptation among knowers and their environments. Knowledge is not something "stored" within a knower; rather, it is *enacted* in effective interactions between knowers and their worlds.

Indeed, from these perspectives, knowledge might be more accurately termed *knowing*, since it is embodied in actions and relationships and is not considered a static or isolatable thing.

Complexity theorists Osberg, Biesta and Cilliers (2008) offer one further useful insight: A *temporal* alternative to representationism's *spatial* epistemology. They argue that knowledge should not be framed in terms of correspondence between an independent world and what is "in one's head"; rather, it should be understood in terms of the relationship between one's actions and their consequences (p. 221).

These same theorists offer a helpful summary of the more integrated, sophisticated perspective towards knowledge that I am advocating in this concluding section:

> [M]odels and theories that reduce the world to a system of rules or laws cannot be understood as pure representations of a universe that exists independently, but should rather be understood as valuable but provisional and temporary tools by means of which we constantly renegotiate our understanding of and being in the world. (p. 218)

> There is no final truth of the matter, only increasingly diverse ways of interacting in a world that is becoming increasingly complex. (p. 223)

Together, these ideas may point to a more useful and sophisticated way of thinking about disciplinary knowledge and interdisciplinary integration—one that recognizes and engages with the complexity of both knowers and the world.

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Notes

[1] See Newell, AIS Listserve communication, April 13, 2008; *Wikipedia*, 2008, http://en.wikipedia.org/wiki/Transdisciplinarity.

[2] Although Phelps and Davis (2005) use the term "transdisciplinary" rather than "interdisciplinary," their definition of this term is compatible with the definition of interdisciplinary given at the beginning of this article.

[3] It is worth noting that Phelps and Davis's linkage of interdisciplinarity with complexity differs somewhat from the linkage offered by Newell—specifically with respect to how they account for the phenomena studied by individual disciplines. Newell (2001a) sees individual disciplines as concerned with relatively simple components ("variables that are closely and linearly related"); as we saw above, complex systems that incorporate multiple differing components are the proper domain of interdisciplinary enquiry.

By contrast, Phelps and Davis (2005) view even individual disciplines as being concerned with complex systems—each one focused on a differing sort or level of complex system. These differing systems or levels are depicted as being organized in a multilevel or "nested" ecological structure. The job of interdisciplinary (or transdisciplinarity) research, therefore, is to reach across these various complex systems and negotiate among the disciplinary perspectives associated with them.

[4.] Everything from the organs and individuals to health-care organizations have been modeled by Plexus researchers as complex systems "characterized by self-organization, emergent phenomena, order and disorder, nonlinearity, far-from equilibrium conditions, and unpredictable outcomes" (http://www.plexusinstitute.org/complexity/index.cfm?id=9)

[5] Although the authors favor the term "transdisciplinary," their definition of this term—as the development of conceptual and methodological frameworks that not only integrate but transcend their respective disciplinary perspectives—is quite compatible with the definition of interdisciplinary given at the beginning of this article.

[6] Davis and Phelps (2005) make a similar plea for more balanced perspectives, arguing that that human knowing and phenomena in the more-than-human world are "inextricably entangled, but not coterminous" (p. 3).

[7] Interestingly, a parallel discussion about the interface between more-than-human "reality" and social constructions has taken place in the sociological literature. Henry (2007) distinguishes accounts offered by 1) strong social constructionists, who assert that all knowledge is socially constructed and see no need to reference anything outside of such constructions, and 2) weak constructivists, who acknowledge the existence and influence of an underlying objective reality that exceeds—or is not entirely reducible to—human knowledge construction.

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