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CHAPTER 1

Life-Span Development
Concepts and Issues

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LIFE-SPAN DEVELOPMENT: CONCEPTS AND ISSUES

A *Handbook of Life-Span Development* would seem to merit some serious discussion of the meaning of life-span development. *Life-span development* is a phrase that has been a prominent feature of developmental psychology and developmental science since the early 1970s, but few attempts have been made to conceptually clarify its core meaning(s). One could, of course, take the classic empiricist approach and argue that the work of conceptual clarification is quite meaningless—perhaps producing more heat than light—and the phrase is sufficiently defined operationally by the chapters that the reader encounters in the two volumes of this handbook, together with all other volumes of text that in the past have included the phrase *life-span development.* The advantage of this radically empirical and radically pragmatic approach—life-span development is what life-span developmental researchers do—is that it allows us to glide over possible fissures and tensions that might be present in the study of development across the life span, thus offering the broadest of possible umbrellas under which research fortuitously might flourish. On the other hand, such an approach seems somewhat akin to

I express my appreciation to all of the authors in this volume for their tireless work and creative efforts and for their putting up with my obsessions as an editor, but most of all for teaching me so much about life-span development. I send a special note of appreciation to those who entered into a conversation with me about the shape and breadth of life-span development, and those who helped through editorial suggestions and feedback on this introductory chapter, including Ellen Bialystok, Fergus Craik, Jeremy Carpendale, Rich Lerner, Leah Light, Ulrich Müller, John Nesselroade, K Warner Schaie, and Hayne Reese. I must also single out two people for an additional acknowledgment: first, to Rich Lerner, for his constant and unwavering friendship and support over many years, for inviting me to edit this volume, and for his help in numerous ways throughout the process; and second, to Hayne Reese, for his friendship and support over even more years, as well as for being the person who introduced me to life-span development by inviting me to write a paper with him for the very first Life-Span Development Conference at West Virginia University in 1969. That paper—our first of many dialectical collaborations—later became a chapter in the first volume of the life-span development series: Reese, H. W., & Overton, W. F. (1970). Models of development and theories of development. In L. R. Goulet & P. B. Baltes (Eds.), *Life-span developmental psychology: Research and theory* (pp. 115–145). New York: Academic Press. How different my life would have been had we never met.

dropping a group of people into a dark forest and telling them to walk out. If they did enough walking, they might succeed, but they also might forever walk in circles. Some kind of additional directions would be helpful.

This chapter focuses on conceptual clarifications—providing some direction—designed to avoid confusion and facilitate progress toward the goal of enhancing our knowledge and understanding of "life-span development." It is recognized that the directions suggested here may have to be supplemented by finer details, and also that there may be other successful paths. However, the chapter is partially designed to undercut philosopher Ludwig Wittgenstein's acerbic remark when he maintained that "in psychology there are empirical methods and conceptual confusions" (1958, p. xiv), and partially it is designed in acknowledgment of Robert Hogan's comment that "all the empiricism in the world can't salvage a bad idea" (2001, p. 27); but most broadly, it is designed in the hopes of producing more light than heat and providing at least some suggestions for pathways in moving forward in the field of *life-span development*.

The second section of the chapter, The Concept of Development, explores various meanings of the general concept of "development." These meanings have, at times, been taken as competing alternatives, and here a proposal is made that formulates a more inclusive integrative understanding of the area that defines the core of life-span development. Because formulating an integrative understanding requires the application of some principles of integration, the following section, Relational Metatheory, presents "relationism" as a broad-principled method designed to achieve this goal. As a set of principles, relationism is also used to explore other concepts that are central to a life-span approach to development. It will become obvious early in the chapter that "system" plays a central role in the definition and exploration of development. The third section of the chapter, Relational Developmental Systems, discusses "system" and system approaches to the study of development. In this section, various system concepts, such as "closed and open systems," "complex systems," "adaptive systems," and especially "relational developmental systems," are examined. In turn, the notion of relational developmental systems operates as the grounding for the fourth and final substantive section of the chapter, Age, Life-Span Development, and Aging, which focuses on the "life-span" nature of life-span development. In this section, considerations of "adult development," "age," "aging," "time," "description," and "processes" establish the context for a relational (see Relational Metatheory), developmental (see Concept of Development), systems (see Relational Developmental Systems) proposal that integrates life-span development, adult development, and aging within a single-process, dual-trajectory understanding of *life-span development*.

In entering this conceptual arena of inquiry, a few introductory words are needed concerning a distinction that will be central to the exploration of life-span development. This is the distinction between metatheory, theory, and methods. In the heydays of neopositivism, or radical empiricism, theory and method lost their status as two distinguishable but interdependent spheres of science, and in radical empiricism's insistence on monistic materialist solutions, theory became squeezed down into method. A consequence, which has lasted even into the present, is that "theory" came often to designate merely the empirical interrelations among the various antecedent variables associated with outcome or dependent variables. So, for example, when asked about a theory or model of aggression, one could, and often still can, point to a structural equation diagram and show—with lines, arrows, and circles—the correlations and weightings among associated variables and aggression outcomes. Today in a postpositivist scientific world, these concepts of theory and method again need to be differentiated: theory constitutes the distinguishable means of conceptual exploration in any designated area of enquiry; methods are the distinguishable means of observational exploration of that area; and they are differentiated and relationally joined spheres that are necessary coactors in scientific enquiry. To paraphrase Immanuel Kant, theories without methods are empty speculations; methods without theories are meaningless data. This brings us to the notion of "metatheory."

With the emergence of postpositivist science developed in the works of Steven Toulmin (1953), N. R. Hanson (1958), Thomas Kuhn (1962), Imre Lakatos (1978), and Larry Laudan (1977), among others, it became clear that any viable scientific research program entails a set of core assumptions that frame and contextualize both theory and methods. These core, often implicit, assumptions have come to be called *metatheoretical,* and their primary function is to provide a rich source of concepts out of which theories and methods emerge. Metatheories transcend (i.e., "meta") theories and methods in the sense that they define the context in which theoretical concepts and specific methods are constructed. A *metatheory* is a set of interlocking rules, principles, or stories (narrative) that *both describes and prescribes* what is acceptable and unacceptable as theoretical concepts and as methodological

procedures. For example, one metatheory may prescribe that no "mental" concepts (e.g., "mind") may enter theory, and that all change must be understood as strictly additive (i.e., no emergence, no gaps, strict continuity), and hence will be measured by additive statistical techniques. This is a description of some features of early behaviorism. Another metatheory may prescribe that mind is an essential feature of the system under consideration, that the system operates holistically, that novel features emerge, and that nonadditive statistical techniques are a welcome feature of any methodological toolbox. This is a description of some metatheoretical features of what is termed a "relational developmental systems approach," which is described in detail later in the chapter. Metatheoretical assumptions also serve as guidelines that help to avoid conceptual confusions. Take, for example, the word *stage.* In a metatheory that allows discontinuity of change and emergence, "stage" will be a theoretical concept referring to a particular level of organization of the system; in a metatheory that allows only continuity, if "stage" is used at all—it will be a simple descriptive summary statement of a group of behaviors (e.g., the stage of adolescence), but never as a theoretical concept.

Together with metatheory, theory, and method, it needs to be kept in mind that concepts can and do operate at different levels of discourse (see Figure 1.1). Theories and methods refer directly to the empirical world, whereas metatheories refer to the theories and methods themselves. The most concrete and circumscribed level of discourse is the *observational level.* This is one's current commonsense level of conceptualizing the nature of objects and events in the world. For example, one does not need a professional degree to describe a child as "warm" "loving," "distant," "angry," "bright," or even "attached," "aggressive," or "depressed." This observational, commonsense, or folk level of analysis has a sense of immediacy and concreteness, but when reflected on, it is often unclear, muddy, and ambiguous. It is the reflection on folk understanding that moves the level of discourse to a *reflective level,* which is the beginning of theoretical discourse. Here, reflection is about organizing, refining, and reformulating observational understandings in a broader, more coherent, and more abstract field. At the *theoretical reflective level,* concepts are *about* the observational level, and these range from informal hunches and hypotheses to highly refined theories about the nature of things, including human behavior and change. Relatively refined theories may themselves be narrow or broad. For example, some theories of memory are relatively narrow, whereas Demetriou and

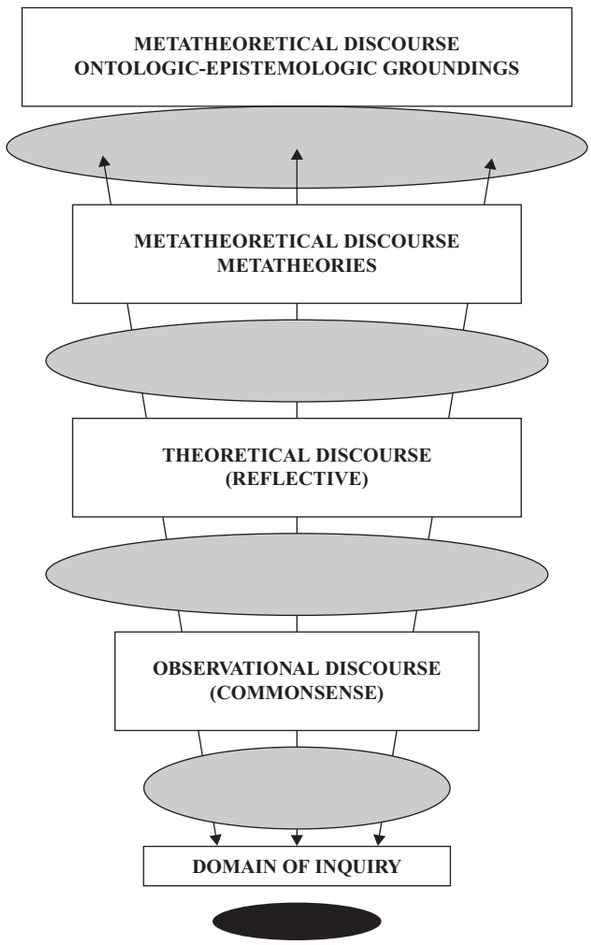

Figure 1.1 Levels of discourse.

colleagues (Chapter 10 of this volume) present a theory of the architecture of mind that is very broad. Similarly, the theories of Piaget, Vygotsky, Erikson, and Werner are grand theories—theories designed to explain a broad sweep of the development of psychological functioning—whereas Bowlby's theory more narrowly focuses on attachment and its development.

The metatheoretical level itself operates above, and functions as a grounding for, the theoretical level. At the metatheoretical level, reflective thought is about basic concepts that, as mentioned earlier, form the contextual frame for the theoretical and observational levels. And here, to make matters a bit more complicated, it is further possible to discriminate levels of metatheory. Thus, arguably, theories such as "relational developmental systems," "dynamical systems," "embodiment," "action,"

and even "information processing," and "behaviorism" actually constitute metatheories that frame specific theories. These metatheories are each grounded in a coherent sets of broader metatheoretical principles. And these, in turn, are grounded at the final apex of the levels of discourse; in those coherent sets of universal ontological and epistemological propositions termed *worldviews,* including at least the classic "mechanistic," "contextualist," "organicist," and a more recent set, representing the synthesis of contextualism and organicism, termed "relationism."

If all of this abstract talk of levels of discourse and metatheories seems too abstract for pragmatic minds, it should be remembered that most of the fundamental issues in psychology originated in abstract concepts, and it is at that level, and only at that level, that they can begin to be resolved. Of course, one can throw away all abstract maps and yielding to the pragmatic urge, just start walking in the forest; but again, although that may get us out of the woods, it may also just keep us wandering in circles.

THE CONCEPT OF DEVELOPMENT

With metatheories, theories, methods, and levels of discourse as background, we can embark on an exploration of *life-span development*. At first blush it would seem that the "life-span" portion is simple enough: life-span development is the study of the development of living organisms from conception to the end of life. This is a satisfactory initial working definition of life span, but later discussions (especially in the final section of the chapter, Age, Life-Span Development, and Aging) point to some rather thorny conceptual and practical issues presented by such a definition of life span. But from this starting point we can say that the field of life-span development entails the scientific study of *systematic intraindividual changes*—from conception to the end of life—of an organism's behavior, and of the systems and processes underlying those changes and that behavior. The field encompasses the study of several categories of change such as ontogenesis (development of the individual across the life span), embryogenesis (development of the embryo), orthogenesis (normal development), pathogenesis (development of psychopathology), and microgenesis (development on a very small time scale such as development of a single percept). But the field is also comparative and thus includes the study of phylogenesis and evolution (development of the species), as well as historical and cultural development. Human ontogenesis/orthogenesis is the most familiar focus of attention of life-span development, and within this series a number of age-related areas of study exist—infancy, toddlerhood, childhood, adolescence, early adult, mature adult, and late adulthood. Both within and across areas, life-span developmental scientists explore biological, cognitive, emotional, social, motivational, and personality dimensions of individual development. The field also maintains a strong research focus on contextual ecological systems that impact on development including the family, home, neighborhoods, schools, and peers, and on interindividual differences.

Organization, Sequence, Direction, Epigenesis, and Relative Permanence

Individual change constitutes the fundamental defining feature of development, but it is important to immediately emphasize that not all change is necessarily developmental change. Developmental change entails five necessary defining features: (1) *organization of processes* (also termed *structure* and *system*), (2) *order* and *sequence*, (3) *direction*, (4) *epigenesis* and *emergence,* and (5) *relative permanence* and *irreversibility.* These features frame two broad forms of change that traditionally have been considered developmental, but have also at times been considered competing alternative definitions of developmental change—transformational change and variational change.

Understanding the place of transformational and variational change in development requires a type-token distinction, which is also a distinction between structure and content. Perception, thinking, memory, language, affect, motivation, and consciousness are *universal* psychological processes *(types),* characteristic of the human species as a whole. Any given percept, concept, thought, word, memory, emotion, and motive represents a *particular expression* of a universal process *(tokens).* Although each form of change is entailed by any behavioral act, transformational change primarily concerns the acquisition, maintenance, retention, or decline of universal processes or operations (types), whereas variational change primarily concerns the acquisition, maintenance, retention, or decline of particular expressions (tokens) and individual differences in expressions.

Transformational Change

Organization

Transformational change is change in the form, organization, or structure of a system. In the case of ontogenesis, the system is the living organism, whereas subsystems consist

of cognitive, affective, and motivational (i.e., psychological) processes together with their biological correlates. Embryological changes constitute some of the clearest and most concrete examples of transformational or morphological change (Edelman, 1992; Gottlieb, 1992). Through processes of differentiation and reintegration, movement occurs from the single-celled zygote to the highly organized functioning systems of the 9-month fetus. Some cognitive and social-emotional phenomena of human ontogenesis have also been conceptualized as reflecting transformational change. For example, sensorimotor action undergoes a sequence of transformations to become symbolic thought, and further transformations lead to a reflective symbolic thought exhibiting novel logical characteristics (see Mascolo & Fischer in Chapter 6 of this volume for an extended discussion of several transformational cognitive levels, and Müller & Racine, Chapter 11 of this volume, for an extended discussion of transformation of the representational system). Memory may reflect transformational changes moving from recognition memory to recall memory. The sense of self and identity (Chandler, Lalonde, Sokol, & Hallett, 2003; Damon & Hart, 1988) has been portrayed by some as moving through a sequence of transformations. Emotions have been understood as differentiations from an initial relatively global affective matrix (Lewis, 1993; Sroufe, 1979). Physical changes, such as changes in locomotion, have also been conceptualized as transformational changes (Thelen & Ulrich, 1991). Transformational change has several closely interrelated defining features, and these give further specification to the concept of developmental change.

System

Transformational change implies an object that is changed. In the epoch when reductionist neopositivism and behaviorism constituted the standard psychological metatheory—when psychology identified itself as a *discipline that took substance rather than process as its ontological* base (Bickhard, 2008)—the object changed was simply observable behavior. At the core of neopositivism and behaviorism—and even more recently in what is later described as "strict" contextualism (see Relational Developmental Systems section later in this chapter)—observed behavior and its associations with biological and environmental variables form the bedrock and exclusive context of inquiry. As a consequence, within these metatheoretical frames, it is possible to identify developmental change with a behavioral change that is split off from (i.e., not relationally connected to) any organization of processes. As psychology moves to a more postpositivist and relational stance—becoming a *process rather than a substance discipline*—it is the living, active, open, self-organizing, and self-regulating system of processes that constitutes the object changed. As an inherently and spontaneously active system, the system acts, and its acts, have the following characteristics: (1) They express the underlying organization of the system (i.e., any act is *expressive*), (2) They function as the means for communicating with the sociocultural world, while changing that and the physical world (i.e., any act is *communicative/instrumental*), and (3) They constitute the basic change mechanism that, through co-action with the world, results in system's transformation. As discussed in detail later in this chapter (see Relational Developmental Systems), it is the active psychological system that organizes and regulates itself through complex and multidirectional relational coactions with its biological, sociocultural, and physical environments (see Greenberg & Partridge, Chapter 5 of this volume, for an extended discussion of a psychology that is biopsychosocial in character). In summary, it is the *relational developmental system* itself that is the object of transformational change.

Order and Sequence

The overt or observable acts of a developmental system exhibit variations (e.g., there are many ways to reach for and grasp a cup), and these variations produce sequences. These behavioral sequences are *contingent* (i.e., under changed conditions can be different). However, change in the form or organization of the system itself exhibits a *necessary order* and *universal sequence* (e.g., the development of "grasping"). Any living system is an adaptive system, and any adaptive system, if it is to live and thrive, necessarily moves from lesser to greater levels of complexity. The transformations from zygote to embryo to fetus, for example, are not contingent; they are universal, and could not be otherwise. Similarly, the transformation of a system characterized by sensorimotor functioning to a system characterized by complex reflective thought represents a necessary and universal ordered sequence.

Directionality

Any notion of order implies a *direction* to the change. That is, any ordered system implies an *orientation toward a goal* or end state. The notion of a goal orientation *(telos)* has often befuddled and even frightened those developmental scientists who continue to grasp on to the anachronism called *neopositivism.* To talk of a telos seems to raise the worry of admitting a discredited teleology into the

science. This fear is based on competing metatheoretical assumptions and conceptual confusions. One conceptual confusion concerns subjective versus objective teleology. Subjective teleology involves *subjectively held* "purposes," "aims," or "goals" (e.g., "I intend to become a better person") and is irrelevant to the definition of transformational developmental change. Objective teleology, in contrast, involves the construction of principles or rules designed to explain—in the sense of making intelligible—phenomena under investigation (e.g., "the development of X moves from lack of differentiation to more equilibrated levels of differentiation and hierarchic integration"). The rule so constructed conceptually "finds" or "discovers" or "identifies" the sequential order and the end state. Any position that seriously accepts the idea of transformational change necessarily accepts both goal directedness and the fact that the specific goal articulated is a theoretical concept—not a slice of physical nature—designed to illuminate the nature of the transformational change under study.

It is simply a conceptual confusion to argue that adequate descriptions are more important than the positing of end points (e.g., Sugarman, 1987), or similarly to suggest a movement away from end points and toward "a more neutral, person-time-and-situation-geared conception of development" (Demetriou & Raftopoulos, 2004, p. 91). There is no "neutral" standpoint, and no description could possibly occur without a positing of end points. The question here is what one would possibly describe if one did not understand development as tending toward some specified end? If one wishes to describe/explain the course of acquiring language, then adult language is, of necessity, the end point toward which development moves. No "description" of the language of the child would be possible without this ideal end point. In a similar fashion, if one wishes to describe/explain the transformational development of reasoning, or thought, or problem solving, or personality, or anything, a conceptual end point must serve as the ideal ultimate model.

A related feature of this confusion over the positing of developmental end point arises from the mistaken notion that positing a goal or end point necessarily leads to an "adultomorphic perspective [that] forces one to view earlier behaviors and functions as immature versions of adult functions" (Marcovitch & Lewkowicz, 2004, p. 113). Central to this argument is its faulty assumption that all developmental change, including transformational change, is additive (linear, strict continuity) and, conversely, the failure to recognize a feature further discussed later in this chapter (see Relational Developmental Systems) that, in open self-organizing systems, nonlinearity (nonadditivity; discontinuity) is frequently the rule. For example, Piaget's interest in examining the development of reasoning process from a self-organizing systems perspective resulted in his identifying deductive propositional reasoning as the end point of inquiry; whether this was a good idea or a poor idea is irrelevant to the current argument. What is relevant is that Piaget described several quite different forms of reasoning (e.g., preoperational and concrete operational) that function as discontinuous precursors to this adult form, and these early forms are not simply immature versions of the adult function. Rather, they are qualitatively distinct forms of reasoning.

A final conceptual confusion is the notion—abroad for many years—that focusing on sequences and positing end points introduces rigidity and denies the *plasticity* of development. This notion is quickly debunked by recognizing that the concept of *equifinality* (i.e., that there are multiple means to the same end) is a core concept in any open, self-organizing systems perspective. Although each level of organization of the system is a part of the normative sequence moving toward a normative end, there are multiple means or action paths to each system level.

From a strictly metatheoretical, especially an epistemological metatheoretical perspective, the centrality of transformational change—including the relational developmental system, order, sequence, and directional characteristics—is meaningful only to the extent that our understanding of developmental science and scientific method in general have advanced beyond the neopositivism of what has been traditionally termed *Newtonian mechanical explanation* (Overton, 1991). In that conceptual system, scientific explanation, and hence science, was ultimately reduced to the search for individual and additive observable forces that were taken as the *causes,* and hence the explanation of development. In a relational postpositivist scientific world, the identification of dynamic *pattern*—both momentarily as a "self-organizing system" and temporally as the organized, sequential directional "relational developmental system"—is logically prior to a detailed analysis of the resources this system uses to grow. From a relational developmental systems perspective—given the system's open, active, transforming, self-organizing, and self-regulating character—neither individual nor combined forces cause development. The developmental system defines the resources and their participation in system change. To consider "genes," "neurons," "brain changes," "cultural

objects," "parents," "peers," or "neighborhoods" to be sets of additive causes that drive development is to miss the point that these are all resources that the developmental system uses to grow. It is the relational developmental system itself that is the cause of development, and this system enacts this development by engaging in a multitude of complex relational actions with these resources. Classically, these actions have been termed *interactions,* but that term is totally inadequate to describing the relational interpenetrations of coacting parts that operate as the developmental system. In order to capture both the merging (or "fusion"; Greenberg & Tobach, 1984) of parts into a single identity, while maintaining their individual identity as differentiations, this chapter uses the terms *interpenetration* (merging) and *coaction* (differentiation; Gottlieb, Wahlsten, & Lickliter, 2006) in place of *interaction,* except in those cases that refer to the simple additive combination of elements. *Interpenetration* and *coaction* are also used in place of *bidirectional interaction* found in other chapters in this volume. However, it should be noted that when other authors use the term *bidirectional interaction,* they reference the same activity termed *interpenetration* and *coaction* in this chapter.

Although a developmental telos is another necessary feature of transformational change, there is an open and empirical question as to what universal telos most adequately captures the broad course of life-span development. Is it "differentiation and integration" (see Mascolo & Fischer, Chapter 6 of this volume, and Müller & Racine, Chapter 11 of this volume, for extended discussions of the place of "differentiation" as the telos of life-span development)? Or might it be some form of the concept "adaptation" (see Bundick & colleagues, Chapter 24 of this volume, for an extended discussion of "adaptation" as the telos of life-span development)? Or some notion of "balance" (see Bialystok & Craik, Chapter 7 of this volume, and Sternberg, Chapter 23 of this volume, for extended discussions of "balance" as the telos of life-span development)? Or could it be some notion of an "attractor" as discussed within systems approaches to the understanding of changes in "open" systems (Overton, 1975)? Or perhaps some integration of all of these concepts? As discussed further later in this chapter (see Relational Developmental Systems), any telos is an interpretation designed to bring conceptual order into system change, and posited end points can vary as a function of a specific area of inquiry. Because this question of the nature of an adequate developmental telos for life-span development becomes critical when considering "life span" itself, an exploration of this issue is postponed until later in this chapter (see Age, Life-Span Development, and Aging).

Epigenesis and Emergence

The concept of epigenesis was originally introduced in biology as a counterweight to the idea of "preformation" in the explanation of the appearance of increasingly organized complexity from a relatively undifferentiated egg to a highly differentiated organism. Although epigenesis has a long history with several twists and turns (see Lickliter & Honeycutt, in press), today, conceptualized as "probabilistic epigenesis" (Gottlieb, 1992), it designates a *holistic* approach to understanding developmental complexity (transformational change). Probabilistic epigenesis is the principle that the role played by any part of a relational developmental system—gene, cell, organ, organism, physical environment, culture—is a function of all of the interpenetrating and coacting parts of the system. It is through complex relational bidirectional and multidirectional reciprocal interpenetrating actions among the coacting parts that the system moves to levels of increasingly organized complexity. Thus, epigenesis identifies the system as being completely *contextualized* and *situated.* The contextualization of the system is important because it points to the necessity of exploring contextual variables as a part of the overall developmental research enterprise (Bronfenbrenner & Morris, 2006).

Epigenesis also points to a closely related feature of transformational developmental change: *emergence.* Transformational change results in the *emergence of system novelty.* As forms change, they become increasingly complex. This increased complexity is a complexity of pattern rather than a linear additive complexity of elements (see Relational Developmental Systems later in this chapter). The butterfly emerges from the caterpillar through the differentiation and reintegration of organization, the frog from the tadpole, the plant from the seed, the organism from the zygote. In an identical fashion, higher order psychological structures emerge from lower order structures; also in an identical fashion, new patterns of organization exhibit novel characteristics that cannot be reduced to (i.e., completely explained by) or predicted from earlier forms. The novel properties are termed *systemic,* indicating that they are properties of the whole system and not properties of any individual part. This emergence of novelty is commonly referred to as *qualitative* change in the sense that it is change that cannot be represented as purely additive. Similarly, reference to "discontinuity" in development is simply the recognition of emergent novelty and qualitative change of

a system (Overton & Reese, 1981). Concepts of "stages" and "levels" of development are theoretical concepts, which within a relational developmental systems perspective reference transformational change together with the associated emergent novelty, qualitative change, and discontinuity. Each of the classic grand developmental figures of the 20th century—Piaget (1967), Vygotsky (1978), Werner (1948), and Erikson (1968)—acknowledged the centrality of nonlinearity and emergence: Piaget and Werner via their ideas of development proceeding through phases of differentiation and reintegration; Erikson through his epigenetic principle of development; Vygotsky in his argument that development is not "the gradual accumulation of separate changes…[but] a complex dialectical process characterized by…qualitative transformations of one form into another [with an] intertwining of external and internal factors" (1978, p. 73).

Systemic emergence is not limited to homogeneous stages such as those offered by the grand theories. Mascolo and Fischer (Chapter 6 of this volume; see also Fischer & Bidell, 2006), for example, in discussing "skill theory" describe development as an "emergent developmental web":

> The developmental web represents development in terms of a series of partially distinct pathways that, depending on developmental circumstances, move in different diverging or converging directions. Higher order psychological structures emerge from the integration or coordination of lower-level structures that develop along partially distinct trajectories. The splitting and converging of developmental trajectories is not something that can be specified or predicted a priori. (p. 163)

In this volume, several other chapters also reference emergence, explicitly or implicitly, as central to their life-span developmental research programs. Demetriou, Mouyi, and Spanoudis (Chapter 10 of this volume) in reviewing the development of mental processing claim that a language of thought—general inferences patterns—and metarepresentational processes are not present at birth but are the "emergent product of guided and reflected-upon domain-specific functioning." (p. 331)

Greenberg and Partridge (Chapter 5 of this volume), following Schneirla (1957), argue that mind is best understood as an emergent systemic feature of organizational transformation:

> Although our view of mind is sympathetic to that of Sperry's, in that we are certainly physical monists and agree that what we call mind is an emergent property, our view extends that of Sperry's to what could be deemed relational emergent monism. Sperry's emergent monism view of mind is still fundamentally reductionistic, arguing that mind is essentially the dynamic macrostate of underlying neurological activity. Although this dynamic macrostate is emergent in the sense that its properties are not fully predictable from the individual states of the underlying neurologic matrix, it is still a state that is subordinate to neurology.
>
> By accepting the pragmatic definition of mind as an integration of cognitive, emotional, and organism $\leftarrow \rightarrow$ context relational behaviors within the developmental system, you place the concept of mind and its subsidiary constructs within the operational realm of psychology.…Thus, we see mind as an emergent function of the dynamic transactions over the entire course of development of the individual organism and its ecological context. (p. 129)

MacWhinney (Chapter 14 of this volume) places emergentism at the center of his analysis of language development:

> Emergentist thinking is basic to the natural sciences. However, it applies equally well to the social, neural, and behavioral sciences (Lerner, 2006; Overton, 2006). The application of emergentism to the study of language and language development over the last two decades has proven to be particularly rewarding. In this chapter, we will explore how emergentist theory helps us understand the growth of language across the life span. (p. 470)

Lewis's (Chapter 18 of this volume) presentation of the development of self and consciousness argues for the centrality of transformational emergence in this process:

> For the adult human, both spheres of consciousness are functional. The implicit sphere of the self is composed of the core processes of the body or implicit consciousness; the other sphere is the idea of me, explicit consciousness that represents an emergent transformation of the core processes.…From a developmental perspective, the core processes of self are present at birth, and the mental state of the idea of me emerges as a developmental transformation in the first two years of the child's life. (p. 651)

In a similar context, Santostefano's (Chapter 22 of this volume) exploration of the development of several forms of self as they relate to developmental psychopathology has at its core the following idea:

> New forms of cognition, emotion, and behavior emerge through this process of self-organization…[and] cause and effect is a relational bidirectional, circular process.

> …Lower order features provide the foundation from which higher order features emerge. But these higher order features, in turn, exert a top-down influence. (p. 798)

Carpendale and Lewis's (Chapter 17 of this volume) theory of the development of social cognition also explicitly recognizes emergent novelty in their discussion of the transformational gap that operates between neurological and psychological functioning. Finally, Müller and Racine (Chapter 11 of this volume) consider symbolic representations as they have been conceptualized in the classic developmental theories:

> Essential for Piaget, Vygotsky, and Werner was the idea that earlier symbolic representations emerge out of pragmatic, communicative activities. For Werner, symbols results from a shift of function: "A novel emerging function becomes actualized at first through the use of means articulated and structured in the service of…[developmentally] earlier ends" (Werner & Kaplan, 1963, p. 66). (p. 379)

Relative Permanence and Irreversibility

A final feature of transformational change of a system is that it is not circular, transitory, or willy-nilly reversible. Transformational change—system change—is relatively permanent, relatively irreversible. This eliminates sleep, digestion, going to the movies, and any behaviors that are readily extinguishable from the list of transformational changes. Although this attribute is generally a straightforward feature of transformational change, it raises an issue with respect to life-span development. If it were found empirically that there were declines in middle or late adulthood in behaviors associated with transformational systems (e.g., if the form of thinking deteriorated or regressed to an earlier form), would this change be considered something other than development? Would it be necessary to introduce two radically different processes into our life-span understanding such as "development" on the one hand and "aging" on the other? Not necessarily. The modifier "relatively" partially addresses this issue. And it might be possible to conceptualize the late adult years as having their own order, sequence, epigenesis (if not emergence), and permanence. However, these issues are better saved for the Age, Life-Span Development, and Aging section of this chapter.

Variational Change

Variational change refers to the degree or extent that a change varies from a standard, norm, or average. Nesselroade and Molenaar (chapter 2 of this volume) describe three kinds of comparisons that constitute the most elemental character of variation: (1) comparisons among kinds of entities (e.g., qualitative differences), (2) comparisons of an entity with itself over different occasions (intraindividual differences), and (3) comparisons among entities of the same kind (interindividual differences). The first of these refers to the outcome of transformational change; the second, intraindividual variation, is the focus of this section. The third comparison, interindividual differences, is related to the concept of development only to the extent that the focus is on change of these differences, and these changes themselves ultimately devolve back into intraindividual variation. The contingent reaching and grasping patterns of the infant's behavior, the toddler's improvements in walking precision, the growth of vocabulary, and receiving grades on an exam are all examples of variational intraindividual change. From an instrumental point of view, intraindividual variational change is about a skill or ability (token) emerging (but not emergent) and becoming more precise and more accurate. Intraindividual variations are generally represented as linear, as additive in nature. As a consequence, this change is generally understood as *quantitative* and *continuous.*

At any given level of form (i.e., any level of a relational developmental system), there are variants that constitute intraindividual variational changes. If thinking is understood as undergoing transformational change, then at any given transformational level, variational changes are found in variants of thought (e.g., analytic styles and synthetic styles). If emotions are presented as undergoing transformational change, then at any transformational level, variational change is reflected, for example, in differences in the degree of emotionality (more or less anxious, empathic, altruistic, and so on). If identity is thought of as undergoing transformational change, then at any transformational level, there is variational change in the type of identity assumed (e.g., individualistic or communal). If the structure of memory undergoes transformational change, there is variational change in memory capacity, speed of processing, memory style, and memory content.

Transformational change has been identified with domain general normative structural issues such as changes that are *typical* of phyla, species, and individuals. In ontogenesis, for example, normative changes in cognitive, affective, and motivational systems have been the central issue of concern. The focus here is sequences of universal forms whose movement defines a path or trajectory. Intraindividual variational change has been identified

with domain-specific content and skill issues. In this case, interest focuses on local changes that suggest a particularity, and a to-and-fro movement or a contingent directionality. Concepts of contingent rather than necessary organization, and contingent rather than necessary change, and concepts of reversibility, continuity, and cyclicity are associated with intraindividual variational change. An example that is central to a number of chapters in this volume is that of intelligence, where fluid intelligence ("for the most part, has been defined by reasoning," Blair, Chapter 8 of this volume) or the similar "control processes" (Bialystok & Craik, Chapter 7 of this volume) are associated with transformational features, whereas crystallized intelligence (knowledge and specific skills) (Blair) or "representations" (Bialystok & Craik), together with processing speed (Blair), are associated with variational features of change.

Transformational and variational changes have also been associated with different mechanisms of change. Transformational change has been associated with the embodied action-in-the-world characteristic of open complex self-organizing and self-regulating systems. Variational change has been associated with information-processing mechanisms related to the encoding, storage, and retrieval of information.

We are here faced with a logical difficulty. As noted earlier, developmental change entails five necessary defining features. However, as it turns out, each feature is associated with transformational change, and none are associated with variational change. Yet, it was also stated earlier that development entails both transformational and variational change. How can this be resolved? Mascolo and Fischer (Chapter 6 of this volume) suggest that the resolution is to identify transformational change as developmental change, and variational as historical change. The difficulty with this solution lies in its exclusivity. The study of change with respect to the individual's acquisition of specific concepts and skills (i.e., variational or historical change), as well as processing mechanisms entailed by those skills, has traditionally been housed within the broad study of development. It would seem prudent to explore whether there might be some principled way this variational component and the transformational component might be integrated into an inclusive framework. That is, it would seem prudent to find a way in which a *de facto* situation—the current field of life-span development includes scientists who study each type of change—can be justified in a coherent, principled fashion.

Transformation and Variation: A Relational Integration

From a metatheoretical perspective, there are two alternative resolutions to the transformational-variational dichotomy: a split resolution and a relational resolution. The split resolution denies the reality of or marginalizes one type of change, thus claiming the other constitutes the really real development. The relational resolution—to be expanded later in the Relational Metatheory section—maintains that the apparent dualism, like any dualism, can better be understood as two interconnected features of the same whole. From the relational perspective, transformation and variation are not alternatives competing for the mantle of "development"; they constitute a whole reflecting two coequal and indissociable complementary process. This solution claims a reality in which the processes assume differentiated functional roles, but each process in itself explains and is explained by the other. Put simply, open, active, holistic systems produce variations, and variations transform the system (Overton & Ennis, 2006a). As discussed later, any living system is open, complex, self-organizing, and self-regulating. Complex open systems by their very nature are inherently and spontaneously active; they produce acts consistent with the structure of the system (flies produce fly acts; pigeons, pigeon acts; and humans, human acts). *Acts are embodied actions-in-the-world, and they succeed or fail to various degrees in attaining their intended goals.* Partial success feeds back to the system, which uses the feedback as a resource in changing (transforming) the system. The transformed system, in turn, produces further variants of the act. Thus, all development entails cyclical movements between transformation and variation that result in increasing complexity of the system and increasingly refined variants (Overton, 2006; Gestsdóttir & Lerner, 2008). As Demetriou, Mouyi, and Spanoudis (Chapter 10 of this volume) state:

> The relations between the general and the specialized processes are complex and bidirectional. On the one hand, general processes set the limits for the construction, operation, and development of the domain-specific systems. On the other hand, specialized processes provide the frame and raw material for the functioning of general processes. (pp. 322)

The relational solution clarifies the *de facto* situation that much of life-span scientific study currently takes place at one or the other pole of the whole, and it encourages an integrated vision for future study. On the other hand, the

relational solution discourages any notion of a systems approach and an information processing approach or a social learning approach as necessarily being competing alternatives. They become competing alternatives only when they become split and one or the other claims the totality.

In this life-span volume, the analyses and reviews by Carpendale and C. Lewis on social understanding (Chapter 17 of this volume), M. Lewis on consciousness (Chapter 18 of this volume), and Müller and Racine on concepts and representations (Chapter 11 of this volume) are examples of inquiry primarily embedded within the transformational pole, stressing the self-organizing system and its mechanisms. On the other hand, the analyses and reviews by Goldin-Meadow and Iverson on gesture (Chapter 21 of this volume), Vasilyeva and Lourenco on spatial development (Chapter 20 of this volume), and Ornstein and Light on memory development (Chapter 9 of this volume) exemplify a primary focus on the variational pole. As a microlevel example of the variational, consider Ornstein and Light's analysis. Research programs that focus on transformations of knowing and thought, moving from the concrete sensorimotor to the abstract reflective, often conceptualize these transforms as *levels*, including levels termed *the metacognitive* and *the metamemorial.* Ornstein and Light's work, in contrast, centers its analysis on information-processing mechanisms; as a consequence, metacognition and metamemory appear within this analysis not as transformational levels, but as one set of factors that among others impact on the encoding, storage, and retrieval of information.

Although less common, some research programs explicitly incorporate both poles of the developmental whole. Despite their seeming acceptance of a development-history dichotomy, Mascolo and Fischer (Chapter 6 of this volume) offer a well-articulated example of an integrated program in their discussion of the development of psychological structures as these are related to behavioral skills: "Psychological structures consist of dynamic integrations [transformational changes] of motive-relevant meaning, feeling, and motor action as they emerge within particular behavioral domains and contexts [variational changes]." (p. 150) Also, Demetriou, Mouyi, and Spanoudis' (Chapter 10 of this volume) presentation of a theory of mental processing considers the developing architecture of the mind as entailing both levels of mental structures (transformational change) and a level of processing capacity (variational changes). And similarly, Ricco (Chapter 12 of this volume) describes a dual processing theory of reasoning development proposed by Overton and colleagues (Overton & Dick, 2007). In this theory, a distinction is drawn between a domain general transformational system termed the *competence system*, and a domain specific variational system termed the *procedural system*. The competence system is characterized by the acquisition of the universal logical features of reasoning, while the procedural system is characterized by highly contextualized on line processing mechanisms.

RELATIONAL METATHEORY

In the course of discussing the concept of development, the term *relational* has frequently appeared. It has appeared as a metatheory at the level of a worldview. It has been featured as a methodology as in "a relational postpositivist scientific world." It has been argued to be an integrative solution to the need for an inclusive and integrated understanding of development. "Relational" has served to qualify the phrases and terms *bidirectional interpenetration, multidirectional interpenetration,* and *differentiation.* It has also been used to point to a specific type of "developmental system." Similar usages are found in a number of the chapters in this volume. Given these multiple usages, and because later discussions—especially of the role of systems and the place of age/aging in life-span development—will involve relationism in a central fashion, this section elaborates on the meaning of this concept.

Relationism—a relational metatheory—represents a principled synthesis of what Stephen Pepper (1942) referred to as the contextualist and the organismic worldviews (Overton, 2007a; Overton & Ennis, 2006a, b). As a synthesis, relationism is composed of a coherent set of ontological and a coherent set of epistemological principles. The ontology of relationism entails a reality based on *process* rather than substance (Bickhard, 2008). This ontology has classically been defined as an ontology of *Becoming* (Allport, 1955; Overton, 1991). It includes process, activity, change, and necessary organization as defining categories. Becoming contrasts with categories of substance, stability, fixity, and contingent organization found in other worldview-level metatheories. M. Lewis (Chapter 18 of this volume) in his exploration of consciousness and Müller and Racine (Chapter 11 of this volume) in their analysis of representations and concepts discuss a number of implications that arise from taking an active versus a passive organism approach to the study of life-span development. The active organism concept is a direct consequence of the ontology of Becoming found in relationism, whereas the

passive (or reactive) organism concept reflects the ontology of stasis and uniformity (Overton, 1976), found in the atomistic, reductionistic worldview called *mechanistic*.

The ontologies of active versus passive organism, as M. Lewis (Chapter 18 of this volume) and Müller and Racine (Chapter 11 of this volume) demonstrate, have critical implications for both theory and methods in the study of life-span development. *In fact, the notion of a self-organizing, self-regulating system is incomprehensible unless it is embedded in a Becoming ontology*. Nevertheless, despite this importance, this section is more directly concerned with the epistemological principles of relationism. The epistemology of relationism is, first and foremost, a *relatively inclusive* epistemology, involving both knower and known as equal and indissociable complementary processes in the construction, acquisition, and growth of knowledge. It is "relatively" inclusive, because "inclusion" itself—much like Hegel's master–slave dialectic—can be grasped only in relation to its complement "exclusion." Thus, just as "freedom" must be identified in the context of "constraint," "inclusion" must be identified in the context of "exclusion."

Relational epistemology specifically *excludes* Cartesian dualistic ways of knowing, because Cartesian epistemology trades on absolute exclusivity; it is a "nothing-but" epistemology that was founded on atomism. Here, in the last analysis, nothing counts but "atoms" in their additive combination, whether the atoms are genes, or neurons, or responses, or pieces of the sociocultural world. Cartesian dualism claims to cut nature at its joint, dividing any whole into pure forms that constitute absolutely decomposable pieces (i.e., it "splits" the whole and converts it into an aggregate of elements) resulting in a dichotomy. This "divide-and-conquer" strategy is not simply analysis, but analysis in which the whole is treated as epiphenomenal. For example, subject is split from object, mind from body. Having forced the dichotomy, Cartesian thought makes these epistemological claims: (1) The natural (material, physical, objective) constitutes the ultimate foundational real, the ultimate "atoms" on which all else is built; (2) one of the pieces of the whole is more real than the other; and (3) therefore, the less real must be explained (i.e., reduced) to the more real. As one example among many possible examples of fundamental split dichotomies (Table 1.1), consider the splitting of subject from object, mind from body. After the split, a decision is required as to which constitutes the foundational real that will do the explaining and which constitutes the apparent real that will be explained. If the ontological position is that the physical constitutes the foundational real—as in all neopositivist and many behavioristic approaches—thinking, reasoning, perception, motivation, affect, and so forth must necessarily be explained by the atoms of biology (genes, neurons), and the sociocultural and physical environments. Because splitting is pervasive in Cartesian epistemology, these "atoms" are themselves treated as split pieces, and attempts to explain specifically how they might come to constitute the whole are necessarily additive. Any behavior or process thus becomes the additive "interaction" of genetic, neurological, and environmental pieces. "Interaction" is here placed in scare quotes to emphasize that this is not an interaction of relational interpenetration, coaction, or reciprocal bidirectionality or multidirectionality, but an interaction in which the pieces maintain their split-off identity.

Table 1.1 Fundamental Relational Categories

Subject	Object
Form	Matter
Stability	Change
Transformation	Variation
Universal	Particular
Transcendent	Immanent
Analysis	Synthesis
Unity	Diversity
Interpretation	Observation
Certainty	Doubt
Absolute	Relative
Expressive	Instrumental
Variation	Transformation
Intrapsychic	Interpersonal
Reason	Emotion
Biology	Culture
Person	Biology
Culture	Person
Nature	Nurture

The epistemology of relationism heals splits and resolves dualisms—false dichotomies—that in a postpositivist era are recognized as retardants to scientific progress. And, importantly, relationism does this healing in a coherent, principled manner. Efforts at moving beyond Cartesian dichotomies are not new, but since the 19th century's rejection of Hegel's metaphysical system, few systematic efforts at doing this healing in a principled fashion have been attempted. Calls for relational thinking are also not new. Holism was a central characteristic of William James's work, and Putnam (1995) describes how James's commitment led to the "obvious *if implicit* rejection of

many familiar dualisms: fact, value, and theory are all seen by James as interpenetrating and interdependent" (p. 7, emphasis added). James (1975) addresses virtually all the traditional dichotomies of split-off traditions, and he, together with Dewey (1925), argue for a relational interpenetrating understanding of universal-particular, inner-outer, subject-object, theory-practice, monism-pluralism, and unity-diversity. However, neither James nor Dewey articulated an *explicit set of principles* designed to support this argument.

In recent times, the scientific significance of thinking relationally has been discussed from the vantage point of several disciplines including physics (Smolin, 1997: "Twentieth century physics represents a partial triumph of this relational view over the older Newtonian conception of nature" [p. 19]); anthropology (Ingold, 2000: "How can one hope to grasp the continuity of the life process through a mode of thought that can only countenance the organic world already shattered into a myriad of fragments?… What we need, instead, is a quite different way of thinking about organisms and their environments. I call this 'relational thinking'" [p. 295]); biology (Robert, 2004: "To understand the relationship between genotype and phenotype, we must transcend the dichotomy between them in two ways: we must grasp the phenotype of the gene and we must recognize that the relevant developmental space does not begin nor does it end with the genome-in-context. It begins, instead, with the genetically *co*-defined primary, initially unicellular, organism" [p. 66]); and science studies (Latour, 2004: "Their [the sciences] work consists precisely in inventing through the intermediary of instruments and the artifice of the laboratory, the *displacement of point of view.*…They make it possible to shift viewpoint constantly by means of experiments, instruments, models, and theories.…Such is their particular form of relativism—that is, *relationism*" [emphasis added] [p. 137]). However, again, despite the many calls for a relational approach to science, there has been little in the way of articulating a coherent set of metatheoretical principles that may then serve as a guide for how one actually might do relational thinking.

Relationism then is a metatheoretical space representing a synthesis of contextualism and organicism where foundations are groundings, not bedrocks of certainty, and analysis is about creating categories, not about cutting nature at its joints. In place of a rejected atomism, holism becomes the overarching first epistemological principle. Building from the base of holism, relational metatheory moves to specific principles that define the relations among parts and the relations of parts to wholes. In other words, relational metatheory articulates principles of analysis and synthesis necessary for any scientific inquiry. These principles are: (1) the Identity of Opposites, (2) the Opposites of Identity, and (3) the Synthesis of Wholes.

Holism

Holism is the principle that the identities of objects and events derive from the relational context in which they are embedded. Wholes define parts and parts define wholes. The classic example is the relation of components of a sentence. Patterns of letters form words, and particular organizations of words form sentences. Clearly, the meaning of the sentence depends on its individual words (parts define whole). At the same time, the meaning of the words is often defined by the meaning of the sentence (wholes define parts). Consider the word meanings in the following sentences: (1) The *party leaders* were *split* on the *platform*; (2) The *disc jockey* discovered a *black rock star*; and (3) The *pitcher* was *driven home* on a *sacrifice fly*. The meaning of the sentence is obviously determined by the meaning of the words, but the meaning of each word is determined by context of the sentence it is in. Parts determine wholes; wholes determine their parts (Gilbert & Sarkar, 2000).

Holistically, the whole is not an aggregate of discrete elements but an organized system of parts, each part being defined by its relations to other parts and to the whole. Complexity in this context, as further discussed in the next section, is *organized complexity* (Luhmann, 1995; von Bertalanffy, 1968a, b), in that the whole is not decomposable into elements arranged in additive linear sequences of cause/effect relations (Overton & Reese, 1973). In the context of holism, principles of splitting, foundationalism, and atomism are rejected as meaningless approaches to analysis, and "fundamental" antimonies are similarly rejected as false dichotomies. In an effort to avoid "standard" (i.e., neopositivistic) misunderstandings here, it must be strongly emphasized that *nondecomposability does not mean that analysis itself is rejected*. It means that *analysis of parts must occur in the context of the parts' functioning in the whole.* The context-free specifications of any object, event, or process—whether it be a gene, cell, neuron, the architecture of mind or culture—is illegitimate within a holistic system.

Although holism is central to relationism, the acceptance of holism does not in itself offer a detailed program for resolving the many dualisms that have framed an understanding of life-span development and other fields of scientific

inquiry. A complete relational program requires principles according to which the individual identity of each concept of a formerly dichotomous pair is maintained while simultaneously it is affirmed that each concept constitutes, and is constituted by, the other. A program is needed in which, for example, both nature and nurture maintain their individual identity while it is simultaneously understood that the fact that a behavior is a product of biology does not imply that it is not equally a product of culture, and the fact that a behavior is a product of culture does not imply that is not equally a product of biology. This understanding is accomplished by considering identity and differences as two *moments of analysis.* The first moment is based on the principle of the identity of opposites; the second moment is based on the principle of the opposites of identity.

The Identity of Opposites

The principle of the identity of opposites establishes the *identity among parts* of a whole by casting them not as exclusive contradictions as in the split epistemology but as differentiated polarities (i.e., coequals) of a unified (i.e., indissociable), inclusive matrix—as a relation. As differentiations, each pole is defined recursively; each pole defines and is defined by its opposite. In this identity moment of analysis, the law of contradiction is suspended and each category contains and, in fact, *is* its opposite. Further—and centrally—as a differentiation, this moment pertains to character, origin, and outcomes. The character of any contemporary behavior, for example, is 100% nature because it is 100% nurture; 100% biology because it is 100% culture. There is no origin to this behavior that was some other percentage—regardless of whether we climb back into the womb, back into the cell, back into the genome, or back into the DNA—nor can there be a later behavior that will be a different percentage. Similarly, any action is both expressive and communicative/instrumental, and any developmental change is both transformational and variational.

There are a number of ways to articulate this principle, but a particularly clear illustration is found in considering the famous ink sketch by M. C. Escher titled "Drawing Hands." As shown in Figure 1.2, a left and a right hand assume a relational posture according to which each is simultaneously drawing and being drawn by the other. In this matrix, each hand is identical—thus coequal and indissociable—with the other in the sense of each drawing and each being drawn. This is a moment of analysis in which the law of contradiction (i.e., Not the case that A = not A) is relaxed and identity (i.e., A = not A) reigns.

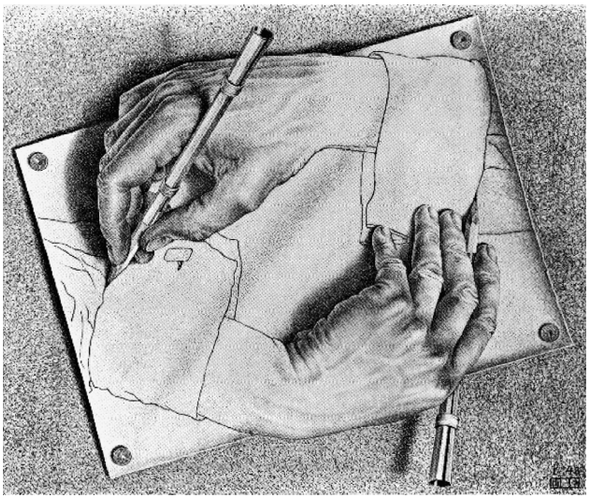

Figure 1.2 M.C. Escher's "Drawing Hands" © 2009 The M.C. Escher Company-Holland. All rights reserved. www.mcescher.com.

In this identity moment of analysis, pure forms collapse and categories flow into each other. Here each category contains and is its opposite. As a consequence, there is a broad inclusivity established among categories. If we think of "inclusion" and "exclusion" as different moments that occur when we observe a reversible figure (e.g., a Necker cube or the vase-women illusion), then in this identity moment we observe only inclusion. In the next (opposite) moment of analysis, the figures reverse, and there we will again see exclusivity as the hands appear as opposites and complementarities.

Within this identity moment of analysis, it is a useful exercise to write on each hand one of the bipolar terms of a traditionally split dualisms (e.g., biology and culture) and to explore the resulting effect. This exercise is more than merely an illustration of a familiar bidirectionality of cause and effects. The exercise makes tangible the central feature of the relational metatheory; seemingly dichotomous ideas that are often thought of as competing alternatives can, in fact, enter into inquiry as coequal and indissociable. It also concretizes the meaning of any truly nonadditive reciprocal determination (Overton & Reese, 1973) and any "circular causality" in a way that simple bidirectionality cannot.

If inquiry concerning, for example, person, culture, and behavior is undertaken according to the principle of identity of opposites, various constraints are imposed, as constraints are imposed by any metatheory. An important example of such a constraint is that behavior, traits, styles, and so forth cannot be thought of as being decomposable

into the independent and additive pure forms of biology and culture. Thus, the notion occasionally put forth by some sociocultural or social constructivist approaches, that society and culture occupy a privileged position in developmental explanation, is simply a conceptual confusion in the context of relational metatheory.

If the principle of the identity of opposites introduces constraints, it also opens possibilities. One of these is the recognition that, to paraphrase Searle (1992), the fact that a behavior implicates activity of the biological system does not imply that it does not implicate activity of the cultural system, and the fact that the behavior implicates activity of the cultural system does not imply that it does not implicate activity of the biological system. In other words, the identity of opposites establishes the metatheoretical rationale for the theoretical position that biology and culture (like culture and person, biology and person, etc.) operate in a truly *interpenetrating* manner. Of course, the identity of opposites also justifies the claim that development is not the transformational change of system or the variational change of behavior, but the transformational/system-variational/behavioral change of the organism.

The justification for the claim that a law of logic (e.g., the law of contradiction) can reasonably both be applied and relaxed depending on the context of inquiry requires a recognition that the laws of logic themselves are not immutable and not immune to background ideas. In some metatheoretical background traditions, the laws of logic are understood as immutable realities given either by a world cut off from the human mind or by a prewired mind cut off from the world. However, in the background tradition currently under discussion, the traditional laws of logic are themselves ideas that have been constructed through the reciprocal action of human minds and world. The laws of logic are simply pictures that have been drawn or stories that have been told. They may be good pictures or good stories in the sense of bringing a certain quality of order into our lives, but nevertheless, they are still pictures or stories, and it is possible that other pictures will serve us even better in some circumstances. Wittgenstein (1953/1958), whose later works focused on the importance of background or what we are calling "metatheoretical ideas," made this point quite clearly when he discussed another law of logic—the law of the excluded middle—as being one possible "picture" of the world among many possible pictures.

> The law of the excluded middle says here: It must either look like this, or like that. So it really…says nothing at all, but gives us a picture…And this picture *seems* to determine what we have to do and how—but it does not do so.…Here saying "There is no third possibility"…expresses our inability to turn our eyes away from this picture: a picture which looks as if it must already contain both the problem and its solution, while all the time we *feel* that it is not so. (paragraph 352)

The Opposites of Identity

Although the identity of opposites sets constraints and opens possibilities, it does not in itself set a positive agenda for empirical inquiry. The limitation of the identity moment of analysis is that, in establishing a flow of categories of one into the other, a stable base for inquiry that was provided by bedrock "atoms" of the split metatheory is eliminated. Here no relativity entered the picture; all was absolute. Reestablishing a *stable base*—not an absolute fixity, nor an absolute relativity, but a relative relativity (Latour, 1993)—within relational metatheory requires moving to a second moment of analysis. This is the oppositional moment, where the figure reverses and the moment becomes dominated by a relational exclusivity. Thus, in this opposite moment of analysis, it becomes clear that despite the earlier identity, Escher's sketch does illustrate both a *right* hand and a *left* hand. In this moment, the law of contradiction (i.e., Not the case that A = not A) is reasserted and categories again exclude each other. As a consequence of this exclusion, parts exhibit *unique* identities that differentiate each from the other. These unique differential qualities are stable within any holistic system and, thus, may form relatively stable platforms for empirical inquiry. The platforms created according to the principle of the opposites of identity become *standpoints, points-of-view, or lines-of-sight,* in recognition that they do not reflect absolute foundations (Latour, 1993). They may also be considered under the common rubric *levels of analysis,* when these are not understood as bedrock foundations. Again considering Escher's sketch, when left hand as left hand and right as right are each the focus of attention, it then becomes quite clear that, were they large enough, one could stand on either hand and examine the structures and functions of that hand, as well as its relation to the other hand (i.e., the *coactions* of parts). Thus, to return to the nature-nurture example, although explicitly recognizing that any behavior is 100% biology and 100% culture, alternative points-of-view permit the scientist to analyze the behavior from a *biological* or from a *cultural standpoint*. Biology and culture no longer constitute competing alternative explanations; rather, they are two points-of-view on

an object of inquiry that has been created by and will be fully understood only through multiple viewpoints. More generally, the unity that constitutes human identity and human development becomes discovered only in the diversity of multiple interrelated lines-of-sight.

The Synthesis of Wholes

Engaging fundamental bipolar concepts as relatively stable standpoints opens the way, and takes an important first step, toward establishing a broad stable base for empirical inquiry within a relational metatheory. However, this solution is incomplete as it omits a key relational component, the relation of parts to the whole. The oppositional quality of the bipolar pairs reminds us that their contradictory nature still remains, and still requires a resolution. Furthermore, the resolution of this tension cannot be found in the split approach of reduction to a bedrock absolute reality. Rather, the relational approach to a resolution is to move away from the extremes to the center and above the conflict, and to there discover a novel system that will coordinate the two conflicting systems. This is the principle of the synthesis of wholes, and this synthesis itself will constitute another standpoint.

At this point, the Escher sketch fails as a graphic representation. Although "Drawing Hands" illustrates the identities and the opposites, and although it shows a middle space between the two, it does not describe a coordination of the two. In fact, the synthesis for this sketch is an unseen hand that has drawn the drawing hands and is being drawn by these hands. The synthesis of interest for the general metatheory would be a system that is a coordination of the most universal bipolarity one can imagine. Undoubtedly, there are several candidates for this level of generality, but the polarity between matter or nature, on the one hand, and society, on the other, is sufficient for present purposes (Latour, 1993).

Matter and society represent systems that stand in an identity of opposites. To say that an object is a social or cultural object in no way denies that it is matter; to say that an object is matter in no way denies that it is social or cultural. And further, the object can be analyzed from either a social-cultural or a physical standpoint. The question for synthesis becomes the question of what system will coordinate these two systems. Arguably, the answer is that it is *life* or living systems that coordinate matter and society. Because our specific focus of inquiry is the psychological, we can reframe this matter–society polarity back into a nature–nurture polarity of *biology* and *culture.* In the context of psychology, then, as an illustration, write "biology" on one and "culture" on the other Escher hand, and consider what system coordinates these systems. It is life, the human organism, the *person* (Figure 1.3a). A person—as a self-organizing, self-regulating system of cognitive, emotional, and motivational processes, and the actions this system expresses—represents a novel level or stage of structure and functioning that emerges from, and constitutes a coordination of, biology and culture (see Magnusson & Stattin, 1998 for an analysis of a methodological focus on the person).

At the synthesis, then, a standpoint coordinates and resolves the tension between the other two components of the relation. This provides a particularly broad and stable base for launching empirical inquiry. A *person standpoint* opens the way for the empirical investigation of universal dimensions of psychological structure–function relations (e.g., processes of perception, thought, emotions, values), the particular variations associated with these wholes, their individual differences, and their development across

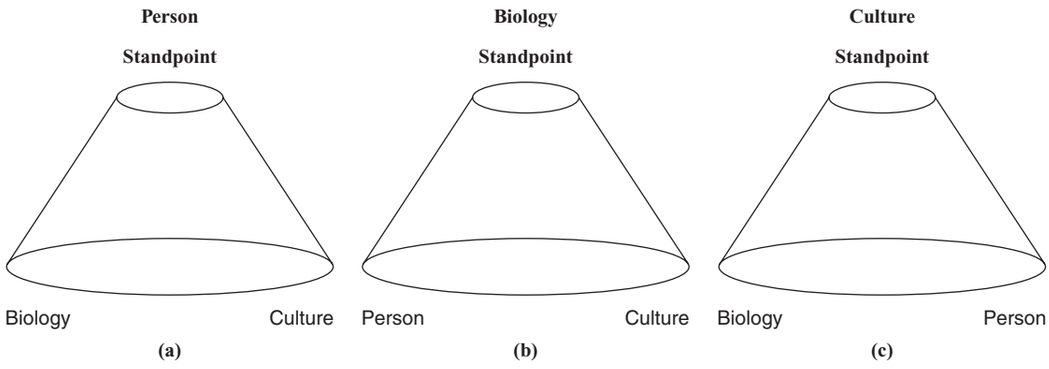

Figure 1.3 Three research program standpoints representing the relational synthesis of wholes: person, biology, and culture.

the life span. Because universal and particular are themselves relational concepts, no question can arise here about whether the focus on universal processes excludes the particular; it clearly does not as we already know from the earlier discussion of polarities. The fact that a process is viewed from a universal standpoint in no way suggests that it is not situated and contextualized.

It is important to recognize that one standpoint of synthesis is relative to other synthesis standpoints. Life and Society are coordinated by Matter; thus, within psychological inquiry, biology represents a standpoint as the synthesis of person and culture (see Figure 1.3b). The implication of this is that a relational biological approach to psychological processes investigates the biological conditions and settings of psychological structure–function relations and the behaviors they express. This exploration is quite different from split foundationalist approaches to biological inquiry that assume an atomistic and reductionistic stance toward the object of study. Neurobiologist Antonio Damasio's (1994, 1999) work on the brain–body basis of a psychological self and emotions is an excellent illustration of this biological relational standpoint. In the context of his biological standpoint, Damasio (1994) emphasizes:

> A task that faces neuroscientists today is to consider the neurobiology supporting adaptive supraregulations [e.g., the psychological subjective experience of self]…I am not attempting to reduce social phenomena to biological phenomena, but rather to discuss the powerful connection between them.…Realizing that there are biological mechanisms behind the most sublime human behavior does not imply a simplistic reduction to the nuts and bolts of neurobiology. (pp. 124–125)

A similar illustration comes from the Nobel laureate neurobiologist Gerald Edelman's (1992; 2006) work on the brain–body base of consciousness:

> I hope to show that the kind of reductionism that doomed the thinkers of the Enlightenment is confuted by evidence that has emerged both from modern neuroscience and from modern physics.…To reduce a theory of an individual's behavior to a theory of molecular interactions is simply silly, a point made clear when one considers how many different levels of physical, biological, and social interactions must be put into place before higher order consciousness emerges. (Edelman, 1992, p. 166)

A third synthesis standpoint recognizes that Life and Matter are coordinated by Society, and again granting that the psychological inquiry is about psychological processes, *culture* or *sociocultural* represents a standpoint as the synthesis of *person* and *biology* (see Figure 1.3c). Thus, a relational cultural approach to psychological processes explores the cultural conditions and settings of psychological structure–function relations. From this *cultural standpoint,* the focus is on cultural differences in the context of psychological functions as complementary to the person standpoint's focus on psychological functions in the context of cultural differences.

This standpoint is illustrated by "cultural psychology," or "developmentally oriented cultural psychology." However, not all cultural psychologies emerge from relational metatheory. When, for example, a cultural psychology makes the social constructivist assertion that social discourse is "prior to and constitutive of the world" (Miller, 1996, p. 99), it becomes clear that this form of cultural psychology has been framed by split foundationalist background ideas. Similarly, when sociocultural claims are made about the "primacy of social forces," or claims arise suggesting that "mediational means" (i.e., instrumental-communicative acts) constitute the *necessary* focus of psychological interest (e.g., see Wertsch, 1991), the shadow of split foundationalist metatheoretical principles is clearly in evidence.

Valsiner (1998) gives one illustration a relational, developmentally oriented *cultural standpoint* in his examination of the "social nature of human psychology." Focusing on the "social nature" of the person, Valsiner stresses the importance of avoiding the temptation of trying to reduce person processes to social processes. To this end, he explicitly distinguishes between the dualisms of split foundationalist metatheory and "dualities" of the relational stance he advocates. Another recent relational cultural perspectives is found in the work of Mistry and Wu (2010), whose sociocultural perspective views culture and individual psychological functioning as mutually constitutive and "individual development is situated and constituted through participation in ongoing, dynamic communities of practice…notions [which] are consistent with the relational metatheory position that culture and person operate in a 'truly *interpenetrating* manner'" (p. 8). Carpendale and Lewis (Chapter 17 of this volume) further illustrate the relational posture of person and sociocultural points of view in the development of social knowledge (see also Mueller & Carpendale, 2004).

When the three primary points of synthesis—biology, person, and socioculture—are cast as a unity of interpenetrating/coacting parts, there emerges what Greenberg and Partridge describe (Chapter 5 of this volume) as a "biopsychosocial" approach to psychology and life-span development. In this tripartite relational systems approach to

life-span human development, each part interpenetrates and "coconstructs" the other or "coevolves" with the other. Development begins from a relatively undifferentiated biosocial action matrix, and through coconstructive (epigenetic) interpenetrating coactions, the biological, the cultural, and the psychological or person part systems emerge, differentiate, and continue their interpenetrating coconstruction, moving through levels of complexity toward developmental ends (Figure 1.4). A critical feature of this synthesis is that once the psychological part system emerges, like any synthesis, it participates as an equal indissociable partner in the total interpenetrating, coconstructive, coevolution, coaction process. Only in a split-off reductionistic context is it possible to envision a "coconstructive biocultural" approach with its clear implication that the psychological system is explained by, driven by, and reducible to the "coevolution" of two pure forms termed the *biological system* and the *cultural system* (Baltes, Lindenberger, & Staudinger, 2006).

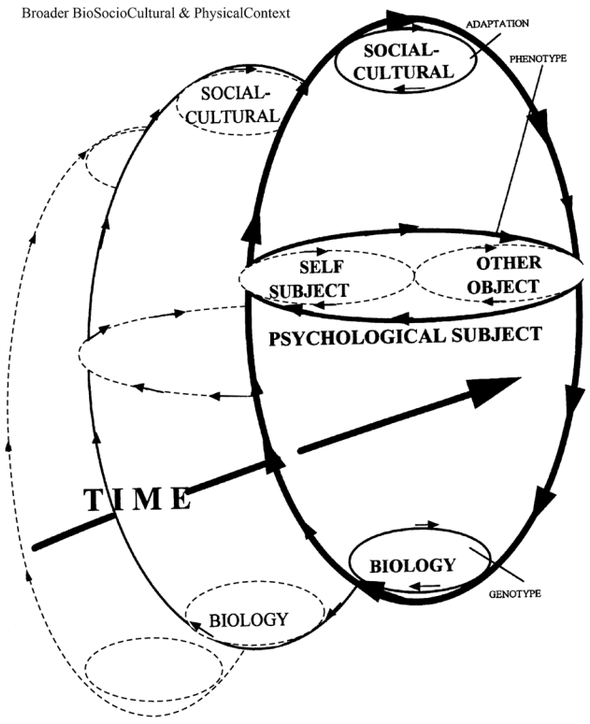

Figure 1.4 Relational emergence and development of the biopsychosocial organism. Within a biosociocultural world, through action mechanisms (*arrows*), a relatively undifferentiated biopsychosocial organism emerges. Through reciprocal interpenetrating coactions, biological, person, and cultural subsystems emerge, and move toward greater articulation, differentiation, and integration.

As a final note concerning syntheses and the view from the center, it needs to be recognized that a relational metatheory is not limited to three syntheses. For example, *discourse* or *semiotics* may also be taken as a synthesis of *person* and *culture* (Latour, 1993). In this case, biology and person are conflated, and the biological/person and culture represents the opposites of identity that are coordinated by discourse.

As a set of epistemological principles, relationism frames a general scientific research methodology or "research programme" (Lakatos, 1978; Overton, 1984) that moves beyond the reductionistic atomism of the positivist era; a methodology in which synthesis and analysis, together with reason and observation, operate in an interpenetrating reciprocal fashion; a methodology that promotes a truly multidisciplinary, multimethod approach to inquiry in which each individual approach is valued not as a potentially privileged vantage point, but as a necessary line of sight on the whole. This methodology facilitates the conceptual integration of theoretical concepts previously considered as competing alternatives as, for example, the integration of transformational and variational change into an inclusive concept of development. From the perspective of this methodology, "relational" becomes an appropriate qualifier for "bidirectional interpenetration" and "multidirectional interpenetration," in clarifying a form of "interaction" that begins and ends in an integrated, interpenetrating coaction of parts, not an aggregate of additive pieces. It serves as a similar qualifier for "differentiation" in emphasizing that differentiations necessarily occur in the context of the integrated parts of the whole.

Relationism also serves as a principled justification for an argument made by several authors in this volume: It is scientifically counterproductive to ignore the integrated whole when analyzing part process, and conversely counterproductive to ignore part processes when exploring the whole. Thus, Turiel (Chapter 16 of this volume) with respect to moral development; McClelland, Ponitz, Messersmith, and Tominey (Chapter 15 of this volume), in regard to self-regulation; Mascolo and Fischer (Chapter 6 of this volume), concerning thinking, feeling, and acting; M. Lewis (Chapter 18 of this volume) examining consciousness; and Santostefano (Chapter 22 of this volume) considering psychopathology, all argue that treating cognition and emotion as if they were split-off, decomposable processes leads to a scientific dead end. In a similar fashion, Carpendale and Lewis (Chapter 17 of this volume) argue against the splitting of social processes and cognitive process in the understanding of "social cognition." And Karelitz,

Jarvin, and Sternberg (Chapter 23 of this volume) discuss the importance to many theories of wisdom—including Sternberg's own theory—of explicitly recognizing and articulating the inherent integration of cognitive and affective development.

Central to the issues of this chapter is the fact that relationism has also served as the metatheoretical frame for the construction for some, but not all, of a family of theoretical approaches termed *relational developmental systems* and a subset of this family termed *dynamical systems.* The following section focuses on the nature of relational developmental systems (Lerner, 2006; Lerner & Overton, 2008; Overton, 2006), keeping in mind the aim of exploring conceptual distinctions in an effort to avoid or ameliorate conceptual confusions, and the aim of clarifying the nature of life-span development.

RELATIONAL DEVELOPMENTAL SYSTEMS

In the exploration of the nature of developmental change it was stated that the object that undergoes developmental change is the *relational developmental system*. In considering the nature of this it should first be noted that "system" represents a *subpersonal* level of explanation (Dennett, 1987; Dick & Overton, 2010; Russell, 1996), which stands in a complementary relation to the *person* level. The person level is constituted by genuine psychological concepts (e.g., thoughts, feelings, desires, wishes) that have intentional qualities, are open to interpretation, and are available to consciousness (Shanon, 1993); in other words, they have psychological meaning. The subpersonal level is constituted by various action systems that are described by concepts such as "scheme," "operation," "ego," "self," or "attachment behavioral system." In fact, consistent with several chapters in this volume, "mind" may be defined as an emergent system that subsumes cognition, emotion, and motivation as relational subsystems.

How then is the relational developmental system to be characterized? What are its identifying features? From the earlier discussion, we know that the system is inherently and spontaneously active, and inherently and spontaneously changing. Activity and change are not the products of other forces; as a consequence, when discussing psychological development, neither biological factors, nor cultural factors, nor any simple additive "interactions" of the two, can be considered to be mechanisms of development. And we know from the earlier discussion that a relational developmental system is one that does not privilege any individual part (the biological, the psychological, the sociocultural). A more detailed specification will further elaborate on these and other system features mentioned earlier, especially as they relate to life-span development.

A system can be defined in various ways. For example, it can be defined as "any collection of phenomena, components, variables" (van Geert, 2003, p. 655). However, this and other "collection" or aggregate-like definitions are inconsistent with holism and, consequently, inconsistent with relationism. A more adequate relational definition of system is "a whole which functions as a whole by virtue of the interdependence of its parts" (Overton, 1975). Thus, a system is by its nature organized and organized holistically. Historically, a general method with the goals of classifying holistic systems in terms of how the parts are organized and establishing *typical patterns* of behavior for different types of holistic systems was called *general systems theory.* The acknowledged father of general systems theory, Ludwig von Bertalanffy, more than 40 years ago pointed to the fact that "general systems"—itself a metatheory—was being interpreted by some within the framework of a "mechanistic" worldview and by some within the framework of an "organismic" worldview (Overton, 1975; von Bertalanffy, 1968a, b). The impact of this often unrecognized conflation was to obscure the specific nature and methods of general systems theory and to obscure the explanatory structure of the approach. Von Bertalanffy—who evidently knew nothing of Steven Pepper's (1942) systematization of "mechanism" and "organicism" as contradictory worldviews—characterized the mechanistic formulation in terms of its principles of the primacy of ontological stasis, atomistic reductionism, and additive and linear organization. He characterized his own organismic perspective in terms of the principles of ontological activity and change, holism, and nonadditive, nonlinear organization. Over the years, the organismic version of the general systems approach was refined and modified (Luhmann, 1995) to include a synthesis with a "contextualist" worldview, and today's direct descendents are termed *developmental* or *dynamic* systems approaches.

Against this historical backdrop, Witherington (2007) has analyzed recent interpretations of "systems" and has demonstrated how again today "systems" is receiving alternative worldview interpretations that fall along similar divergent ontological and epistemological lines as those found in von Bertalanffy's time. Although the mechanistic formulation has moved somewhat to the background—being explicitly identified as taking a "mechanistic approach" is not

currently fashionable—Witherington points out that among current research programs that carry the "systems" label, some operate within the framework of a split-off "strict contextualist" worldview and some within the framework of an integrated "organismic-contextualist" (relational) worldview (Overton, 2007a). Thelen and Smith's (1994, 2006; Smith, 2005) approach is representative of the strict contextualist interpretation, whereas Mascolo and Fischer (Chapter 6 of this volume); Ford and Lerner (1992), Lerner (2006), van Geert (2003; van Geert & Steenbeck, 2005), and Gottlieb, Wahlsten, and Lickliter (2006), among others, represent a relational approach. The main point of differentiation is that *strict contextualists privilege here-and-now explanations* of development, whereas *relationists accept both local contexts and higher order forms (patterns of organization) as explanatory* (van Geert & Steenbeck, 2005). As Witherington says, these differences "affect how each camp views the process of self-organization, the principle of circular [relational bidirectional] causality and the very nature of explanation in developmental science" (p. 127). Stated slightly differently, the relational approach takes the developmental system *qua* developmental system seriously and does not view it as merely the outcome of behavioral variation, whereas the strict contextualist sees variation as the determining cause of system structures.

An understanding of the nature of relational developmental systems requires that a distinction be made between closed and open systems, and between near and far from equilibrium states. All systems operate according to the Second Law of Thermodynamics; all systems exhibit a directionality, moving toward a maximum state of disorder (randomness, death), which is the definition of thermodynamic "equilibrium." The quantitative measure of randomness is termed *entropy.* Thus, systems exhibit an "arrow of time" (Overton, 1994) or irreversible directionality of change moving toward maximum entropy (i.e., a direction from order to disorder). However, before reaching this state, also termed a *target* or *fixed-point attractor* by systems theorists (e.g., van Geert & Steenbeck, 2005), a system evolves to a "steady" or "stable" state.

A system may exchange energy, matter, and information with its environment. A *closed system* is defined as one that *exchanges only energy with its surroundings.* Closed systems have relatively rigid boundaries; they are nonflexible, impermeable. A watch is a standard example of a closed system. Such systems operate in ways similar to a thermostat; other than changing the temperature, little environmental input is needed to maintain effective operation, and causality is one way. Closed systems "near equilibrium" reach the steady state mentioned earlier, and this state is the area where energy dissipation reaches a minimum. This state is also called *homeostasis* (Waddington, 1971). At this steady state, the system is stable and completely analyzable (reducible) into individual components and functional relations between components (i.e., "interactions"). The relation between parts of such a system is one of simple complexity in the sense that these "interactions" between components may be treated as trivial or decomposable. Thus, such a system may be considered uniform, stable, and linear (summative)—the fundamental categories of the machine. This view of a system is exactly the background model used in psychology and other fields to justify both the denial of irreversible directional increases in structure or organization across various evolutionary series and treating biological organisms as steady state input-output computational devices. This was, for example, exactly the model that Fodor (1980) used in his dismissal of the Piagetian perspective that stronger (more complex, more organized) logical systems emerge from weaker logical systems. It is also the model that Levins and Lewontin (1985) criticized when they noted that "modern evolutionary thought denies history by assuming equilibrium" (p. 23). Closed systems near equilibrium do entail an Arrow of Time. However, this end point can be ignored for most practical purposes when considering large-scale thermodynamic (or psychological) issues.

Living systems, as well as other physical systems, according to any plausible interpretation, are not closed: "When we examine a biological cell or a city…not only are these systems open, but also they exist only because they are open" (Prigogine & Stengers, 1984, p. 127). And *open systems*—defined through their *active exchange of matter, energy, and information* with their surroundings—*build and maintain complex order* or organization by exporting entropy into their surroundings. An open system takes inputs from the environment, transforms them, and releases the transformations as outputs. At the same time in this coaction of system and environment, there are reciprocal effects on the system itself (change of organization) and on the environment (transformed environment). That is, the organization becomes part and parcel of the environment (biological and cultural with respect to living systems) in which it is situated just as the environment becomes part and parcel of the system. To borrow from Piaget, open systems are assimilation/accommodation wholes that resist the twin assumptions of trivial "interactions" and additivity of parts. They are dialectical, active, and holistic, and they

define some of the basic features of relational developmental systems.

Open systems resist stable-state machine interpretations. They also attain a steady state, but it is a dynamic state where the rate of input of energy, matter, and information is equal to the rate of energy dissipation of energy and output of material and information. This state is called *homeorrhesis,* meaning that what is stabilized in an active system is not a particular value (homeostasis) but, instead, is "a particular course of change in time" (Waddington, 1971, p. 36). Finally, open systems *maintain* their state of homeorrhesis through "self-regulatory" mechanisms (i.e., processes of maintaining structure and order without explicit instructions or guidance from outside forces; (see McClelland, Ponitz, Messersmith, & Tominey, Chapter 15 of this volume, for an extended discussion of self-regulation).

Although steady state open systems define some of the basic features of relational developmental systems, they do not in themselves introduce a novel directionality to change. In fact, early work in the field of general systems was criticized because it was relatively silent on the issue of directionality; it addressed no developmental direction and was generally content with examining the holistic features of open systems (Overton, 1975). A directionality or arrow of time of *increasing complexity* emerges when *open systems* are driven or exist—as is the case of organisms and of the biosphere as a whole—*far from equilibrium*.

Work on the movement of open systems from lesser to greater levels of complexity was pioneered in the field of thermodynamics by the chemist Ilya Prigogine and his colleagues (Glansdorff & Prigogine, 1971; Nicolis & Prigogine, 1977, 1989; Prigogine & Stengers, 1984). When open systems are far from equilibrium, relatively stationary states become unstable through a fluctuation (i.e., variations or variability) that is "first localized in a small part of the system and then spreads and leads to a new macroscopic state" (Prigogine & Stengers, p. 178). With respect to human development, this means that small behavioral variation occurs in the context of the current organization of the system, and these variations ultimately lead, through positive and negative feedback mechanisms, to a new more complex level of organization. The centrality of variability here is the reason that all relational systems perspectives take intraindividual variability seriously rather than casting it off as error, as is done in classic nonsystems or closed system approaches. As the complex system becomes unstable, a "crisis point" or "bifurcation point" arises and abrupt changes, called *phase transitions,* occur, resulting in the system *evolving into a novel more complex state* that may have properties different from those of the original. The new states, which, *in principle,* are not predictable from the original states, exhibit increased degrees of organization. That is, at a certain point, differentiation and reorganization (transformation) takes place, and this change yields a more complex organization, as well as emergent systemic properties. For example, at birth, the human organism is a complex sensorimotor system, and through variational actions-in-the-world, and their positive and negative feedback loops, this system becomes transformed into a more complex reflective symbolic system, where conscious reflection and symbols constitute emergent properties.

Prigogine termed these states *dissipative structures* and the complex holistic processes that lead to the formation of these states *self-organization.* Self-organization occurs only in complex systems, and it is "a *process of creating structure* [emphasis added] and order without explicit instructions or guidance from outside" (van Geert, 2003, p. 654). Thus, the system is self-organizing in the sense that it operates according to its own principles and not according to the dictates of external forces. It is important to emphasize that self-organization most empathetically does not mean that the system is split off or isolated from its environment. As stated earlier, it exchanges energy and matter with the environment, and it increases in complexity by acting in that environment; it is part and parcel of its environment as its environment is part and parcel of it. When viewed from the psychological standpoint, "environment" refers to both the person's biological and external environments. The psychological system self-organizes and self-regulates using its biological and cultural/physical contexts as resources, not as driving forces.

Although the randomness of the arrow of thermodynamic equilibrium will prevail in the long run—importantly here for a life-span approach, living organisms do eventually decline and die—on the way, the arrow of irreversible nonequilibrium thermodynamics "allows for the possibility of spontaneous self-organisation leading to structures ranging from planets and galaxies to cells and organisms" (Coveney & Highfield, 1990, p. 168).

A close relation exists between self-organization and the chaos called *dynamical chaos* or *deterministic chaos.* These terms are used to define irreversible, nonlinear systems that are incredibly sensitive to initial conditions. Deterministic chaos differentiates this kind of paradoxically predictable randomness, which is internally generated by a system, from the uncontrolled effects of "stochastic" fluctuations

caused by the environment. When an irreversible process (e.g., chemical clock reaction) is pushed far from equilibrium, the evolution that occurs can be represented as a series of alternative choices or, as mentioned earlier, moves to new states. As a system fluctuates and reaches new bifurcation points or phase transitions, choices available to the system multiply in ways that lead to unpredictable dynamic behavior. Although this behavior appears random, it is, in fact, minutely organized. Furthermore, the evolution of a system can still be understood in terms of a target, goal, end point, or *attractor.* In this case, however, it is not a fixed-point attractor of thermodynamic equilibrium, but what is called a *strange attractor.* More broadly, attractors are end states or goals or recurrent patterns that ultimately stabilize and become increasingly predictable (Thelen & Smith, 1994). Van Geert (2003) points out that attractors can take a number of forms. As examples, there is the simple *point* attractor where the system develops toward a stable state (e.g., "the adult speaker's stable level of linguistic skill [p. 658]" or a given overall developmental level such as Piaget's "concrete operational" or "formal operational" states). There are also *cyclical* attractors where, as the name implies, states of the system run through cycles as, for example, in neo-Piagetian stage theory, "which assumes that every stage is characterized by a repetitive cycle of substages" [Case, 1990] (p. 658). In fact, all developmental acquisitions can be described as attractor patterns that emerge across time.

As structure is to function, the organization of the living system is to the activity called *adaptation.* Open systems far from equilibrium have been termed *adaptive.* Adaptation here refers how the system responds to changing environments—"perturbations" in systems language (see Santostefano, Chapter 22 of this volume)—so as to increase its probability of survival or to maintain its far from equilibrium state, not in the sense of "adjusting" to an environment. Adaptive systems are defined in contrast with "determined" systems. In determined systems (see Jones, 2003), the relation between inputs and outputs are exactly and reproducibly connected. For example, an automobile is a determined system. Whenever the driver presses the accelerator or turns the steering wheel, both driver and passenger expect the auto to speed up or turn. All components of the auto must be fully determined to achieve this collective response. And determined systems are linear—small inputs resulting in small outputs; large inputs in large outputs—thus, outputs are predictable. In adaptive systems, the parts follow simple rules, whereas the behavior of the whole system is not determined. A flock of birds is a simple adaptive system. There is no bird-in-chief. Each bird follows simple rules such as "avoid obstacles," "align flight to match neighbors," and "fly an average distance from the neighbors." Each bird has a choice of response within the rules; thus, individual behavior is not highly determined. However, given these simple rules, highly complex and adaptive flock behavior emerges (Jones, 2003).

This short introduction to adaptive open systems far from equilibrium reveals that they exhibit a relational complementarity of structure and function—an integration of transformation and variation. They are epigenetic. The system grows through relational multidirectional interpenetrations/coactions of parts including "circular causality" (i.e., the relational bidirectional interpenetration of interlevel—top down and bottom up—causality); they are ordered, sequenced, directional, and irreversible. In summary, they are *relational developmental systems.*

It again needs to be pointed out that relational developmental systems are subpersonal level constructs, and they constitute both formal and dynamic pattern explanations of personal-level meanings and changes of meanings (cognitive, emotional, motivational meanings). As an example, consider a favorite among dynamic systems investigators: "Theory-of-Mind." Leaving aside the general controversial issues surrounding this concept (see Chandler & Birch, Chapter 19 of this volume; Carpendale & Lewis, Chapter 17 of this volume), theory-of-mind is an inference made about a changed pattern of meanings concerning social understandings of self in relation other people. (i.e., the change from "I know that others have the *same* thoughts, beliefs, wishes, desires as me," to "I know that others have thoughts, beliefs, wishes, desires that are *different* from mine"). Notice that this inference is made at the person level, which entails, as stated earlier, genuine psychological concepts (e.g., thoughts, feelings, desires, wishes). That is, there is a change in the way the child thinks. If we look at this same change in pattern at a subpersonal level (i.e., the level of "system"), this change pattern *qua* pattern is the relational developmental system. The ontogenesis of theory-of-mind considered as a system operates according to the principles of open systems far from equilibrium in moving from a lower to a higher level of complexity. Furthermore, when the system activity—termed a *generator* in system language—is translated to a behavioral level, it is called *embodied action* (van Geert & Steenbeck, 2005). In the final analysis, *the microscopic mechanism of all psychological development is the organism's embodied action-in-the-world* (Overton, 2007b; Overton, Mueller, & Newman, 2007). However, to be clear, embodied action

is not simply physical movements and states; action entails intentionality, and intentionality is a feature of all acts from the most sensorimotor to the most reflective or metarepresentational. Thus, to claim that embodied action is the mechanism of development in no way contradicts, for example, Demetriou, Mouyi, and Spanoudis's argument (Chapter 10 of this volume) that metarepresentation is a significant mechanism of development. Similarly, when MacWhinney claims that "language depends on a set of domain-general mechanisms that ground language on the shape of the human body, brain, and society" (Chapter 14 of this volume, p. 472), he is arguing the relational developmental systems position that action of the embodied system ultimately constitutes the mechanism of development.

This introduction to relational developmental systems opens the way to now focus more directly on the life-span meaning of life-span development.

AGE, LIFE-SPAN DEVELOPMENT, AND AGING

One may wonder whether this lengthy abstract discussion might successfully have been avoided by simply defining development as changes in behavior that occur with age, or age-related changes in behavior. Some, especially those functioning within a strict contextualist behavioral orientation, do, in fact, follow this path, arguing that both "development" and the concept "aging" are merely descriptive, and reduce to "age-related change" in behavior. In the context of this choice, the behavioral change group goes on to conceptualize biological factors, cultural factors, and additive combinations of biological and cultural factors as "mechanisms" of behavioral change, or factors that "influence" or "shape" change. On the other hand we have already seen that from a relational developmental systems perspective, although cultural and biological factors are important resources of the system, the general mechanism of development is the developmental system itself, whereas the microscopic mechanism is embodied action-in-the-world; there is no shaping or influencing by split-off forces.

Furthermore, "age-related change" has other problems associated with its use. "Age-related change" is a phrase that is embedded in method; it is not a substantive term. Although it is a convenient empirical marker, when the phrase spreads from the results section to the introductory and discussion sections of a research study, one can be reasonably confident that the project lacks *conceptual* substance. Age has no unique features that differentiate it from time; age is simply one index of time, and there is nothing unique or novel about units of age-time (i.e., years, months, weeks, minutes). Should it be said that development is about changes that occur in time, as some have (e.g., Elman, 2003), or that time is a "theoretical primitive"? Time can hardly be a theoretical anything, as time, in and of itself, does nothing and implies nothing. As Wohlwill (1970, 1973) pointed out, time certainly cannot be an independent variable; it is merely a dimension along which processes operate. All change, even changes discussed earlier in this chapter that are entirely transitory and entirely reversible, occurs "in" time. Thus, if "changes in time" were accepted as definitional, this statement would collapse into the proposition that development is about any and all change. Such a position could be adopted only within the most radical neopositivist and strict split-off contextualist framework. Outside this framework, "development" has always been a far richer and more substantive concept.

When it comes to considering "life-span development," or "adult development," or "aging," the situation becomes more complex and difficult. This complexity involves not only issues of metatheory and theory. As made clear by McArdle (Chapter 3 of this volume), there are specific and complex methodological and data analytic challenges that must be addressed when we extend our developmental perspective across the life span, especially through the use of the long-term, longitudinal research. In addition, however, the sociology of developmental science adds to the difficulty of considering life-span development, adult development, or aging. There are professional groups, journals, and funding agencies that are dedicated to the study of "development," including "life-span development" and "adult development." There are professional groups, journals, and funding agencies dedicated to the study of "aging." And there are some groups and journals that lay claim to the combination of "life-span development and aging" as their field of inquiry. In an effort to discover whether there might be a consensus with respect to the difference/similarity of life-span development and aging, while editing this volume and writing this chapter, I consulted with a number of senior research scientists whose work spans both areas. The outcome of this nonscientific survey was the fairly uniform agreement that the distinction is quite unclear. Reading the history of the American Psychological Association (APA), Division 20—currently named the "Division of Adult Development and Aging" (Birren & Stine-Morrow, 1996)—one finds that as originally established in 1947, the division

was called the "Division on Maturity and Old Age." Its current title did not appear until 1970. In 1975, a Division 20 committee report asked whether a proposed curriculum should "focus on the subject of aging, of life-span development, or both?" (Birren & Stine-Morrow, 1996, p. 6). However, there was no discussion about what "either" or "both" might mean. And when the APA began its publication of the journal *Psychology and Aging,* the first editorial of this new journal declared that it was to be dedicated to "dealing with adult development and aging." (Lawton & Kausler, 1986, p. 3). Clearly from early on there has been some sort of implicitly felt difference between life-span development and aging, but this difference has remained vague at best.

One of my consultants, Fergus Craik, pointed out that, "whereas 'adult development' is a rather positive term, suggesting improvement, clearly 'aging' is negative, suggesting decline and decay" (personal communication, September, 2009). Craik suggests retaining both terms for exactly this reason, but placing both under the umbrella of "life-span development." Craik further argues that both "adult development" and "aging" constitute process rather than neutral descriptive terms; thus, under this proposal, there are two separate processes, a developmental process and an aging process. This approach seems to be a solution that has some positive features and one with which many are comfortable. However, a significant problem for others is that the proposal tends to marginalize "life-span development," as this term becomes simply a descriptive umbrella phrase that subsumes several seemingly disconnected process terms including "infant development," "child development," "adolescent development," "adult development," and "aging."

An alternative to the type of solution Craik proposes begins by representing "life-span development" itself as a process, not a simple descriptive umbrella term. Life-span development is about the relational developmental system, and the relational developmental system is an active self-organizing process that functions across the life span. However, and this is the key to this alternative proposal, although the life-span developmental process necessarily entails trajectory, there is nothing associated with the concept that requires that the trajectory remain an absolute constant from conception to the end of life. It is entirely consistent with the concept of a single life-span developmental process that life begins on one broad trajectory and at some point or during some epoch, moves on to another broad trajectory. Despite the change in direction, features associated with the process, including sequence, order, directionality, epigenesis, and irreversibility, are all retained. When the broad trajectory changes during the life course, the emergence of structural novelty is ultimately replaced by its relational twin—the devolution or dedifferentiation of the system. Nevertheless, development continues as a process across the life span from conception to the end of life. A related feature of this "single process" proposal is that, within the life-span process, the epochs of infancy, childhood, adolescence, adulthood, and late adulthood constitute the purely descriptive parsing of time. In the adult and late adult epoch, adult development and aging become two sides of the same coin. As the trajectory changes, a primary interest in the stability of the system, and resources that the system uses to maintain itself, avoid devolution, and generate new adaptive goals, would tend to be described as the study of "adult development." On the other hand, a primary interest in issues related to decline would tend to be described as the study of "aging." And, of course, there would often be mixed interests, which would constitute "adult development and aging."

Consider this proposal in the context of relational developmental systems concepts. Structure and function constitute a relational bipolarity: Systems are active and activity implies system. We know that adaptive (function) open systems (structure) far from equilibrium both build and maintain complexity (structure); early development is about both building and maintaining system complexity. From some time in the middle years of life, the building of increased system complexity necessarily slows and moves into a dynamical "phase space" of maximum complexity. As an open system, however, the system continues to maintain complexity by exporting entropy into its surroundings. That is, in human terms, the adaptive intraindividual behavioral variations, which across several epochs serve to build complexity, increasingly come to serve the function of maintaining complexity. Adaptive strategies can result in maintaining the structure of the developmental system. However, the fixed point attractor of thermodynamic equilibrium necessarily comes into play and ultimately describes a trajectory of systems devolution completing its developmental course at the end of life. Exactly when this attractor comes into play is an empirical issue, undoubtedly related to developmental resources and undoubtedly exhibiting large individual differences. For some, devolution could begin quite early, whereas in another, it might not emerge until shortly before the end of life.

Thus, the relational developmental system has two *telos*: one an inclined plane leading to maximum complexity and efficiency, and the other a declined plane leading

to a final equilibrium. The availability of both biological and cultural resources constitutes a central issue with respect to building and maintaining a psychological system's complexity, and they remain a central issue in the devolution of this competence. It bears repeating, however, that neither biological resources, nor cultural resources, nor any additive "interactions" of these resources drive development. The motor of the developmental system is the system itself, and the microscopic mechanism of this is the organism's embodied action-in-the-world regardless of trajectory.

This integrative single-process dual-directionality approach to life-span development is consistent with concepts presented in this volume and elsewhere. "Fluid intelligence" (Blair, see Chapter 8 of this volume), "control processes" (Bialystok & Craik, see Chapter 7 of this volume), and "fluid mechanics" (Baltes et al., 2006) represent behavioral manifestations of the transformational pole of the developmental system. In early development, these systems become increasingly complex, and in late adult development, devolution ultimately occurs (Bialystok & Craik). "Crystallized intelligence" (Blair), "representations" (Bialystok & Craik), and "crystallized pragmatics" (Baltes et al., 2006) are behavioral manifestations of the variational or information-processing pole of the developmental system. Processes at this pole become increasingly effective and efficient, and generally maintain this status across early and late developmental epochs, although some decline may occur in the ability to access and manipulate representations (Bialystok & Craik, see Chapter 7 of this volume). It is the skills and procedures developed in relation to this pole that serve as resources for system maintenance, as well as for novel adaptive goals in late adulthood. Taken together, according to Bialystok and Craik, the two-part processes of control and representation maintain an adaptive dynamic *balance* across course of life:

> Thus, although there may be a tendency for control to dominate in middle life and representations to dominate in both early and later life, all cognitive performance throughout the life span rests on the *interaction* between these two sets of factors, although the balance may tilt from one to the other for various reasons. (p. 218)

Mascolo and Fischer (Chapter 6 of this volume) focus, as do Müller and Racine (see Chapter 11 of this volume), on the inclined plane of increasing organizational complexity, and within this context, they emphasize the importance of environmental supports in the expression and maintenance of this competence. Although they argue that because there is a decline with advancing age, there is no development in this epoch, this part of their general approach loses its force in the single-process dual-trajectory life-span development proposal. That is, their argument is premised on the notion that there is no structural or system "progression" involved in adult and late adult development. Within the integrated process proposal, however, there is, in fact, progression toward those very features that Mascolo and Fischer claim as necessary criteria for developmental change, that is, an "*optimal outcome, end point* or *form"* (Mascolo & Fischer, Chapter 6 this volume). It is only from a human subjective experiential perspective that thermodynamic equilibrium or the complete devolution of the system is not "optimal"; but regardless, it is certainly an outcome, an end point, and a form.

The single-process dual-directionality approach is also consistent with positions that focus on the positive features of early development and late adult development (for a discussion of "thriving," see Bundick, Yeager, King, & Damon, Chapter 24 of this volume; for positive features of late adult development, see the discussion of "cognitive reserve" and "compensation" by Bialystok & Craik, Chapter 7 of this volume). In early development, for example, Lerner and colleagues' (2005) "5 Cs" (confidence, competence, character, compassion, connection) model of positive youth development focuses on skills that enhance early development as it moves toward greater complexity.

Although the developmental trajectory of all individuals during the late adult years is necessarily toward the ultimate end of life, *successful late adult development* (also called *successful aging* in the literature) refers to individuals whose cognitive and emotional spheres of life, as well as their social goals and satisfactions, operate well above the average. To account for both the enhancements of successful late adult development and the losses, the Balteses and their colleagues (Baltes & Baltes, 1990; Baltes & Freund, 2003; Baltes et al., 2006) posited a Selection, Optimization, and Compensation (SOC) model, where *selection* entails choosing and committing to goals, *optimization* refers to acquiring and refining the means needed to accomplish these goals, and *compensation* refers to maintaining a given level of functioning via the discovery of alternative means when existing means are lost. Returning to the co-relative enhancement of early development, Gestsdottir and Lerner (2007) refer to the SOC model as it applies to adolescence as "intentional self-regulation" (p. 508). And in Chapter 15, McClelland,

Ponitz, Messersmith, and Tominey elaborate on this feature of system self-regulation as it applies across life-span development:

> …self-regulation is involved when an adolescent selects a college and/or career path, and it underscores how adaptively an adult navigates life transitions such as becoming a parent, planning for a child going to college, being a productive citizen, retiring, and optimizing health and development in late adulthood. Self-regulation also enables us to manage the mental and physical challenges that become increasingly prevalent as we age and confront difficult events, such as a partner or spouse dying. Thus, throughout the life span, self-regulation is a critical factor in our ability to manage our emotions, cognitions, and behavior. (p. 510)

A corollary of this proposed integrative single-process dual-directionality of life-span development is the fact that "aging" is considered a descriptive, not a process term. Although processes take place during aging, there is no "aging process" or "process of aging." As discussed earlier, age itself reduces to time, and although processes operate within time, time itself cannot be a process. It appears that when the phrase *aging process* is used, it most frequently entails making an implicit appeal to a split-off biological process. Here again, however, it is important to guard against importing a context-free biology, however implicitly, as a mechanism that drives the system. To repeat, biological processes and their development constitute a resource of the life-span relational developmental system, not a mechanism of its early or late development. The fact that this resource declines during the later years of life is important, in the same way that the decline of cultural resources is important, but this loss does not constitute a mechanism. "Aging" is a descriptive term that refers to the late adult years; it is not an explanation of what occurs in those years. There is, for example, no such thing as "aging-induced decline." On the other hand, "late adult development" as a part of the life-span process of development is a process term, and as such it has broad explanatory powers.

As a final issue with respect both to the concept of life-span development and the single-process dual-trajectory proposal to the relation between life-span development and aging, it is worth noting that the concept "maturation" sometimes enters life-span discussions in a manner similar to that of "aging." "Maturity" itself is simply a surrogate term for end point, goal, or attractor. One may reach biological maturity, cognitive maturity, or emotional maturity, and we may speak of the mature perceptual system, language system, self system, adults, and so on. Occasionally, one also finds mentioned the "maturation" of these systems. In this case, the term either functions as an extremely vague and uninformative substitute for "development," and is best avoided, or functions as surrogate for "biologically determined," and is best avoided. Used in either of these latter two fashions, the term is as empty as its twin "growth."

"Maturation" does become more problematic when it is introduced in life-span human developmental discussions to reference a context-free biological process, as in, for example, a statement such as "cognitive mechanics reflect the influence of maturational processes, whereas cognitive pragmatics reveal the power of culture." Splitting-off biological processes as context-free causal agents and encapsulating these processes as a vaguely defined "maturational process" add nothing to advancing an understanding of cognitive, affective, social, or motivational life-span development.

CONCLUDING REMARKS

This chapter represents a conceptual exploration of what it means to say that we are life-span developmental scientists who study life-span development. As it turns out, the meaning of this proposition is relative to the metatheoretical grounding on which it rests. Split metatheoretical groundings characteristic of the era of neopositivist or radical empiricist methodology, as well as contemporary "strict" contextualism, cut the very nature of development into sets of dualistic competing alternatives. Within this grounding, variational change is pitted against transformational change, continuity of change is pitted against discontinuous change, nature is pitted against nurture, structure against function, constructivist perspectives against information-processing perspectives. On the other hand, relational metatheory, emerging as a viable scientific grounding in the postpositivist era, functions as the context for an integrative perspective on development and developmental issues. Relationism, as a synthesis of the worldviews contextualism and organicism, conceptualizes development as a holistic, active system in which variational and transformational change, continuity and novelty, biology and culture, structure and function, constructivism and information processing operate as integrative, interpenetrating/coactive components. Within split approaches, external forces—environmental or biological—drive psychological development. Within

a relational developmental systems approach, the active system's actions-in-the-world constitutes the overriding mechanism of development, whereas biology and culture constitute system resources. Split perspectives faced with life-span issues of growth and decline resolve these issues—true to their metatheoretical directives—by assuming competing alternative processes: one "developmental," one "aging." Relational developmental systems resolve the same issues through an integrative single-process dual-trajectory understanding of a single overarching process called *development.* Thus, in the final analysis, what life-span developmental scientists, in fact, do is study *development* from conception to the end of life.

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