3  Ecological Perspectives in Human Development: A Comparison of Gibson and Bronfenbrenner

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In this chapter we provide a brief overview of ecological perspectives as they relate to human development, as the background to more extensive discussion of the perspectives taken by two theorists, James Gibson and Urie Bronfenbrenner. Despite their very different foci (Gibson being concerned primarily with perception, Bronfenbrenner with social contexts) and their different levels of analysis, they share basic assumptions and, we shall argue, their perspectives should be viewed as complementary. The assumptions that they share derive from their acceptance of an ecological perspective.

What is an ecological perspective? It is a standpoint for conceptualizing the changing maturing person in relation to a changing environment — social, physical, and psychological. The ecological perspective is shared with other frameworks within which human development is considered, ranging from cultural psychology as represented by Shweder (1990), Rogoff (1990), and Valsiner (1989), through the co-constructionist perspective on development (Tudge, Putnam, & Valsiner, in press; Wozniak, 1993), and encompassing developmental psychobiology (Gottlieb, 1992, in press; Johnston, 1985). Although the ecological perspective, and the term ecology, originated (at least in modern day science) in biology, its use spans several disciplines, among which is developmental psychology. There, it is linked most notably to the work of James Gibson and Urie Bronfenbrenner. For both of these theorists an ecological perspective has unique meaning, yet fundamentally they share a belief in the

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necessity of viewing the individual and the environment as they relate to and define each other. They have built their theories upon this premise.

Ecology is the study of organism—environment interrelatedness. The coining of the term ecology is usually credited to the German zoologist and evolutionist Ernest Haeckel. In 1873 Haeckel proposed a new science (called ökologie, from the Greek word oikos, for living place or house) to study organisms in their environment, which he believed to be inseparable parts of a whole (Bubolz & Sonntag, 1993).

In the late nineteenth century, interest in person—environment interrelatedness grew, accelerating with the emergence of Darwin's theory of evolution and the role of the environment in adaptation and species survival. This was also a time of rapid urbanization, industrialization, and social reform, and there was concern about how individuals and families would fare in the face of such change. The use of the term ecology appeared in the study of the family as early as 1892. Ellen Swallow Richards unsuccessfully tried to persuade the co-founders of home economics (the early name of the field devoted to the study of children and families in context) to name the new discipline oekologie, in keeping with their aim of studying individuals as social beings relating to their immediate environments (Bubolz & Sonntag, 1993; Clarke, 1973). Other disciplines, such as geography (Barrows, 1923) and sociology (Burgess, 1926; Park, 1936; Thomas & Znaniecki 1918–1920), also incorporated ecological approaches early in the century. The perspective has also appeared in anthropology, economics, and human—environment relations (Bubolz & Sonntag, 1993).

Ecological Ideas in Historical Perspective

The idea that the study of human development must involve consideration of the context or environment in which it takes place is not new. Indeed, it has been around for at least a century (Bronfenbrenner, 1993; Valsiner, 1992; van der Veer & Valsiner, 1988). The study of development in relation to environment can be traced to Germany in the 1870s and the research of Schwabe and Bartholomae on influences of neighborhood environment and the development of concepts in children. These scholars concluded "It is an undeniable fact that the average individuality of the child in a
metropolis... is a different one, in consequence of the influence of his surroundings, from that of a child living in a rural district or in a small town" (quoted in Bronfenbrenner & Crouter, 1983, p. 36). Many other scholars have contributed to the emergence of ecological approaches to human development since then, and several of them will be mentioned in the following pages. These scholars have not at any time represented the mainstream of psychology (developmental or otherwise), but their contributions to current trends toward a greater acceptance of contextualism and ecological models should not be underrated.

For example, in U.S. psychology at the turn of the century, James Mark Baldwin (1895) wrote that the question "How does the individual organism manage to adjust itself better and better to its environment?...[was] the most urgent, difficult and neglected question of the new genetic psychology" (pp. 188-189, quoted in Cairns, 1992, p. 19). In the Soviet Union, similar interest was being shown in the ways in which individual development and the social world were interrelated. Lev Vygotsky's cultural-historical theory clearly linked development with social context. In Vygotsky's theory, learning takes place through interaction with more competent others, and all development is framed within a context that is socially created at both local and broad societal levels and is affected by the developing nature of the individual (Tudge et al., in press: Tudge & Winterhoff, 1993; van der Veer & Valsiner, 1991; Vygotsky, 1978; Wertsch, 1985). Dewey's understanding of development was very close to Vygotsky's in that Dewey (1911) believed that "mind and character require a culture medium in order to develop" (p. 422) and saw development as a process that is related to social practices, beliefs, and ideologies. Both theorists echoed Pierre Janet's idea of sociogenesis: knowledge being first interpersonal and then becoming intrapersonal (van der Veer & Valsiner, 1988; Tudge et al., in press).

Organismic theorists Kurt Goldstein (1939) and Ananda Angyal (1941) argued for holism, a related concept. Drawing from Dewey's article "The Reflex Arc Concept in Psychology" (1896), Angyal (1941) held that attempts to separate individual from environment were futile since given the complexity of their interpenetration, any resulting separation would create an artificial distinction. Angyal described the total entity, or biosphere (which comprised the biological, social, and psychological individual), not as interacting parts, not as constituents which have independent existence, but as aspects of a single reality which can be separated only by abstraction" (p. 100).

These perspectives have never been at the forefront of psychology, particularly as practiced in the United States, where it has been and continues to be dominated by an experimental and reductionistic model adopted from the physical sciences, rather than an ecological perspective derived from biology. Although some psychologists have argued for a more holistic approach (considering the interrelatedness of individual, physical, sociocultural, and cultural aspects of development), the discipline has been dominated by those who have taken a dichotomous stance on the relation between the individual and environment.

The origins of this dichotomous stance can be traced back to the nineteenth century and associationist thought (see, e.g., Boole's Laws of Thought, 1854). The dichotomy was instantiated at the time of the official recognition of the discipline as a science, when in 1879 Wilhelm Wundt opened his laboratory in Leipzig, Germany. Wundt distinguished between experiences that are open to individual introspection and those that are social in nature, the latter being, in his view, quite separate (Laboratory of Comparative Human Cognition, 1983). Wundt believed that the study of both was essential and, indeed, complementary (Cole, 1989). However, the rift between empirical and descriptive psychological investigation has endured to the present day. In ensuing years, North American psychologists working in the traditions of functionalism, behaviorism, and experimental and cognitive psychology have striven to "control" context and values in the quest for objectivity (equated with the physical sciences) and the building of a numerative science of thought and behavior (Suplee, 1977). Ironically, this positivist perspective was embraced most fully by social scientists during the time when philosophers of science began to seriously doubt its usefulness (Daston, Oppelt, Wehl, & Steinmetz, 1990; Suplee, 1977).

To several psychologists, however, it was evident in the early years of the new discipline that a purely experimental and reductionistic methodology could not adequately answer all questions pertaining to psychological phenomena. Criticism of reductionism in the United States can be traced to pragmatists John Dewey (Wertsch, 1991) and William James, and in Germany to Wilhelm Dilthey (Cole, 1979). For example, John Dewey (1902) believed development to be the interaction of forces within the ma-
turing child with social values, goals, and meanings of the adult world; “The education process is due to the interaction of these forces” (p. 272, quoted in Cahan, 1992). From an ideology of progress, Dewey emphasized that the social world was dynamic rather than static (Cahan, 1992).

The ideas of Dewey and James laid the foundations for symbolic interactionism, and indeed two of its early leaders, Cooley and Mead, were trained in the tradition of pragmatism. While this group contributed to early excitement with scientific methods in the United States, their principal ideas centered on the social construction of meaning, or socially based development. Symbolic interactionism is premised on the reciprocal nature of person-social environment relationships. Humans are seen as creating together a symbolic world, which in turn shapes their behavior. In Charles Horton Cooley’s writing (1902/1956) the process by which the concept of self develops is clearly social and dialectical. The “looking glass self” emerges through interactions with others in the environment; the child acts socially, perceives others’ assessments of the behavior, and bases his or her reaction on that perception (1902/1956). Likewise, in George Herbert Mead’s view, development of the mind (meaning and consciousness) is a social process. Consensual meaning arises out of interpersonal actions and responses (Mead, 1934/1956). Furthermore, in the immediate settings in which people live there was thought to be continuous mutual influence. Ernest E. Burgess (1926) believed that the behaviors and actions of each family member could, and would, change the interaction patterns of all other members of the family. Thus, symbolic interactionism is about the nature of the interactions between human beings, who act in relation to each other and perceive and interpret each other and themselves (Charon, 1979). It is, in effect, about person-environment interrelatedness.

In midcentury, holistic approaches to the study of development were again put forward, most notably by Kurt Lewin and psychologists working in the Gestalt tradition, the locus of much opposition to reductionism (Gardner, 1980). Wertheimer and Kohler proposed that psychological analysis should start with the perceptual field as a whole. In the Gestalt model, field is differentiated into constituent parts, figure and ground. These parts should be studied not in isolation, however, but in terms of their mutual influence (Hall & Lindzey, 1985). Kurt Lewin shared this Gestalt emphasis on interactions among a totality of factors in a given context (Lewin, 1931). After his death in 1947 two of his colleagues, Roger Barker and Herbert Wright, continued to investigate the role of environmental forces on the “lifespace” of the child (Barker & Wright, 1951; Wright & Barker, 1950).

This, then, was the intellectual climate in which the ecological perspective grew. To illustrate it more fully, we shall discuss two different theories that are both termed ecological and that while they have very different emphases, are quite complementary — those of Gibson and Bronfenbrenner. Both theories grew out of dissatisfaction with contemporary approaches to psychology. Gibson (1973), for example, wrote that “experimental psychology today suffers from the defect that what is known is mostly irrelevant and what is relevant is mostly unknown” (quoted in Reed, 1988, p. 9). What was relevant in his view was perception, which he defined as the relation between person and environment, a position that derived from the work of the Gestalt theorists. Bronfenbrenner, who himself was strongly influenced by Lev Vygotsky and Kurt Lewin, also rejected the associationist dichotomy and the positivist position that social science needs to be pure (value-neutral and context-free) to be useful and scientific (Bronfenbrenner, 1977, 1979), and stressed the need for social relevance in research. Bronfenbrenner (1977) held that neither scientific rigor nor relevance to the real world need be forgone in the study of human development, stating, “The orientation proposed here rejects both the implied dichotomy between rigor and relevance and the assumed incompatibility between the requirements of research in naturalistic situations and the applicability of structured experiments at an early stage in the scientific process” (p. 194):

Especially in recent decades, research in human development has pursued a divided course, with each direction tangential to genuine scientific progress. . . . The emphasis on rigor has led to experiments that are elegantly designed but often limited in scope. This limitation derives from the fact that many of these experiments involve situations that are unfamiliar, artificial, and short-lived and that call for unusual behaviors that are difficult to generalize to other settings (p. 193).

Gibson’s Theoretical Framework

James Gibson was trained as an experimental psychologist at Yale during the 1920s. His intellectual development and experimental
work is detailed in the biography *James J. Gibson and the Psychology of Perception*, by Edward Reed (1988), who described Gibson as a "distinguished dissident." Gibson studied human behavior and perception at a time when most psychologists were examining learning in rats. He continued to study perception and during World War II provided a description of the visual information used by pilots to land airplanes. When studying computers became more predominant than studying rats, Gibson remained focused on perception and described his position as an ecological approach to psychology (perception being the primary foundation area to examine). Although surely influenced by the ideas of philosophers and modern scientists (such as Darwin, Russell, Whitehead, Einstein, William James, and Kurt Koffka) as they coincided in the intellectual community in the 1920s (Reed, 1988), Gibson nonetheless departed from many of the ideas of these early influences. Reed (1988) suggests that Gibson's development of his ecological framework was not so much a product of any single incident or idea but rather the progression in his work and thinking about perception up to the publication of his last book, *The Ecological Approach to Visual Perception* (1979). The corpus of Gibson's work represents 50 years of experimental research and conceptual publications. (See Reed, 1988, for the complete list of Gibson's publications.) The following description given by Reed (1988) nicely places James Gibson in historical context:

As a young man, Gibson was an optimist and a pragmatist, someone who believed that experimentation in the social sciences could help elucidate human behavior and thereby help make the world a better place. Later he came to doubt his early optimism about the value of experimentation in psychology. ... The story of Gibson's life is the story of this personal transformation and the changes in psychological theory and practice that made him a distinguished dissident. It is the story of someone who learned to see for himself in the heady days of American pragmatism and experimentation and never stopped looking at things in his own way. (p. 25)

James Gibson (1979) concentrated his attention on perception: his theory of perception is prototypically ecological, his position being that perception is understandable only in terms of both the perceived and the perceiver. His belief was that perception is "direct" as opposed to mediated by inference and representation, positions more commonly taken by psychologists. Gibson argued that there is information in the optic array that is directly available to be "picked up" by a perceiver. Perception defines a relationship between an active organism and its environment, development being the change in this relationship over the course of the organism's life. Gibson argued that the information is "inexhaustible" but that more of it becomes known over time through perceptual learning. This type of learning, he believed, is characterized by a process of differentiation, rather than construction (Gibson & Gibson, 1955). Gibson and his wife, E. J. Gibson, argued that meaning does not need to be constructed.

To explain why construction was not relevant for perception, the Gibsons used three primary concepts: reciprocity of the organism and its environment, information, and affordances.

Gibson (1979) stated that perception cannot be understood by examining the perceiver alone, but only by examining the relationship between the perceiver and the environment that is the object of perception. One aspect of this reciprocity is the close link in Gibson's theory between perception and action, a link related to the concept of affordance.

An affordance, in Gibson's terms, can be described as the possibility for action on the part of an actor in an environment. The constraints of the actor and the constraints of the environment mutually contribute to such possibilities for action. For example, a rigid surface affords locomotion, a path affords pedestrian locomotion, a stairway affords ascent and/or descent, an object of an appropriate size affords grasping, a rigid object with sharp edge affords cutting, and so on. In each case, however, the affordance relationship between organism and environment is defined simultaneously by properties of the organism and properties of the environment. Thus, a 6-month-old infant would not perceive a large rigid surface as one affording walking, but as one affording crawling. In the case of the object to be grasped, the adjective appropriate can be understood only in terms of the organism's characteristics: What is graspable for an adult may not be graspable for an infant. Similarly, exploratory behaviors that allow the organism to "probe the environment... reveal information that specifies relevant environmental properties" for the organism (Adolph, Eppler, & E. Gibson, 1993). Accordingly, perception of the environment is necessarily perception of the self. In the course of development, perceivers tune their actions by differentiating the information that is relevant in the environment for the purpose of performing some action or activity. The affordance relationship
captures the linkage that James Gibson proposed between perception and action. Action is guided by perception and action over time informs perception.

What, then, is perception? According to Gibson, perception is based on information pickup. An organism, equipped with perceptual systems (visual, auditory, proprioceptive, etc.), picks up information available in the environment (the optic array, the auditory array, etc.). This process is direct and does not require inference or other cognitive processes, a radical departure from more traditional accounts of perception.

Gibson described in great detail the possible information conveyed in the optic array. Observers with perceptual systems (evolved to use just the sort of information specified by the layout, surfaces, and objects in the environment) pick up information that specifies the properties of surfaces and objects (available "in the light"). Gibson (1979) described, from an ecological perspective, an approach to "ecological optics" (as opposed to classical optics) that requires an initial description of the environment "since what there is to be perceived has to be stipulated before one can even talk about perceiving it" (p. 2). Gibson argued that the information in an illuminated medium should not be assumed to "stimulate receptors" as in classical optics, but should be considered information in the light that can activate the perceptual system tuned to pick it up. Thus, perception is not the processing of sensory inputs, but the extracting of invariants from the stimulus. The information in ambient light, along with sound, odor, touch, and natural chemicals is inexhaustible. A perceivers can keep on noticing facts about the world she lives in to the end of her life without ever reaching a limit. There is no threshold for information comparable to a stimulus threshold. Information is not lost to the environment when gained by the individual, it is not conserved like energy. (Gibson, 1979, pp. 7, 94)

In sum, Gibson's theoretical framework assumes that the perceive and the environment are inseparable. As is true of other ecological positions, the strong position is taken that the study of the individual isolated from his or her environment (or, for that matter, of the environment without consideration of the organisms inhabiting that environment) may allow empirical clarity but will not inform understanding of human development.

Research within Gibson's Ecological Framework

Clearly, from Gibson's perspective, perception is an activity that occurs across time. Perception is thus dynamic and is a relationship between an organism and its environment. If there is information to specify the properties of the environment and if the perceiver picks up this information, it then becomes important to identify the information in order to understand how a perceiver uses that information to guide activity. Two questions are relevant: What is information and what is the affordance relationship? Scholars using the Gibsonian framework have conducted research addressing both questions.

What sort of information can be identified? To start, information that is used to perform an action might be empirically described. This information is available in optic flow patterns created by self-motion (on tactile patterns created by self-motion and perceivers use it to guide activity. Apparently, this type of information is extracted in the course of activity; it does not need to be constructed. Lee (1980) identified the parameter tau, which specifies "time to contact." In the case of plummeting gannets, tau specifies when to pull their wings back before "contacting" a body of water. For humans, tau specifies when to apply pressure to one's automobile brakes to avoid collision. Tau (with constant velocity) "is a precise measure of time remaining until the distance between the eye and the surface is reduced to zero" (Neisser, 1988, p. 5). In another line of research, the visual information used by perceivers to perform and judge the aesthetic qualities of human motion has been identified (Gray & Neisser, 1993; Gray, Neisser, Shapiro, & Kouns, 1991; Scully, 1986). Kinematic information (isolated by using point-light displays) in gymnastics (Scully, 1986) and ballet (Gray & Neisser, 1993) specifies the qualitative aspects of some movement. Identifying the information that perceivers use in physical activities or in judging human motion begins to address the first research question.

Other research has identified the information available "in the light" that specifies whether an opening affords passage. Warren and Whang (1987) have shown that perceivers use the ratio of aperture width and eye height to judge whether they can go through a particular doorway. Critical chair heights and riser heights (the vertical distance from one stair to the next) are also specified via visual information relative to the perceiver's eye height (Mark, 1987; Mark & Vogeze, 1988). In these cases, the visual information identified
specifies a relationship between the environment and the percieve. Furthermore, the activities (avoiding collision, traversing passageways, sitting, or climbing stairs) are guided by the pickup of information that specifies what the environment affords the actor.

A limited amount of developmental research has been conducted to examine the perception of affordances (for a recent review of work supporting an ecological interpretation, see Adolph et al., 1993). In their review Adolph and her colleagues present the guidelines for conducting developmental research within an ecological perspective. First, the affordance itself needs description; second, the information that specifies the affordance should be identified; and third, the perceptual and action capabilities of the perciever must be assessed.

This third aspect has been little explored in research with either adults or children (but see Adolph, 1993). However, this aspect is essential to Gibson's theory and has been poorly understood. The constraints on both sides of the affordance relation — those of the environment and of the actor — must be described to grasp fully Gibson's contribution to understanding human development. Earlier criticisms of Gibson's theory (Fodor & Pylyshyn, 1981) were based on an assumption that the information that specified an affordance was simply the visual information that specified some property of the environment or of objects. These critics failed to recognize the essentially interactive nature of Gibson's theory — that the actor also must pick up self-information to respond to the information provided by the environment. If perception of the environment is copereception of the self, then information that specifies the environment also specifies the self, or the actor's position in the environment. If the environment affords some action for the perciever, it is in relation to the perceivers action capabilities or the actor's biomechanical constraints. In brief, the information that specifies the possibility for action resides in the relationship between actor and environment — a quintessentially ecological position.

As we argued in the introduction to this chapter, an ecological perspective in general acknowledges the relationship between organism and environment. Gibson's ecological framework specifies an empirical approach that aids understanding of the relationship between actors and the physical environment. Gibson also discussed the relationship between people. For the perciever, another person provides "the richest and most elaborate affordances" (Gibson, 1979, p. 135). Gibson was keenly aware of the possibilities for action afforded by one person in relation to another, and although the issue of "social affordances" was not so clearly articulated in his theory as that of the affordances of the properties and objects of the physical environment, Reed (1993) has argued that this is because Gibson attempted to "transcend the usual dichotomy between the social and the physical environment" (p. 53). In a later section we shall discuss the ecological perspective of Bronfenbrenner, which concentrates primarily on the relationship between the developing person and the developing social environment. The work of E. Gibson (e.g., Adolph et al., 1993; E. Gibson 1969, 1988; E. Gibson & Olum, 1960) and that of Neisser (1988, 1994) is particularly interesting, in that they have taken J. Gibson's work further in two relevant directions, the developmental and the social, and thereby closer to the position taken by Bronfenbrenner. Eleanor Gibson may be said to have "co-constructed" the Gibsonian framework, taking the developmental concepts that were implicit (but not made explicit) in her husband's work and extending them greatly. She also developed a theory of perceptual learning (E. Gibson, 1969). Neisser, on the other hand, has indicated the ways in which an ecological approach to perception can serve as the foundation for a framework that encompasses the social environment. For reasons of brevity, we have decided here to focus solely on Neisser's extensions.

The Ecological Self: Extending the Gibsonian Framework

Neisser (1988, 1993), working from a Gibsonian perspective, has described a framework for understanding the self. Neisser suggests that there are at least five kinds of self-knowledge: the ecological self, the interpersonal self, the extended self, the private self, and the conceptual self. The ecological self is primary, being directly perceived from the start. As one would expect, given its basis in Gibson's theory, the ecological self is experienced as the environment is perceived. In other words, perception of the environment is perception of the self situated in that environment. According to Neisser (1988), the interpersonal self is also directly perceived. Research on the earliest mother-infant interactions (Stern, 1985; Trevarthen, 1979) is cited as evidence for this claim: J. J. Gibson's (1979) principle that all perceiving involves co-perception of environment and self applies also to the social environment and to the interpersonal self, i.e., the self that is embodied.
in these interactions. Just as the ecological self is specified by the orientation and flow of optical texture, so the interpersonal self is specified by the orientation and flow of the other individual's expressive gestures; just as the ecological self is articulated and confirmed by the effects of our own physical actions, so the interpersonal self is developed and confirmed by the effects of our own expressive gestures on our partner. (Neisser, 1988, p. 10)

Young children are actively engaged with the people, objects, and physical properties of their environments. They are curious and willing to explore their world from a very early age. These explorations and interactions contribute to their acquisition of real-world knowledge and ultimately to an ability to reflect on those interactions. These same explorations and interactions contribute to a child's sense of self (Neisser, 1993). From these earliest experiences, young children begin to develop concepts about physical objects and psychological constructs. These earliest concepts are influenced by the nature of the child's competence in physical actions and by the quality of the earliest social interactions (Neisser, 1993).

Neisser's framework for understanding the development of the self places the ecological self and the interpersonal self as the foundation for the later development of the extended, private, and conceptual selves. This framework represents a promising extension of Gibson's ecological theory of perception into the other areas of human development such as memory, affect, concept formation, and cognition in situated activity.

Neisser has suggested a further theoretical extension to Gibson's direct perception system (Neisser, 1993). In addition to a direct perception system, Neisser proposes a second perception system—a recognition system that is distinct from, but complementary to, the direct perception system. This “re-cognition” system allows the perceiver to acquire knowledge about what categories things belong to or to recognize that the present object is an exemplar of other similar objects. While the direct perception system specifies where one is situated in the environment with respect to the physical layout or to social interchanges, the recognition system allows for the acquisition of knowledge about what things are with respect to culturally specified meaning. These two systems are “about different things, use different kinds of information; and provide different kinds of certainty” (Neisser, 1992, p. 23). Furthermore, these two systems surely cooperate in ways perhaps like Rumelhart and McClelland's PDP parallel distributed processing) networks (1986). Neisser's two systems view, together with his self-knowledge framework, promises to further distinguish Gibson's important contribution.

How does one move from these theoretical premises to empirical research in human development? Research on affordances is evolving as it addresses such issues as infants' developing locomotion (Adolph, 1993), their manipulation of objects (Eppler, 1990), reaching and grasping (Roach & Sanders, 1990), development of knowledge about intermodal unity (E. Gibson, 1984), the use of tools (Leeuwen, Smitsman, & Leeuwen, in press), and autistic children's understanding of social affordances (Lovelace, 1991). For example, infants' developing manipulation skills can be viewed as a continuum progressing from mouthing objects to banging objects to more sophisticated exploration of objects with both hands. Over the course of the first year, as these skills develop, the level of differentiation of the affordances of those objects develops concomitantly (Adolph et al., 1993). Studies within the Gibson's framework of affordances have direct application to the concerns of those working with young children and their families, although translating the findings from these studies into workable applications remains an important task. For now, we know that adopting the Gibson's ideas about perception and development requires attention not only to the developing capabilities of the individual, but to the relationship between the developing capabilities of the individual and the properties of the environment and the objects and people in it. As Adolph and her colleagues (1993) suggest, we must describe the affordance relationship inclusive of the constraints of actor and the environment. As the actor, or the developing child, changes in action capabilities, so too will the possibilities for action with respect to the environment—which in effect changes for the individual as more information is differentiated and additional possibilities for activity are revealed. Development, then, is the change in this relationship across the life span. The requisite research methodology will examine the relationship between the actor and his or her environment (physical or social).

Neisser's conceptualization of five kinds of self-knowledge suggests a number of research questions. Perhaps most central is the question of the self and its development. Since Neisser's formulation of self-knowledge differs from Cooley's and Mead's to the extent that not just social but ecological activity is central to a fuller understanding of self, several new lines of research are possible. For example,
the competence and sense of agency engendered by activities in and operations on the physical environment become important measures to assess. Measures of positive affect and reciprocity in adult-child or child-child interactions (the interpersonal setting, which also is present from the start) could be examined along with measures of the ecological self. The ecological self highlights an additionally important aspect of human development—an aspect not considered by other purely social-based theories of the self. One line of research currently using this framework is attempting to describe the origins of young children’s implicit theories of intelligence (Gray, Hogan, Rodarmel, & D’Agostino, in preparation). Framed within Neisser’s theory of self-knowledge, these scholars are attempting to identify the origins of at least one aspect of the conceptual self. It is possible that early behavioral patterns that preschool children exhibit (a mastery approach or helplessness approach to solving problems or learning skills) emerge from the ecological and social contexts that young children participate in, and that these patterns are early indicators of young children’s implicit theories of intelligence. If children’s early ecological and social activities can be linked to the learning goals they assume, it becomes possible to track the development of at least one aspect of their conceptual selves—their emerging, but implicit theories of intelligence.

Within Neisser’s framework, it becomes essential to take an ecological perspective in order to understand the origins of beliefs about the world. For example, starting from a position that cultures influence beliefs, one can find differences with respect to a concept like intelligence (Lutz & LeVine, 1983; Stevenson et al., 1989), but little more can be done to identify the origins of these differences apart from invoking preexisting differences in cultural belief systems. However, through an examination of the earliest interactions that individuals have in both their physical and social environments, the contribution of the self as an active agent is highlighted. The individual acts and interacts not only in a social environment, but in a physical environment, in which they live, a world rich in information about possibilities for action within it and about possibilities for interaction with the others who share it. Asking what information is available to the perceiver.

how the perceiver uses this information to guide activity, how affordances support action and interaction, how self-knowledge develops and contributes to development, and where beliefs about the self and the world originate are all questions that relate specifically to an ecological framework.

To fully understand human development from an ecological perspective, we might first assume that development occurs within the individual who is not separable from his or her environment. What Neisser has offered is an opportunity to test, empirically, Gibson’s claims and to ground other aspects of development in Gibson’s ecological theory of perception. As we shall show, what Bronfenbrenner has done is to take a similarly ecological framework, equally interactive, but focused more on the systemic properties of the environment, from the physical and social and extending to the historical and cultural in its local and broadest sociocultural manifestations.

Bronfenbrenner’s Theoretical Framework

The first major difference between Bronfenbrenner’s position and that of Gibson has to do with the ways in which they treat the environment. If Gibson’s approach to the human-environment relationship is one that has to date focused on perception of the physical environment, Bronfenbrenner’s deals primarily with the social environment. A second difference has to do with the notion of direct versus indirect relations. As we have described it, Gibson was primarily concerned with direct relations, those aspects of the environment perceived directly and immediately by the individual. Bronfenbrenner believes that although the direct effects of the immediate social and physical environment (“proximal processes” in his terminology) are very important, these cannot be well understood without taking into account more distal processes—historical, cultural, social, and environmental conditions that affect the developing child only indirectly.

A third apparent difference between the ecological positions espoused by these two theorists has to do with the nature of the relations between individual and environment. Gibson’s position was quite unequivocal; an understanding of the individual above or the environment alone is totally impossible. Any understanding of individual function must specify features of the environment and vice versa. Bronfenbrenner’s position is less clear; scholars who draw on
his early writings have represented his position as focusing almost exclusively on environmental influences on development (Bubolz & Sontag, 1993). A casual reading of Bronfenbrenner’s early writings on the ecology of human development reveals that they are very well developed with regard to the various contexts in which developing humans find themselves, but have little to say about the nature of the developing organisms themselves. As late as 1986, Bronfenbrenner was talking about the “influences” of various contexts on the family, as though developments within the family (or within the developing organism) or influences of the family on the outside world (or influences of child on family) were of less importance.

However, this seemingly unidirectional approach to development (albeit a highly differentiated unidirectional approach) was, we believe, always more apparent than real. As we have argued with regard to Gibson, a theory is never developed outside an intellectual context. Theories are not simply informed by theoretical traditions on which the theorist wishes to build; they are shaped by theorists against which he or she is arguing. At the time when Bronfenbrenner wrote The Ecology of Human Development (1979), the vast majority of studies of children’s development, particularly in the domain of cognition, treated that development as context-free (see the discussion in Bronfenbrenner, 1989). It was at that time that he made his telling critique of the field: “It can be said that much of developmental psychology is the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time” (1977, p. 513). As Bronfenbrenner (1993) later expressed it, “The developmental attributes of the person are defined, both conceptually and operationally, without any explicit reference to the environment in which they occur, and are presumed to have the same psychological meaning irrespective of the culture, class, or setting in which they are observed, or in which the person lives” (p. 9).

Bronfenbrenner’s primary goal at that time was thus to provide a much more differentiated and complex sense of the different “systems” that influence the developing person, and the interrelations between them. Using the metaphor of the matroschka (Russian nesting doll), Bronfenbrenner (1979) portrayed the developing child as being at the center of an interconnected set of contexts, including those that directly impinged on the child (contexts at the microsystem and mesosystem levels) and those that affected the child indirectly, mediated by those with whom the child came into direct contact (contexts at the exosystem and macrosystem levels).

The various systems were defined as follows. A microsystem is a setting in which the developing person is situated. Microsystem effects relate to the activities in which the person engages and which he or she observes, the roles taken by the participants in those activities, and the interpersonal relations between the person and those around him or her. These interpersonal relations are affected by the personality and temperamental characteristics of the interacting individuals, their belief systems, and so on, all of which are in dynamic flux over the course of development. Family, school, peer group, workplace, church all constitute examples of microsystems, in which the individual develops in conjunction with different sets of social partners.

Individuals inhabit more than one microsystem, however; the child engages in one set of activities at home, another with his or her peers, yet another in church, and yet different activities at school. Interpersonal relations are with one set of people in one such microsystem, with another in another microsystem. In some cases, there are consistencies between activities, interpersonal relations, or both in the various microsystems in which the child exists; in other cases the linkages between them are less consistent. The relations between microsystems constitute the mesosystem.

There are, of course, many contexts with which the developing individual does not have direct contact, but which nevertheless exert an indirect effect. In the case of children, the prototypical such context is the parental workplace; experiences that the parents have at work often have an influence on the activities and interpersonal relationships that the child experiences directly. For example, parents who can exercise a good deal of self-direction at work may be more likely to encourage initiative and independence in their children, whereas those for whom success at work is linked to following directions carefully may be more likely to encourage compliance in their children (for more details, see Tudge & Putnam, Chapter 9, this volume). Linkages of this nature comprise exosystem effects.

The broadest level that Bronfenbrenner discussed is the macrosystem, which also exerts its effects indirectly, mediated by those with whom the developing person comes into contact. Macrosystem effects are those at the cultural level, with culture here considered at both the societal and within-societal levels, including social class.
race, and ethnicity (see Tudge & Putnam, Chapter 9, this volume). Belief and value systems, cultural tools and institutions, and material resources and opportunities that are available to the cultural community all affect the developing person, albeit indirectly. For example, industrialized societies have typically removed opportunities for children to learn the skills necessary to become economically self-sufficient through direct participation, and instead required that they learn in specialized institutions (schools) that are far removed from the contexts in which children will eventually be expected to practice those skills. The situation is quite different in technologically simple cultures (hunter-gatherer and simple agrarian groups), in which children are expected to learn through observation of and participation in the tasks they will eventually use quite independently. Such overarching organizations of the cultural group clearly have enormous implications for children's development.

If these various systems constitute the layers of the marioshka, then the chronosystem represents the passage of the doll through time. Chronosystem effects are those that relate to change or stability in the various contexts that have an impact (direct or indirect) on the developing person and changes in the nature and characteristics of that person. Chronosystem effects force attention on the fact that, as the individual changes, he or she does so in an ever-changing set of contexts at every layer of the entire ecological system, from changes within the family to changes at the historical and cultural level (see Shanahan & Elder, Chapter 4, this volume).

In his earlier work, Bronfenbrenner (1979) concentrated almost exclusively on the contexts in which development occurred, paying little attention to aspects of the developing individual and leaving chronosystem effects quite implicit. However, to view Bronfenbrenner's position as espousing a simplistically unidirectional model of development would be totally incorrect. As early as 1983, and in a slightly more differentiated form in 1988, he described a typology of models of development. At about the same time (Bronfenbrenner, 1989), he made quite explicit his concept of development, using this concept as a foundation to discuss these models. Essentially what he did was to expand on Lewin's equation \( H = f(PE) \) — that behavior is a function of an interaction between person and environment — by substituting development for behavior. This substitution is, of course, of critical importance. Whereas Lewin's position is concerned with an outcome at a given point in time,
refers to as microsystem (person-process) models, those that post a
causal process that stems from characteristics of the person (studies
of genetic transmission or the impact of specific physical or physi-
ological characteristics on later development) or that stem from
events in the child’s proximal context (studies of the ways in which
development occurs in the course of face-to-face interaction or under
the influence of particular local or proximal environmental condi-
tions). The second type, called process-context models (and much
less used in developmental psychology) allow the assessment of ways
in which particular contexts differentially affect developmental pro-
cesses (such as interpersonal interactions) themselves.

The third and final type of process-related model that Bron-
fenbrenner (1988) discusses is the person-process-context model, the
theoretically and methodologically most complete model to fit the
expanded Lewinian formulation that Bronfenbrenner believes to be
most useful for developmental research. In brief, this model allows an
assessment not only of the interactive nature of individuals and their
environments, both proximal and distal, but also of the processes of
development that are at work. The person-process-context model
requires that researchers consider the interactive ways in which de-
veloping individuals are influenced by and simultaneously influence
the contexts that envelop them. Bronfenbrenner (1995) labels these
individual characteristics “developmentally instigative” — character-
istics that are not expected to remain fixed, but respond to (and effect
responses in) the surrounding contexts. These individual characteris-
tics have to do with such “personal stimulus characteristics” as an
infant’s fussiness, calmness, liking of being held, and physical attrac-
tiveness. These characteristics are, of course, simultaneously personal
and social, bringing about responses from those around the infant.
Other developmentally instigative characteristics include individual
differences in reaction to, interest in, and exploration of the world
(social and physical), persistence, and belief systems about the world,
particularly beliefs about the extent to which the individual can effect
change in that world.

If these are the personal attributes that the model needs to con-
sider, what constitutes the context? As might be expected from
our early discussion, context cannot be restricted simply to the
microsystem, but must incorporate linkages between the systems,
from micro to macro. Bronfenbrenner (1993) describes contexts as
also having “developmentally instigative” characteristics that, in in-

These aspects of the physical, social, and symbolic environment
may be viewed at all levels from the most proximal (microsystem) to
the most distal (macrosystem). For example, a family can become
relatively disorganized with fewer resources in the period surround-
ing a divorce; similarly, an entire society can experience disorganiza-
tion and lack of resources, as during a war or in time of economic
adversity. Similarly, within any society, prospects for one group may
be systematically curtailed. These macrolevel effects clearly have
their effects at the exosystem, mesosystem, and microsystem levels,
and as Bronfenbrenner’s discussion of the work of Elder and his
colleagues (Elder, 1974; Elder & Caspi, 1990) makes clear (see also
Stanahan & Elder, Chapter 4, this volume).

Finally, in terms of the person-process-context model, the pro-
cesses of development must be specified — how does a particular type
of environment link to a particular outcome with some people but
not others? Bronfenbrenner draws on his own earlier studies with
Cochran (cited in Bronfenbrenner, 1988) to show how similar envi-
ronmental conditions affect girls and boys differently. He also dis-
cusses the work of Elder and his colleagues indicating that the age at
which children experienced the Depression as well as their gender led
to very different outcomes. The concern with process, of course,
forces attention on aspects of both the developing individual and the
developing environment.

As if to compensate for his apparent concentration on the contexts
of development (the environmental part of Lewin’s equation) in his
early writings on this subject (an emphasis occasioned by the contem-
porary focus solely on aspects of the individual), Bronfenbrenner has
subsequently made quite clear the explicitly interactive nature of the
system. For example, echoing Marx, Bronfenbrenner (1993) states
that “human beings are not only the partial products, but also the
partial producers of their environment” (p. 6). To stress its interac-
tive nature, Bronfenbrenner and Ceci (1994) now refer to the model
as a “bio-ecological paradigm of human development” (p. 568). This
dialectical or transactional approach to human development is ech-
oded throughout the pages of Bronfenbrenner’s most recent writings.
on the subject. Bronfenbrenner and Ceci (1994) argue that "from the moment of conception, the actualization of inherited predispositions for embryological development and physiological activity do not occur in a vacuum, but are differentially responsive . . . to the intrauterine environment" (p. 580). The authors go on to state, moreover, that "the power of innate propensities is in no way reduced after birth, for, as the child begins to interact with persons, objects, and symbols, the external environment becomes genetically loaded as the active organism selects, modifies, and partially constructs its own world" (p. 580). The embedded nature of individual and context is clearly marked; in an earlier discussion of cognitive development, Bronfenbrenner and his colleagues state, "The context in which cognition takes place is not simply an adjunct to the cognition, but a constituent of it" (Ceci, Bronfenbrenner, & Hake, 1988, p. 24).

Bronfenbrenner (1993) is thus at pains to point out that the effects of individual and environmental factors are not only not simply additive, but may vary both in strength and direction. The relation between them, he argues, is synergistic.

Unlike Gibson, who collected a great deal of data as he was developing his position, Bronfenbrenner has not been highly active in gathering empirical data. His chosen task, instead, has been to focus on the data gathered by others, illustrating the ways in which their data exemplify one or other of the models discussed earlier. He often goes further, however, pointing out ways in which the scholar could have expanded on the design in such a way as to approximate more closely to the person-process-context ideal. He has focused on research both from a historical perspective (Bronfenbrenner & Crouter, 1983) and in using the most relevant of contemporary research (Bronfenbrenner 1979, 1986, 1989, 1993). His most recent endeavor has been to use research that comes close to using a person-process-context model to indicate the problems underlying the position taken by contemporary behavior geneticists (Bronfenbrenner & Ceci, 1994). In this paper the authors describe microsystem processes as "proximal processes" and draw on research that indicates the presence of synergistic relations between these proximal processes and the broader settings (both cultural and historical) within which these proximal processes are set.

The critical issue in this expanded treatment is that of process—how heritability relates to development, and the processes of gene-environment interaction. "At the core of the problem lies...the need to identify the mechanisms through which genotypes are transformed into phenotypes" (Bronfenbrenner & Ceci, 1994, p. 568). The argument that Bronfenbrenner and Ceci make is predicated on the view that the mechanisms are not simply unidirectional, but interactional or synergistic, and the authors draw on a wide range of studies that support this position (e.g., Gottlieb, 1991; Kandel, Schwartz, & Jessell, 1991). Erlenmeyer-Kimling (1972) argues that "gene-environment interactions are numerous and that treatment effects are frequently reversed in direction for different genotypes" (p. 201), and Wahlsten (1994) makes much the same argument, criticizing heritability analysis as used in behavior genetics, which "requires an assumption that heredity and environment do not interact...[However,] the additive model is not biologically realistic" (pp. 248–249). Instead, aspects of the developing individual and the developing context in which the individual is situated (proximal processes) need to be considered simultaneously in order to understand "dynamic and historically determined processes which give rise to structure and motion by virtue of the dialectical interplay of the internal and external, the nucleus and the cytoplasm, the individual and society" (p. 254).

As would be expected from our previous discussion of the person-process-context model, the range of heritability is much greater than behavior geneticists have argued, depending on the characteristics of the proximal processes (necessarily an interaction between the developing child and those with whom the child comes into contact) in interaction with developmentally instigative characteristics of the broader context. Specifically, Bronfenbrenner and Ceci (1994) argue that if "proximal processes serve as a mechanism for actualizing genetic potential" (p. 572), contexts in which proximal processes are strong would be those in which most of the expressed variation was related to genetic endowment. Contexts characterized by weak proximal processes, on the other hand, would appear to indicate a much smaller impact of genetic endowment. Bronfenbrenner and his colleagues draw on the research of a number of scholars (Drillien, 1964; Fischbein, 1960; Luster, Rhoades, & Haas, 1989; Moorehouse, 1991; Tulkin 1977; Tulkin & Kazan, 1972 – all cited in Bronfenbrenner & Ceci, 1994) to show how proximal processes as varied as maternal beliefs, the quality of mother-child interaction, the extent of school-related experiences encountered in the home, and the degree of monitoring of adolescents had different impacts on the developmen-
tual outcomes for children in poorer environments than for those in more favorable environments. What is particularly striking is that the effectiveness of proximal processes varies according to the outcomes of interest — whether having to do with competence or dysfunction. These effects are difficult if not impossible to interpret within a behavior-genetic framework.

What remains to be clarified in this account, however, is the definition of high versus low levels of proximal processes. During Bronfenbrenner and Ceci’s discussion of the work of Drillien (1964), high seems synonymous with “good” or “quality” processes of mother–child interaction, low being equated with “poor process” (1994, pp. 574–575). As a number of scholars (Ogbu, 1981; Tudge et al., in press) have argued, the quality of mother–child interaction (for example) cannot be assessed without consideration of the culturally defined standards of competence — what counts as competent (or quality) interaction in one culture may be defined quite differently in another. The relation between such historically and culturally relevant factors to proximal processes lies at the center of Bronfenbrenner’s systemic theory, but makes it difficult to place interactional processes (or any other processes) on a single continuum of development, as Bronfenbrenner and colleagues appear to have done.

Conclusion

We have examined ecological approaches to development, setting them in their historical and intellectual context, and focusing on two — the theories of James Gibson and Urie Bronfenbrenner. The central concern of all ecological theories is the mutual relationship or mutual reciprocity between developing individuals and their environment, and in this respect Gibson and Bronfenbrenner share a common basic assumption. Also, they were both unhappy with the dominant trend in the field of psychology, a trend based on viewing individual and environment as dichotomous entities whose influences on development could be examined separately. The ecological perspective, as such, predates both theorists, as we have shown; whereas Bronfenbrenner (1979) acknowledged that scholars stand “on the shoulders of giants, and mistake the broadened vision for our own” (p. xi), Gibson’s application of ecological principles to perception was a radical departure.

If these are the similarities in their positions, what was different about them? At the heart of the Gibsonian position is perception, a basic psychological process — but one that in Gibson’s framework intrinsically links the perceiver and the perceived. In Bronfenbrenner’s case, the key concept is that of proximal process — that is, relatively enduring “progressively more complex reciprocal interaction between an active, evolving bio-psychological organism and the persons, objects, and symbols in its immediate environment” (Bronfenbrenner & Ceci, 1994, p. 572). It is immediately apparent that while the attention to reciprocity is shared, Bronfenbrenner’s focus is at a different level of analysis than that of Gibson. The environment is central to both, but there is a difference at the level of description of the relationship between the individual and the environment. It would be easy to draw a distinction between the two theorists based on a cleavage between the social (Bronfenbrenner) and the physical (Gibson) environments that their research addresses. But both theorists were wiser than that. As we mentioned, Gibson held that perception of any object was simultaneously perception of the self. Moreover, Reed (1988, 1993) has stated that Gibson did not draw a clear distinction between the social and the physical environment, and argues that his theory fits well with aspects of Vygotskian theory. Costall (1989) also argued that “the social context of cognition was indeed a central concern for Gibson, and one which figured in some of his earliest formulations of his theory” (p. 11). However, it is difficult to reconcile Gibson’s account of direct perception, perception that is unmediated and in no way constructed, with the perception of activities in the social world. Even perception of physical objects may be mediated by the co-construction of beliefs and meanings attributed to such objects within a particular culture. It is interesting to note that Neisser’s extension of Gibson, in which the constructed nature of cognitive processes features prominently, may do more than simply extend the theory when proposing that there may be two distinct perceptual systems — a direct system and a recognition system — that can account for culturally constructed knowledge.

In the case of Bronfenbrenner, the social environment does indeed figure prominently (although always, as we have pointed out, in interaction with aspects of the developing individual). However, the physical environment has its great role to play in his theory. Indeed, the nature of the proximal processes varies in environments charac-
terized as being either rich or poor in material resources. Economic hardship, whether having to do with features of the physical environment (quality of housing, safety of the neighborhood, etc.) or the availability and nutritional quality of food, interacts with proximal processes to have an impact on outcomes for the developing individual. Interestingly, where in some of his early formulations (e.g., Bronfenbrenner, 1979, p. 127) he cites approvingly Thomas’s dictum that “If men define situations as real, they are real in their consequences,” he has subsequently made clear that material and physical resources have their objective as well as subjective impact (Bronfenbrenner & Ceci, 1994).

We would like to draw attention to the two theorists’ conceptions of development and process. As Siegler and Crowley (1991) argue, any study of developmental processes must include observations that are dense “during the period of change relative to the rate of change of the phenomenon” (p. 607). Development of a skill, such as how to solve a model-copying problem, may take place over a relatively short period of time, whereas development of reading typically takes place over years. Processes of development may thus be observed over microgenetic, ontogenetic, historical, or even phylogenetic time (Juthe et al., in press). Gistz believed that the “process of extracting information” (viewed as increasing differentiation) occurred across the life span, but his concern with perceptual processes was centered at the microgenetic level, developmental processes being captured and described by direct experimentation (Gistz & Gibson, 1955).

By contrast, Bronfenbrenner is interested in the study of processes at each and every level, being concerned with the ways in which processes at macro levels (historical and cultural) through the micro levels (proximal processes) affect development. His perspective necessarily relates development to developing characteristics of the individual, as they interact with developing characteristics of those other individuals and social settings in which the individuals play a part, and to developing aspects of the environment (physical and social) that have an impact, direct and indirect, on the individual and that are, in turn, influenced by the individual. Bronfenbrenner’s theory, unlike that of Gistz, clearly fits within the framework presented by Shanas, Vakilin, and Gottlieb (Chapter 7, this volume); his ecological system has a structure that is both hierarchical and horizontal, relations between levels of the system and between elements at any one level are transactional/dialectical, and time, or processes of development, are viewed in terms of an interplay between historical, ontogenetic, and microgenetic levels.

In conclusion, it seems clear that the theories of both Gistz and Bronfenbrenner are truly ecological, as we have defined that term. The key fact is that, for both, relations between individual and environment are central. These relations are essentially dialectical or synergistic; the criticism leveled at both for having a unidirectional perspective (that Gistz was concerned solely with properties of the physical environment and that Bronfenbrenner was interested only in the effects of the social environment) are simply not tenable. Their theories are necessarily concerned with change over time, and Bronfenbrenner’s theory is explicitly developmental, although this has often been ignored by critics. For Gistz, the individual picks up information that simultaneously guides activity and specifies the self. Perception is dynamic and change is inherent in the activity of perception. Again, the relationship between the perceiver and the perceived changes across time. With increasing economy, the perceiver differentiates more or different aspects of the available information. The development of skills and expertise in some domain may be described in this way (Gray & Neisser, 1993). Through activity, then, the individual attains an increasingly differentiated knowledge of the thing being acted on and of the self. Continuing activity is necessarily different since now the object being acted on is better differentiated and the individual doing the acting is different – there is a synergistic interplay throughout. For Bronfenbrenner, processes of development are at the core of his theory, with activity between developing individual and social partners the key to understanding both stability and change. These interpersonal interactions, of course, are most fully understood by considering them in broader historical, cultural, and social contexts, and the relations between them are synergistic.

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