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APPLIED DEVELOPMENTAL PSYCHOLOGY

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PREFACE

Applied Developmental Psychology provides a forum for scientific research on human development, with particular emphasis on the important real world tasks and problems facing children and adults. It has become increasingly clear in recent years that what were once regarded as basic and universal changes in cognitive and social development result in part from specific experiences in the natural environment of the child. As such, fuller understanding of the nature and sources of psychological growth necessitate examination of the everyday lives of children. Moreover, significant progress in our understanding and treatment of childhood disorders has revealed how studying abnormal development can illuminate the nature of normal growth. Reawakening of interest in this "applied perspective" has added vitality and excitement to current developmental research and in addition has brought a more balanced and integrated outlook on developmental questions.

Volume 2 of the series highlights the diverse areas of applied developmental research into which scientific work is expanding. As with the inaugural volume, the questions addressed are complex, the approaches multidisciplinary, there is a healthy mix of basic and applied work, and most important is an abiding focus on real-world issues in the everyday lives of children.

The selections in the present volume provide excellent examples of the depth, diversity, and dynamism of applied developmental science.

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DEVELOPMENT AS EXPLANATION: BEYOND THE UNICORN MIND

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I. Introduction

Developmental psychology has traditionally shared a rather uncomfortable alignment with the fundamental concepts of modern theoretical psychology.

Though its historical roots extend far beyond those of general psychology (Cairns, 1983; Morrison, Lord, & Keating, 1984), the field has, with the notable exceptions of Freud, Lewin, and Piaget, drawn its theoretical impetus primarily from the "basic" disciplines of experimental psychology. General experimental psychology provided the basics, the fundamentals, the universal principles of sensation and perception, learning and cognition, motivation and emotion, etc. The fundamentals were then applied, with minor if any modification, to the developing individual. That application has, moreover, been a passive one: a principle or process may appear at one point during development and be absent at an earlier one, but there has been little serious concern that the principle and/or its manifestation might itself be altered during the process of development. Instead, in most analyses the basic principle is implicitly assumed to remain unchanged as the individual unfolds under the influence of a fixed set of psychological fundamentals. As a result, the flow of information in psychology has been largely *unidirectional.* Developmental analysis benefited from work in the basic areas, but few assumed the operation of the fundamental process was itself altered during development; few believed that an understanding of the "fundamental" itself might result from developmental thinking.

The traditional relationship between developmental psychology and general experimental psychology can be characterized by the metaphor of growth (Sameroff, 1983). The growth metaphor characterizes development as a process of accretion. The total psychological entity in a sense becomes larger, but its fundamental psychological operation is unchanged in a passive process of psychological addition. The growth metaphor results in part from what Morrison *et al.* (1984) called the "universalist assumption." "[L]aboratory research encouraged investigators to focus on general processes (such as attention, memory, attachment, or dependency) which presumably applied to all behavior at all times" (p. 11). The fundamentals, universal processes, were assumed to be present from some relatively early point. The individual's context or experience added to the total, but the universal itself did not change. Keating (1984) summarized the contemporary hold of this tradition in research on human intelligence:

> In an otherwise perceptive commentary on the necessity of including within theories of human intelligence a recognition of the actor's scripts, plans, and goals, Schank (1980) nevertheless completes his analysis by suggesting that to get to the core of an individual's intelligence, we should place the individual in a totally novel situation that requires the discovery and solution of a problem posed so that the subject cannot "rely on any prior cultural information"! (p. 12)

The universal processes of intelligence somehow exist apart from the diversity added by culture. It is assumed that the manifestation of intelligence may grow with time and experience, but its fundamental core is unchanged.

Within the confines of the growth metaphor, the burden of explanation rests, as the word implies, with the fundamentals. Once their inner workings and interactions are understood, the larger psychological picture is a product of filling in the experiential gaps. As such, the differences by which the same fundamentals are manifest in different situations, in different individuals, and in different cultures are irrelevant. Individuals are merely allomorphs: structural variations of the same thing. The differences result from the gaps, not from the fundamentals. As in the example above, if we take away the added complexity of cultural information, we are left with an essential core. That core provides a fundamental understanding of the phenomenon in question. Therefore, to explain, all we need are the fundamentals. The rest is a matter of technology and application.

This metaphor saw its heyday during what Cairns (1983) called "the middle period" in the history of developmental psychology. However, despite serious challenge from within (Gottlieb, 1983; Keating, 1984; Morrison *et al.*, 1984; Rogoff, 1980), it remains the dominant metaphor of development (Sameroff, 1983). In as methodologically liberal a series as the *Handbook of Cross Cultural Psychology,* for example, Volume 3 (1980) is subtitled "Basic Processes." It includes sections on perception, cognition, emotion, and motivation. Developmental psychology is the subject of Volume 4. In what sense is development not a basic process? It is nothing more than the continued dominance of the passive metaphor of growth, for which the editors of the above volumes are somewhat apologetic, that renders development an exercise in filling in experiential gaps "surrounding" the fundamentals. The implicit assumption is, of course, that we must aim to isolate the pure basic process unencumbered by the vagaries of development, of individuality, and of experiential history.

The thesis of this article is that this metaphor and its venerable tradition in scientific psychology are fundamentally in error. The error, I argue, results from experimental psychology's reliance on an inappropriate model of science. I suggest that the nature of psychological phenomena requires a different model of science and a different approach to explanation. Moreover, the implications of the newer model extend beyond the paradigms of developmental psychology per se. They touch on the broader philosophical base of the discipline as a whole. For in this model both developmental psychology and applied developmental analysis play a critical role, not in the application of fundamental principles, but in the emergence of explanatory generalities throughout scientific psychology. As such, they are central to the explanation of all psychological phenomena.

Passive, unidirectional metaphors are becoming less and less useful in the life sciences. In biology, for example, fundamentals cannot exhaust explanation (e.g., Mayr, 1982; Hull, 1975). I suggest that in psychology there are no fundamentals to be understood without regard for how the processes of development in the context of individuals and cultures, that is, in the context of history, have transformed the role of the "fundamental" principle itself. The nature of the fundamental is grounded in the occurrence of development in a particular context. This view entails important departures from the traditional approach to explanation. In this view, explanation requires more than simply analyzing fundamental principles extracted from the larger psychological entity; rather, explanation entails an understanding of how that entity results from the transforming processes of development. In what follows I argue that the implications of adopting a more dynamic metaphor for development require a wholly different model of psychological science, one no less materialistic than more traditional models, but one more in accord with the characteristics of psychological phenomena. The model accepts the material basis of all psychological phenomena, but, in doing so, it does not deny their complex, dynamic, and historical character. Moreover, this model has special implications for developmental psychology. It implies that developmental analysis is not a substantive area of inquiry, but a necessary aspect of explanation itself. It requires that developmental analysis become a part of explanation, not a set of questions relying on the application of explanations obtained elsewhere.

II. Essentialism

Elsewhere (Logan, unpublished manuscript) I have argued that the dominant model of science in experimental psychology reflects the tacit acceptance of a philosophy of essentialism. Essentialism, which originates from Plato (Popper, 1957), assumes that a precise understanding of any natural phenomenon requires uncovering a fundamental underlying principle. Hidden beneath the changeable world of description are greater, more general truths, "the realities which lie behind appearance" (Popper, 1968, p. 104). Popper (1968, 1983) argued that essentialistic philosophies have provided the philosophical foundation for much of modern science. Stripped of the otherworldly metaphysical implications of pure Platonic Idealism, a modern version of essentialism, dressed either as Galilean science or as the more philosophically neutral instrumentalism, has dominated models of science for the last two centuries.

In essentialism, events are classed together depending upon their adherence to the basic principle defining the class. Any differences between events assumed to instantiate the principle are disregarded as irrelevant. Rather, a profound understanding of the event depends upon the demonstration that its fundamental character can be encompassed by the more general formal principle. In Newtonian physics the orbit of the moon was explained once it was seen as a manifestation of the combined effect of the inverse square law, describing the force of gravity, and the law of centripetal force (inertia). Specific parameters relevant only to the moon were, in the language of the twentieth century, merely boundary coundi-tions; they in no way altered the fundamental explanatory impact of the principles of gravity and inertia. The explanatory power of these fundamentals was in fact greater by virtue of their ability to predict specific attributes of the instance in question, i.e., the moon's impact on the precession of the equinoxes, and changes in the tides. The moon is understood as a particular instance of a more general truth, and that truth stands, independently of the existence of this or that moon. In the 1943 version of Hullian psychology, drive reduction was the necessary and sufficient condition producing an increment in habit strength. Specific responses, different drives, distinct contexts in which those drives were manifest were irrelevant. Drive reduction captured a fundamental principle by which sets of apparently distinct phenomena were thought to instantiate one underlying fundamental. As the unit that embodied that fundamental, the *hab* was formally defined by the number of reinforced trials ($H = 1 - 10^{-aN}$, where N is the number of reinforced trials). Differences in this or that drive, this or that response, or, for that matter, this or that organism did not alter the nature of the more general truth. They were the psychologist's boundary conditions.

In essentialistic science, the explanatory principle, which Plato termed the *eidos* or essence (Hull, 1965a), is represented by the natural law. General laws are assumed to extract that fundamental, to uncover the general principle shared by apparently disparate phenomena. The phenomenon is explained by virtue of attributes which can be described by or derived from the fundamental principle. To the extent that the characteristics of the phenomenon correspond to those predicted by the fundamental principle, that principle explains the phenomenon. Though they may appear very different, all phenomena to which the principle applies belong to a common class; they are not as different as they might appear. Rather, they share a common underlying reality: the principle or essence that defines the fundamental property shared by all. The motion of the moon is fundamentally the same as that of the earth, or that of a billiard ball.

The pervasiveness of essentialism as a model for all science comes from its venerable tradition in physics, and from the tendency on the part of philosophers and scientists alike to regard physics as the prototype science. Psychology inherited the essentialistic model, not through a self-conscious analysis of the philosophical requirements of psychological phenomena, but through the discipline's unquestioned reliance on physics as the prototype science. We come to it honestly, from philosophers who believe in the fundamental explanatory unity of science, from the dominance of logical positivism in the period when psychology emerged as a science (Turner, 1967), from the historical influence of Newton and Locke (Collingwood, 1946), and from the direct impact of figures such as Descartes, Helmholtz, and Fechner, themselves physicists.

III. Populational Thinking in Biology

Until the late nineteenth century, essentialistic thinking and the physics prototype pervaded the biological sciences as well (Mayr, 1982). Species (see Hull, 1965a,b) were treated as hydrogen atoms: there was assumed to be some fundamental property that defined all cardinals as cardinals, and this property was considered both necessary and sufficient to define a bird as a cardinal. Logically, populations of cardinals were no different than populations of hydrogen atoms. Ernst Mayr (1982) has argued convincingly that the Darwinian revolution in biology depended on the overthrow of essentialistic thinking and on the rejection of physics as the prototype science. Darwin's most unrecognized contribution to modern thought was the replacement in biology of essentialism with populational thinking (Mayr, 1959, 1961). Without this fundamental shift in the attitude of the biological sciences, the substantive Darwinian revolution—the theory of evolution by natural selection—could not have occurred.

Mayr (1982) develops his historical analysis of modern biology into an increasingly widespread, nonessentialistic philosophy of the biological sciences. Resting heavily on the transformation in thinking about the species concept necessary for the Darwinian revolution, he argues that essentialism is demonstrably inappropriate for the biological sciences. He maintains that because of the unusual characteristics of the phenomena of life, the life sciences must be defined by an entirely different attitude of mind: one that rejects the essentialism of the physical sciences and instead adopts the populational approach that revolutionized evolutionary biology. This, in turn, entails that many of the traditional criteria of science developed for and extended from physics must be revised for the life sciences. Mayr maintains that we need a different model of science, a distinct philosophy of science, adapted to address the unique problems of the life sciences. What are these problems and how are they reflected in the clash between populational and essentialistic thinking?

The populational attitude rejects the essentialistic assumption that there exists a disembodied truth or principle which is somehow separate from distinct instances or which defines the fundamental principle by which we understand all instances as basically the same. Individuals are unique entities, and no individual may be considered a typical instance of a separate general truth. Variation among different individuals is itself real; it must be understood as a part of living nature, not disregarded in the attempt to uncover something fundamental that will make all these different things look alike. In populational thinking there is no single defining property or process that can exhaustively explain the thoughts and actions of a population of living beings. There is, therefore, no generality that can do for the biological sciences what the laws of motion do for populations of large, slowly moving things as different as the moon, the planets, and the billiard balls of earth.

> Populational thinkers stress the uniqueness of everything in the organic world. What is important to them is the individual, not the type. They emphasize that every individual in sexually reproducing species is uniquely different from all others. . . . There is no "typical"

> individual, and mean values are abstractions. . . . This uniqueness of biological individuals means that we must approach groups of biological entities in a very different spirit from the way we deal with groups of identical inorganic entities. This is the basic meaning of populational thinking. The differences between biological individuals are real, while the mean values which we may calculate in the comparison of groups of individuals (species, for example) are man-made inferences. (Mayr, 1982, pp. 46–47)

Mayr's views are not a return to vitalism, nor a reversion to spiritualism or teleology. Rather, they represent an effort to understand natural phenomena without eliminating their diversity. "Hardly any aspect of life is more characteristic than its almost unlimited diversity" (Mayr, 1982, p. 133). Yet, traditionally, essentialistic science has aimed to "subsume the vast diversity of the phenomena and processes of nature under a much smaller number of explanatory principles" (Mayr, 1982, p. 23). A populational approach does not attempt to understand the attributes of separate instances as similarities caused by the same fundamental principle. Rather it sees instances as individuals and groups of individuals as populations. The relationship between one individual and another is not one of class inclusion, but one of historical continuity (Mayr, in Ruse, 1984). Through historical continuity (Hull, 1975), this approach recognizes and attempts to account for differences. When the essentialist tradition is extended to phenomena whose only essence *is* diversity, all that remains is an abstracted reification possibly representative of none.

Mayr (1982) bases his arguments on the differences which distinguish organic and inorganic systems. Many of these are matters of degree rather than kind, and some of the issues raised may apply to nonbiological systems as well. Differences distinguishing the path of a falling rock yesterday from the path it takes tomorrow are real too. What then are the differences which require such a different attitude of inquiry? Mayr enumerates several; in my view, the two most important are the staggering complexity, and, perhaps more centrally, the historical nature of living systems. Karl Popper (1968) has said that the methods of physics were developed to account for phenomena that are "well isolated, stationary, and recurrent" (p. 339). Biological phenomena, by contrast, are complex, open systems that can almost always admit additional complexity. As implied by the term *system* (Sameroff, 1983), they are neither isolated nor stationary, and they are the causal product of historical sequences that can never recur. Both their enormous complexity and their open historical nature render essentialism inappropriate for the study of living systems.

The clearest example of the historical character of living systems is the evolution of species. Assume for a moment that, as in evolutionary biology, the species is the relevant unit of inquiry, the "individual" to be explained. What makes two different species different from one another? Most biologists point to a history of different mutations, a history of sampling error in the separation of populations, a history of distinct patterns of natural selection, and/or different histories of immigration and emigration. Different species must be understood as different individuals in terms of their distinct ancestral histories. The theory of evolution cannot work without granting a significant causal role to historical statements. The physicist's falling rock, too, may have a different history yesterday and tomorrow. But, traditional methods of physics do not give that distinct history a *significant causal role* in the fundamental path taken by the falling rock. Here is the critical difference:

> [E]volutionary theory is radically unlike comprehensive theories in physics and chemistry. For the latter are wholly systematic and non-historical, whereas the former combines systematic and historical elements. This "double-barrelled" feature of evolutionary theory is one of its most distinctive characteristics. Part of the theory utilizes historical data in the form of fossils, reconstructs unique, non-recurrent evolutionary histories, and advances historical explanations. (Goudge, 1961, p. 17)

History transforms the "path" of the biological system; it does not substantially alter the path of the rock.

By example, Goudge (1961) discussed two evolutionary phenomena that can be explained only by understanding the historical sequence leading up to them: homologies and vestiges. Of vestiges he said,

> These are bodily parts which are relatively small in size and which have little, if any, ascertainable role in promoting the viability of their possessors. The parts represent useless remnants of structures or organs which are bigger and functionally effective in some other present-day organisms. Familiar examples are the veriform appendix in man, rudimentary limbs in certain snakes, the wings of flightless birds, etc. How is the presence of such useless structures to be explained? (1961, p. 67)

Goudge quotes D. A. Moody:

> Now the presence of these vestiges would be accounted for if they were inherited remains of organs and structures which once had an adaptive function in the lives of ancestral organisms. But we have plenty of evidence that such ancestral organisms existed; and it is reasonable to suppose that their adaptive needs, being different from those of their descendants, would require fully developed organs and structures of the sort now represented by vestiges. The presence of these vestiges is to be expected, given the general character of the history of life. Hence they are satisfactorily explained in terms of that history, together with certain assumptions which are plausible. (Moody, 1953, quoted in Goudge, 1961, p. 67)

Vestiges cannot be understood as a product of general mechanisms of adaptation operating on contemporary species; they are remnants of history.

In evolution, historical concepts have also become central to understanding how the evolution of complex phenotypes might have been preserved during processes of selection possibly spanning millions of years. Here the historical element is central to understanding not just a minor vestige, but the outcome of the process of evolution itself. One such historical concept is preadaptation. Wilson (1975) defines preadaptation as "a previously existing structure, physiological process, or behavior pattern which is already functional in another context and available as a stepping stone to the attainment of a new adaptation" (p. 34). Because in Darwinian evolution natural selection can only operate on preexisting variation—that is, on variation in the gene pool before the selective parameters of the environment have changed—a history of different selection factors that have molded the gene pool of ancestors is central to understanding the raw material upon which contemporary selection pressures may operate. If the relevant preexisting variant is not already in the gene pool, natural selection cannot put it there. Its presence, and the evolutionary effectiveness of contemporary mechanisms of selection, therefore, depend centrally on the history of past selection. Its absence can prevent the process of natural selection from having any effect whatsoever. Under some circumstances, a preadapted character can be modified in subsequent generations in the absence of the operation of natural selection. Historically based past changes are the raw material on which contemporary processes "operate." Introduction of the same contemporary process might have an entirely different, or possibly no, effect on a system with a different history.

This is well and good, but how do these ideas bear on the contemporary state of scientific psychology? Psychological phenomena, too, are complex, open, and historical; therefore, arguments against the validity of essentialistic thinking in the biological sciences apply to psychology as well. David Hull (1975) stated that "living organisms are the paradigm cases of historical entities" (p. 256). It seems ironic that such obviously historical entities have, in experimental psychology, been stripped of their historical nature by a methodology that makes every effort to make them seem as alike as possible, by a methodology that seeks to "account" for differences by subtracting them in the search for common attributes reflective of a common principle. Numerous appeals to the history of the organism notwithstanding, our methods aim to cancel out variation, to eliminate uniqueness, and to understand individuals as variable manifestations of basically ahistorical principles.

That history should be a truly significant element of psychological explanation is not a new idea (e.g., Gergen, 1980; Ossorio, 1978; Riegel, 1976). It has been recommended by representatives of most major systems of psychology: Wundt (Diamond, 1984), Hall (Cairns, 1983), Watson (Cairns, 1983), and Freud (Sulloway, 1979). Its implications for the conduct of scientific psychology were perhaps most clearly drawn by Gordon Allport (1937).

> [T]he psychologist . . . has succeeded in discovering the orderly processes of the "generalized mind," but the phenomenon of individuality, so deliberately excluded, returns to haunt him. . . . The generalized mind is entirely mythical; . . . still with considerable tenacity,

> psychologists have held to convention, abstracting from minds . . . such properties as suit their convenience, and their convenience is determined largely by scientific tradition. (p. 6)

In an effort to put some meat on the generalized mind, Allport introduced the distinction between nomothethic and idiographic analyses as *complementary* aspects of psychological explanation. But, the distinction got lost in psychology's self-conscious rush to emulate physics. Populational thinking provides an alternative model of science, one compatible with the historical character of psychological phenomena. Developmental analysis is central to this model, for in a populational psychology development is not the passive recipient of basic essential processes derived from adult rats or college sophomores; rather, it represents the historical element required in the explanation of all psychological phenomena.

IV. Proximate and Ultimate Explanation in Biology

The importance of historical explanation in understanding biological systems has been fully incorporated into the methods of the biological sciences. It is most clearly represented by the now common distinction between proximate and ultimate methods of "causation" in biology (Mayr, 1961). Causation is a philosophically troublesome and changing concept (e.g., Kuhn, 1977). Therefore, a less problematical way of presenting this distinction is in terms of distinct levels of analysis or of distinct perspectives from which one might approach the explanation of biological phenomena.

Proximate analyses are most reminiscent of Aristotle's efficient cause. They refer to the immediately antecedent conditions which reliably produce the effect to be understood. The term *proximate* is intended to suggest the close temporal proximity between antecedent condition and resulting effect. In biology, physiology of digestion and the immediate decrease in temperature that produces thermoregulatory basking in lizards are proximate conditions. Proximate analyses ask the question "how," and answers are therefore often phrased in terms of the mechanisms which immediately give rise to the phenomenon of interest. In psychology, the processes of encoding and retrieval that result in the memory of a particular word or instance are the proximate causes of that memorial episode.

Ultimate analyses (also called distal analyses), by contrast, ask "why." To distinguish the ultimate "why" from teleological or final cause, Mayr stated that "the evolutionist has in mind the historical 'how come' when he asks 'why?' " (1961, p. 1502). Ultimate analysis seeks explanation in conditions temporally removed from the event to be understood. In the biological sciences, ultimate analyses often involve describing sequences of historical preadaptations antedating a particular evolutionary outcome. In one of the classic examples of the importance of preadaptation in the evolution of behavior, the courtship sequence of *Hilara sartor,* the balloon fly, is explained historically. In the balloon fly, males weave reproductively inert, empty silk balloons and then gather in swarms. Females, attracted by the swarms, select a mate from the group of balloon-carrying males. However, only after he has presented her with his silk balloon, do the two fly off and mate. Why is successful mating in this species contingent upon the female's receipt of a silk balloon? Kessel (1955) described the behavior of hundreds of different extant species of related flies of the family Empididae. Their courtship activities ranged from little or no activity preceding mating to those most similar to the balloon fly. In the latter, the male presents the female edible prey or prey fragments wrapped in silk. The silk prey presumably nourishes the female just prior to mating, thereby immediately increasing her egg-laying capacity. In extant species that are themselves predatory, the prey exchange may prevent the female from eating the male.

Kessel postulated that the diverse courtship strategies of closely related extant species reflect the preadaptive stages typical of extinct ancestral species. Therefore, they describe preexisting adaptations that provided the basis for future change, change now evident in the balloon fly. The balloon fly is, however, not predatory and the silk balloon contains no nutritive material. In this species, the balloon is thought to function entirely in communication, possibly signaling male quality to the female. As with many communicative signals, the morphology of the signal itself is arbitrary and unrelated to the communicative function of that signal. Why not use a metabolically less expensive flower petal, as many bower birds do? The explanation for the morphology of the signal is found in the history of preadaptations. The gift of a silk balloon was available for selection as a communicative ritual only because an ancestral history of predation selected balloon exchange for other reasons. Only historically, because the ancestors of the balloon fly once exchanged prey items prior to mating for what in the past were adaptive reasons, does the ancestral variability preadapt the population for the outcome evident now. Without an understanding of that preadaptive history, general concepts such as natural selection can suggest that something might happen, but, by themselves, they cannot explain specific evolutionary outcomes.

Ultimate analyses are usually equated with evolutionary analyses. It is best, however, to think of this perspective as analyzing the temporally distal or historical conditions that constitute the necessary addition to the explanation of historical phenomena. Ultimate analyses, in this sense, are historical analyses. In biology, they are required by the dynamically historical character of living systems. It is therefore with the ultimate level of analysis in biology that the rejection of essentialism, and with it many of the criteria of science inherited from physics, is strongest. Ultimate analyses focus on specific events—the evolution of *this* species. Because the history reconstructed by ultimate analysis is unique, the analysis is not assumed to be general, and the phenomenon it produces cannot be repeated. Ultimate analyses incorporate an historical context that, in the language of evolutionary biology, preadapts or conditions the operation of general processes. Because that history is gone and "future" histories may be entirely different, though just as important for future development, ultimate analyses cannot be predictive. The result is a style of explanation that violates many of the time-honored traditions of science: repeatability, predictability, generality. Yet, because the systems they attempt to explain are historical systems, a comprehensive understanding of living systems must incorporate both proximate and historical analysis.

Equally important, since history plays a causal role in the contemporary functioning of the system, ultimate analysis is necessary to complete an account of why the proximate process operates as it does. The event or phenomenon cannot be, as traditional models of science have held, exhaustively explained by generally occurring mechanisms or principles that produce the same fundamental result each time they occur. Such generalities are certainly important. The all-important status of the concept of natural selection in evolutionary biology is abundant testament to this. But, those generalities do not perform the same exhaustive function in explanation prescribed for the physical sciences. Here the methodological implications of the two approaches are most distinct. The process may recur, but because history plays a causal role, that process cannot produce a similar outcome. From the populational perspective, generalities are not manifest in common attributes or familial similarities among the phenomena that they commonly affect (Logan, unpublished manuscript). They cannot be, for each phenomenon is also significantly transformed by its own unique history. In some cases, that history may cancel the impact of the supposed central process. Therefore, no outcome can be explained by stripping each of its characteristic variability. That variability is incorporated into the process itself. Only by bringing that variability into the causal process can the life scientist understand how a widespread process such as natural selection in biology can produce different outcomes in different individuals or in different contexts. The populational approach seeks to understand processes by seeing how, in conjunction with a specific history, they result in differences, not commonalities. Explanation in any branch of the life sciences, psychology included, necessarily involves both styles of explanation.

V. Populational Psychology

The psychological analog of the ultimate level of analysis in biology is required for the development of populational psychology. Herein lies the explanatory centrality of developmental analysis. For, just as phylogenetic development provides the historical element required in the explanation of species, ontogenetic development—developmental psychology—provides the necessary historical element in the explanation of individual organisms. The central explanatory role of development follows logically from rejection of the growth metaphor and the essentialistic assumption at its base. A populational psychology must be based on an entirely different model of development, one that recognizes the transforming role of history. Several alternative models are currently available; those most compatible with populational thinking are based, not in essentialism, but in a philosophy of contextualism.

Stephen Pepper (1942) described four dominant world perspectives in Western thought: formalism, mechanism, organicism, and contextualism. Each represents a "mode of cognition" of potentially unlimited scope, and each is based on what Pepper called a root metaphor. This is a model or analogy that describes how all phenomena encompassed by the perspective will be understood. The root metaphor generates sets of categories that prescribe "basic concepts of explanation and description" (p. 91). These in turn provide the basis for interpreting all other areas of inquiry. In their scope, their untestability, and their incommensurability, Pepper's world hypotheses foreshadowed Kuhnian paradigms. World hypothesis are, however, in a sense larger; they provide a cognitive framework for approaching any event or object in the world.

Of the four, contextualism is the most compatible with a populational model of development. Contextualism is primarily synthetic rather than analytic, and contextualism is most comfortable with change and unpredictability. "The ineradicable contextualistic categories may thus be said to be *change* and *novelty*" (Pepper, 1942, p. 235; author's italics). In keeping with its synthetic character, contextualism emphasizes the fusion of elements. Change and novelty do not merely add to the total; they transform it. "Where fusion occurs, the qualities of the details are completely merged in the quality of the whole" (Pepper, 1942, p. 243).

In recent years, psychologists have become increasingly disenchanted with the traditional philosophy of explanation, one, I would argue, based in essentialism. Many of the most telling objections come from extensions of contextualism. Sameroff (1983) argued that contextualism has been less influential in developmental psychology than either mechanism or organicism "because of its complexity." Developmentalists are, however, gradually coming to the view that the phenomena of development are themselves sufficiently complex to require a more complicated world view. In the preface to Volume 1 of the fourth edition of the *Handbook of Child Psychology,* William Kessen previewed the changes that distinguish this recent survey of the field. He stated that "the singular theme heard throughout" the diverse topics of the volume "is the theme of contextual child psychology. . . . [C]hild psychology . . . now confronts frankly the complexity of the child's life and takes more intellectual risks in trying to understand the child in context" (p. ix). In psychology, contextualism is emerging as a paradigm that grants both the complexity and, at least tacitly, the fundamentally historical nature of psychological phenomena. As such, it represents the germ of a populational psychology. However, that germ extends beyond a new model of development. In addition, it entails a psychology in which developmental trajectories provide the ontogenetic history required to explain all psychological phenomena.

Contextualism and populational thinking level many of the same criticisms against the traditional approach. Barbara Rogoff (1980) argued that

> [T]he role of context has been overlooked in the field of cognitive development. (p. 131). . . . Psychologists often think that it is possible, in principle and in practice, to examine cognitive processes without concern for the content or context of what is being processed, i.e. to neutralize the task so that performance reflects "pure process." (p. 130). . . . [I]t is the attempt to infer an enduring general quality of the subject group (whether cognitive capability, stage of cognitive development, or personality type) that requires situations to be equivalent. The problem of [situational] equivalence disappears when the test or observation is not attempting to gauge an underlying quality independent of situational constraints, but rather is interested in determining the psychological processes occurring in an event involving people in specific situations. (p. 129)

That "enduring general quality" is the essentialist's form, and the tendency to overlook the importance of context belies the essentialistic assumption that once that enduring general quality is isolated, no fundamental change occurs by placing the phenomenon in context.

There is mounting evidence in cognitive development that the phenomena of interest do not exist out of context. The clearest illustrations of the inappropriateness of cross-contextual generality come from attempts to take those general processes out of Western culture and extend them to other peoples. The most general conclusion of this work is that predictions of general-process, culturally universalist approaches are invalid as soon as they leave the culture in which they were generated. Rather, results usually reflect the "context boundness of culture-dependent cognitive skills" (Laboratory of Comparative Cognition, 1983, p. 321).

Kearins (1981), for example, compared spatial memory skills of semiliterate Aboriginal children inhabiting the western deserts of Australia with those of urban Westernized Anglo-Australian children. The existing literature indicates that Aboriginal children score consistently lower than their white Australian peers on standardized culture-fair tests of cognitive ability. Kearins, however, developed experimental tasks that modeled the cognitive skills naturally required of Aboriginal children in adapting to the unpredictable desert environment of Western Australia. The children's tribes were seminomadic, and the tasks involved spatial memory such as might be required in foraging or returning to a campsite from any of several directions. The tasks were laboratory-like spatial