# How Conceptually Unified Is the Dynamic Systems Approach to the Study of Psychological Development?

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ABSTRACT— *A core theme of this special issue on the past, present, and future contributions of the dynamic systems (DS) approach is its potential to unify developmental psychology by resolving false dichotomies and embracing the rich complexity inherent in development. This commentary raises some questions about the underlying ontological unity of the DS approach as applied to developmental psychology, a unity that many of its proponents take for granted. Specifically, the focus is on the nature of process and the means by which dichotomies are resolved in this approach to illustrate the contention that a fundamental ontological divide remains. Future substantive progress in the DS approach critically depends on resolution of this ontological divide.*

KEYWORDS— *dynamic systems; process; dichotomies; conceptualization; ontology*

For the last 30 years, the field of developmental psychology has struggled both to embrace the rich variability and complexity inherent in development and to embed this variability and complexity within a systematic, organizational framework. Concerns about the need to account for variability in all its manifestations have resulted in a field punctuated by numerous, domain-specific "mini-theories" but bereft of an overarching approach to unify all of these variants (Fischer & Bidell, 1998; Witherington, 2007). The dynamic systems (DS) approach may well be on the verge of doing precisely this. At this critical juncture in our field, it is imperative to self-reflect and evaluate, exactly what Tom Hollen-stein (2011) has done in coordinating this special issue involving appraisals of the DS approach from four of its most preeminent scholars. We welcome the opportunity to comment on Fogel's (2011), Lewis's (2011), Spencer, Perone, and Buss's (2011), and van Geert's (2011) critical evaluations of and reflections on DS's past, present, and future—on the theoretical and empirical foundations it has laid for the future direction of our field.

All four contributors agree that the DS approach holds tremendous promise as a unifying framework for developmental psychology. This framework serves to integrate previously fragmented phenomena, levels of analysis, and competing conceptualizations of development across a wide variety of content domains, from classic instantiations in the field of motor development to more recent work in the areas of cognition, language, and socioemotional processes. From a reconciliation of micro-level flux and macro-level pattern, of real-time and developmental-time scales, of organizational stability and reorganizational change, of quantitative processes and qualitative transformations, a key contribution of the DS approach is to bridge dichotomies. All four of the contributions also agree on the constructs foundational to the approach: emergence, self-organization, and nonlinearity. Together, these constructs thematically organize the DS approach around the spontaneous emergence of patterns in systems, absent rules or prescriptions, through multicausal processes. In effect, the components of a system give rise to qualitatively distinct, dynamically stable—as opposed to static—forms that are irreducible to yet utterly dependant on the very components that gave rise to them.

Complementing these conceptual advances are new advances in the methodologies and tools with which we examine developmental phenomena. The DS approach reorients the field to the nature of process itself and to the need for studying the process of change as it unfolds in real time, via microgenetic analyses beautifully illustrated in Fogel's (2011) contribution. As such, DS methodologies emphasize smaller *n*, intensive observation studies that yield both group data and unique individual trajectory data. The DS approach provides mathematical instantiation,

in the form of differential/difference equations and modeling techniques, of its overarching principles and has yielded an ever-increasing array of new methodological paradigms for studying developmental process, such as Lewis's state space grid approach. All four contributions in this special issue agree that DS's empirical efforts are still in their infancy and require continued elaboration. Yet, as Spencer et al. (2011) note, the list of DS's empirical contributions is already substantial and influential. The key to DS's future success seems to rest in increased methodological rigor in the application of its ideas on the one hand and more effective dissemination of both its unifying principles and its methodological tools on the other, in the hope that such dissemination will eventually precipitate a fieldwide paradigm shift in our approach to the study of development.

All four critical evaluations differ somewhat in their appraisal of DS's empirical success: van Geert (2011) and Lewis (2011), for example, are much more circumspect about its progress than are Spencer et al. (2011), who cast a far more promising light on DS's empirical base. Such disagreements are more exception than rule; DS's top scholars largely agree on the nature of DS's past contributions and the direction of its future endeavors, with work in developmental neuroscience considered especially likely to bear fruit. Yet, as Lewis cogently points out, "conceptual rifts" persist across different perspectives within the DS approach, to which van Geert alludes as well. Lewis highlights the work of the Dutch masters (e.g., Molenaar & Raijmakers, 2000; van der Maas & Molenaar, 1992; van der Maas & Raijmakers, 2009; van Geert & Steenbeck, 2005) as illustrative of the strong degree of correspondence that exists between DS and Piagetian principles. Spencer et al.'s critical evaluation, in contrast, draws a strict conceptual divide between Piaget and the DS approach, arguing that Piaget's framework, like those of nativism and cognitive/information processing, has been supplanted by the "systems metatheory" and should be left behind because it is fundamentally incompatible with DS. This echoes what Thelen and Smith (1994, 2006) have long argued: Piaget's overall approach to development is at odds with the approach that DS articulates. Instead, Spencer et al.—like Thelen and Smith (1994, 2006) and many of DS's progenitors in the study of motor skill coordination (e.g., Turvey, Shaw, & Mace, 1978)—stress the conceptual alliance of DS with the Gibsonian ecological approach. Thus, the rift Lewis points to—between those who want to "dethrone" Piaget and those who see him as one of their own—raises critical questions about the ontological unity of the DS approach (Witherington, 2007). Such a rift, in fact, cuts to the heart of DS, as it bears directly on the very conceptualization of developmental process frequently touted as a central, unifying focus of the approach (Spencer, Dineva, & Schoner, 2009).

## PROCESS

With which approach—Piagetian or Gibsonian—does DS align? Or is it ontologically compatible with both? From a Gibsonian vantage point, development, whether in the form of perceptual learning or of affordance development, fundamentally involves a process of discovery. The environment is meaningfully structured and offers information available for "pick up" (Gibson, 1979; Gibson, 1982). This information is "discovered," "revealed," and "uncovered" developmentally by the organism through its ever-expanding exploratory activities, which allow it to detect new properties of the world and to extract more and more invariant groupings as well as more differentiated, specified information (Adolph, Eppler, & Gibson, 1993; Gibson, 1982; Gibson & Pick, 2000). Note that the "new" information detected is new only to the perceiving organism; it constitutes objective properties of the world and hence preexists an organism's interaction with it (Gibson & Pick, 2000; Varela, Thompson, & Rosch, 1991).

In contrast, from a Piagetian vantage point, development fundamentally involves a process of construction. The organism must construct its own reality by actively structuring and transforming the world, a process whereby the world and the organism structure one another, with the "world as known"—or knowledge—being a truly emergent product of this continual interplay rather than a discovery of a preexisting reservoir of inherently meaningful information (Furth, 1969; Piaget, 1952, 1954; Reese & Overton, 1970). From the Piagetian perspective, meaning must be actively constructed and does not inhere in the world, contrary to the realist assumptive base of the Gibsonian perspective (Varela et al., 1991). The world becomes meaningful, an object of knowledge, only in the context of an organism actively structuring it—assimilating it—and in turn actively accommodating to it (Furth, 1969).

Both of these process accounts are relational in that organism–environment relations occupy the heart of developmental process, as does the activity of the organism. But the constructivist position of the Piagetian approach carries with it fundamentally different ontological assumptions than does the realist, "discovery" stance of the Gibsonian approach. For the Gibsonian, an organism's activity is in the service of discovery of a previously existing world, in contrast to the Piagetian, for whom an organism's activity is in the service of the actual construction of a "lived world" (Varela et al., 1991), a known reality that cannot exist independent of the knower. Spencer et al. (2011), in endorsing Gibson's theoretical perspective while decrying Piaget's, have set their version of DS on ontologically different footing than those DS proponents, like Lewis (2011), who argue for compatibility between Piaget and DS. And the nature of this metatheoretical divide, we argue (see also Witherington, 2007), cuts even more deeply than simply a division between Piagetian and Gibsonian camps. DS proponents who both endorse a Gibsonian framework and actively reject a Piagetian one promulgate an exclusionist, either/or framework for DS. In contrast, DS proponents who support compatibility with the Piagetian framework seem to view the DS approach as an inclusive framework within which both Piagetian and Gibsonian perspectives represent just that—alternative but equally legitimate perspectives that represent different poles of the DS approach, which serves as

a higher order, relational metatheory (Overton, 1994). This conceptual rift, in other words, targets the very nature of how dichotomies are bridged (Witherington & Margett, 2009).

## BRIDGING

Just as there are different ways to construe the nature of developmental process within the DS approach, so there are differences in the very handling of the dichotomies that have historically plagued developmental psychology. For all four evaluations in this special section, a core contribution of the DS approach is the bridging of falsely dichotomous gaps in developmental psychology, such as the gap between micro and macro levels of analysis or that between real-time and developmental-time phenomena. But there is more than one way to bridge developmental psychology's gaps, and it is evident that DS proponents are not necessarily uniform in their method of bridging. One can bridge these gaps via synthesis, in which the dichotomous components defining the gap are unified at a higher level of abstraction (van Geert & Fischer, 2009). Alternatively, one can bridge gaps by privileging one member of the binary pair and repudiating the legitimacy of its counterpart. These two potential approaches to bridging mirror, respectively, the relational and split metatheories that Overton (2006, 2010) has delineated, and both approaches are at work, according to Witherington (2007), in the DS ontological framework.

In looking to the future of the DS approach, Spencer et al. (2011) astutely identify the need to integrate our understanding of dynamic processes across multiple levels of system and temporal organization. Yet the nature of this integration will depend on the very conceptualization of different levels of analysis and time scale, which in turn depends on how one bridges the gap. For Thelen and Smith (1994, 2006), the real-time level of specific action-in-context assumes privileged status over developmental time, because developmental time is simply a "history of past here and nows" (Thelen & Smith, 1994, p. 216), an "accrual of real-time events" (p. 244). By their DS account, developmental change becomes a quantitative accumulation of real-time change, a succession of task-specific adaptations. Such a conceptualization contrasts sharply with a view of developmental time as truly emergent from—and hence irreducible to—the real-time level of temporal organization, a view that Fischer and Bidell (2006) offer in asserting that developmental time

> is not simply an atomistic heap of many microdevelopmental processes but the cumulative process in which all the microprocesses participate. . . . [A]t the microdevelopmental level of analysis, we find phenomena that do not appear at the macrolevel, and vice versa. (p. 363)

Accepting the irreducibility of developmental time in turn establishes the basis for an ontological commitment to reciprocal structure–function relations in the form of circular causality, whereby macro-level developmental patterning constrains the very micro-level dynamics that give rise to it (see Witherington, 2011, for a discussion of the central role circular causality needs to play in the DS approach).

Illustrating the dynamic field approach, Spencer et al. (2011) ground infants' A-not-B task performance in terms of infants' general reaching and memory skills, their particular history of reaching to and looking at A, issues related to the task space itself, and the timing of infant reaching relative to the object's hiding. Through this grounding, the dynamic field approach captures the particulars of infant in-the-moment behaviors embedded within a real-time, task-specific context. Absent from this approach, however, is the organizational embedding of infant here and now, A-not-B behavior in a developmental sequence of prior and subsequent organizational forms. This is precisely what Piaget did by viewing the A-not-B error in the context of infants' progressive objectification of the world and differentiation of self from world, extending from infants' early tracking efforts under conditions of object occlusion to later manual search efforts under invisible displacement. Instead of embedding the particularities of infant action in a task-specific context, Piaget's explanatory framework captures the context-general, organizational stance of the infant toward its world during a given period of development. In effect, Piaget's focus captures "the person in his characteristic multitude of contexts," as van Geert and Fischer (2009, p. 327) write, embedded within a developmental sequence of transformation in these organizational stances.

Rather than viewing these as complementary frameworks, proponents of the dynamic field approach soundly reject the Piagetian explanatory framework for its formal causal stance, assigning instead ontological exclusivity to the here-and-now assembly of action in context. Such privileging of the local-to-global direction of process effectively repudiates the global-to-local direction of process captured by the "downward causation" loop of circular causality. According to dynamic field proponents, macro-level phenomena like developmental time or higher order systems such as reflective judgment are little more than epiphenomenal byproducts of real-time process, as the unidirectional march from real time to developmental time of Spencer et al.'s (2011) Figure 1 attests. Yet, as van Geert (2011) points out, any complex DS has dual identity (the Janus principle of systems thinking). Every system both is a higher-order system comprising lower order, interacting components and itself constitutes a lower order component among other interacting components of a higher order system. Thus, *any* level of analysis—from systems within the organism, to the organism as a system in itself, to systems at the level of organism in context—is an ontologically viable level of analysis for the DS approach, just as various levels of organizational abstraction, from lower order concrete acts to higher order concepts and representations, are ontologically "real" (van Geert & Fischer, 2009). As van Geert highlights in this special section, his DS approach embraces numerous levels of abstraction in

structure and function, considering as equally "serious candidates" both the neurologically grounded mechanisms of dynamic field theory and the "higher-order or macroscopically defined mechanisms" (van Geert, 2011, p. 276) of Piaget, Vygotsky, and others. Along these same lines, Lewis (e.g., Lewis, 2000b; Lewis & Ferrari, 2001) has gone to great lengths to include multiple levels of analysis and multiple processes and organizational frameworks in his writings on DS, consistent with Overton's (2006) relational metatheoretical approach. Furthermore, Fogel, King, and Shanker's (2008) edited volume *Human Development in the Twenty-First Century: Visionary Ideas From Systems Scientists* amply demonstrates how easy it is to implement the DS approach, at least metaphorically, at all levels of organizational analysis and abstraction, from hermeneutic to strictly operational frameworks.

## CLARITY

All of this suggests that beneath the veil of purported unification lies a foundational conceptual divide in the metatheoretical framework DS espouses, a divide that most DS proponents continue to either ignore or undervalue. Yet this divide threatens the very coherence of the DS's explanatory framework. An immediate goal for DS proponents, at a minimum, should be a more extended, explicit, and systematic assessment of the conceptual rifts Lewis (2011) reminds us of in his evaluation. Rather than focusing on disseminating an already unified conceptual framework, DS proponents need to continue their efforts at promoting the very unity—in the form of conceptual cohesiveness and internal consistency—they claim exists. Disagreement even emerges among DS proponents as to what exactly the DS approach is. Is it a new metatheoretical framework for developmental psychology (Spencer et al., 2006; Spencer et al., 2009)? Or is it simply a mathematical realization of von Bertalanffy's (1968) general systems theory, the influence of which has been well established in developmental psychology for decades (Beek, Hopkins, & Molenaar, 1993; Oakes, Newcombe, & Plumert, 2009; van der Maas & Hopkins, 1998)? Or is the DS approach a "theory-free" set of tools for investigating phenomena from disparate theoretical and potentially metatheoretical vantage points, as van der Maas and Raijmakers (2009) suggest? Do these DS tools empirically instantiate classic, theoretically postulated developmental processes (such as those associated with Vygotsky, Piaget, and others), or do they reflect conceptual advances in the nature of the processes themselves?

Among its proponents, fundamental differences still exist in the very definition of the DS approach. Clearly, DS means different things to different people, but in the absence of even basic agreement over whether DS constitutes methatheory or merely "theory-free" instrumentation, little empirical progress is possible, for the nature of the approach constrains its application and the interpretations attached to its "products." If the DS approach is a metatheory, there needs to be consensus at the metatheoretical level so that the theories—such as Spencer's dynamic field theory and Fogel et al.'s (1992) social process theory—that derive from it can be adequately compared. If fundamental disagreement at the "meta" level exists for the DS approach, then any comparison of specific DS theories makes no sense because those theories could well be operating under different truth criteria and consequently could not be adequately evaluated at a purely empirical level (Kuhn, 1962; Pepper, 1942). Lack of critical appraisal at the level of fundamental metatheoretical issues precludes the admirable future goals of making the DS approach more accessible both conceptually and empirically. Until greater unification emerges as to the nature of the approach itself, there is no way to establish whether disagreements among DS proponents are matters for empirical resolution or of fundamental conceptual divide.

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