
Developmental Science in the 21st Century: Emerging Questions, Theoretical Models, Research Designs and Empirical Findings

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Introduction

Our task in this paper is to speculate about the future of developmental psychology in general and social development in particular, and we shall do so in the light of past achievements. The first step in such an enterprise, and perhaps the last as well, is telegraphed in the subtitle. The message thereon refers to the elements of a framework that can be used for describing the nature and status of a particular scientific field. In recent years, that field under consideration has been increasingly referred to as **developmental science**.

Upon carrying out a search of the literature, we discovered that, although theoretical articles in this domain have been appearing for more than two decades, the first attempts to provide a formal definition of a theoretical model for developmental science, and to carry out empirical research focused on its investigation, did not occur until the late 1990s (Cairns, Elder, and Costello, 1996).

The formal definition of the domain appears in a 'Collaborative Statement' by the three authors:

Developmental science refers to a fresh synthesis that has been generated to guide research in the social, psychological, and biobehavioral disciplines. It describes a general orientation for linking concepts and findings in hitherto disparate areas of developmental inquiry, and it emphasizes the dynamic interplay of processes across time frames, levels of analysis, and contexts. Time and timing are central to this perspective. The time frames employed are relative to the lifetime of the phenomenon to be understood. Units of focus may be as short as milliseconds, or as long as years, decades, and millennia. In this perspective, the phenomena of individual functioning are viewed at multiple levels—from the sub-systems of genetics, neurobiology, and hormones to those of families, social networks, communities, and cultures. (Op. cit., p. 1)

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Clearly, the foregoing statement also pertains to the subject matter of the present article. Consistent with its title, the statement by Cairns and his colleagues calls for linking processes across diverse domains of human functioning over extreme ranges of time and timing. But the statement contains no particulars with respect to which processes, in which developmental domains, or over what periods of time are to be the focus of investigation.

We hasten to add, however, that this was not the volume's purpose. What was intended, and achieved, was to break new ground for psychological research. For that reason it is appropriate, and perhaps even obligatory, to place on record the reaction to the 'Collaborative Statement' by one of the authors of the present article. The reaction appears in the opening paragraph of the 'Foreword' to the volume by Cairns and his colleagues (1996, p. 9), and reads as follows:

Seldom in reading a scientific manuscript does one feel impelled to identify it as a potential scientific milestone. In this instance, the milestone may well be a significant step toward the evolution of a new and more powerful paradigm for the scientific study of human development. To be sure, as the authors of the volume emphasize, any 'new paradigm' . . . still lies far ahead. Nor do the authors claim principal credit for having themselves achieved the progress that has been made. Rather, they call attention to what they have perceived as an emergent convergence and isomorphism, mostly over the past two decades, in the work of scientists in different disciplines, employing seemingly different theoretical perspectives, reporting results specific to delimited substantive domains, and yet, in the present author's view, all producing patterns of findings encompassable within the same general model of developmental structure and process.

We quote this paragraph, because we ourselves are among the developmental scientists who are engaged in the formulation and application of a general model for the scientific study of human development. But while general in scope, its aim is more focused and specific. In effect, the model undertakes a necessary and more difficult next stage in developmental science, namely, proposing and investigating 'linking concepts in hitherto disparate areas of developmental inquiry' that emphasize 'the dynamic interplay of processes across time frames, levels of analysis, and contexts', in which 'time and timing are central.'

The theoretically-oriented research program in which we have been engaged addresses these very questions. Begun—without consciously recognizing the fact—almost half a century ago (Bronfenbrenner, 1951), it did not become an explicit, life-long scientific endeavor until almost a decade later (Bronfenbrenner, 1960). The first systematic, comprehensive expositions of the model, together with related empirical evidence, appeared in 1970 and 1979, and were followed by two major, integrative reformulations, published in successive editions of the *Handbook of Child Psychology* in 1983 (Bronfenbrenner & Crouter) and 1998 (Bronfenbrenner & Morris). Thus the present undertaking, still under way, constitutes the fifth effort of its kind.

Although from its very beginnings this long-range endeavor has been primarily theoretical in aim and content, empirical findings have throughout played a critical role in two complementary ways:

1. by seeking and obtaining empirical findings that might call into question relationships posited in the existing theoretical model;

2. by suggesting alternative, more-differentiated or more parsimonious theoretical formulations that might accommodate existing empirical findings.

The Developing Ecology of Human Development

The principal and direct focus of our research programme is not on analyzing the development of human beings as such, but on further developing the scientific tools—the theories, research designs, and corresponding empirical findings—that are required in order to improve our understanding of the conditions and processes that shape human development. Moreover, in the present instance, our primary interest is not in the forces that have shaped human development in the past, but in those that may already be operating today to influence what human beings may become tomorrow. Yet, given that human evolution, at least up till now, has been a slow process, the past and the present still provide our best clues to the future.

The authors of *Developmental Science* did not include a definition of the phenomenon under investigation: that is, of *human development* itself. But, given the task we have undertaken, such a definition becomes essential for our still-ongoing effort to complete the next major reformulation of what is now referred to as the **bioecological model**. We cast it within the framework in which we believe it belongs—namely, that of developmental science.

Developmental Science is the systematic scientific study of the conditions and processes producing **continuity and change over time** in the biopsychological characteristics of human beings—be it over the life course, across successive generations, retrospectively through historical time, or prospectively in terms of implications for the course of human development in the future.

We have now set the stage for the main task we have undertaken. It involves comparing the most recent version of the **bioecological model** (Bronfenbrenner and Morris, 1998), with its emerging successor still in preparation by Bronfenbrenner and Evans. The 1998 statement appears in the form of two Propositions. We proceed by considering the Propositions one at a time, and, in each case, then introducing any modifications with respect to the four defining properties specified in our subtitle; that is, in terms of ‘emerging questions, theoretical formulations, research designs, and empirical findings.’ The last, of course, are not likely to be available. The most we may be able to do will be to take into consideration any existing findings that are relevant to the preceding three domains and use them as a basis for future formulations.

Here is the original Proposition I [with minor clarifications of terminology].

Proposition I

Throughout the life course, human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment. To be effective, the interaction must occur on a fairly regular basis over extended periods of *time*. Such enduring forms of interaction in the immediate environment are referred to as *proximal processes*. (Bronfenbrenner & Morris, 1998, p. 996)

As used in the bioecological model, the concept of **proximal process** requires further elucidation:

A **proximal process** involves a transfer of energy between the developing human being and the persons, objects, and symbols in the immediate environment. The transfer may be in either direction or both; that is, from the developing person to features of the environment, from features of the environment to the developing person, or in both directions, separately or simultaneously.

In short, proximal processes function as the engines of development.

Proximal Processes are distinguished in terms of the two major kinds of developmental outcomes they produce.

Competence is the demonstrated acquisition and further development of knowledge, skill, or ability to conduct and direct one's own behavior across situations and developmental domains. The outcome can occur in any domain—intellectual, physical, motivational socioemotional, or artistic—either by itself, or in combination with one or more other spheres of activity.

Dysfunction refers to the recurrent manifestation of difficulties in maintaining control and integration of behavior across situations and different domains of development. (Bronfenbrenner & Morris, 1998, p. 1002).

This dichotomy confronts us with the following question: If proximal processes are indeed the 'engines of development', what are the differences between those that produce dysfunction vs. competence?

The first significant change introduced in the current reformulation of the bioecological model addresses this issue indirectly through the introduction of a new construct in the form of a Corollary to Proposition I.

Corollary Ia **Exposure** refers to the extent of contact maintained between the developing person and the proximal processes in which that person engages. Exposure varies along the following dimensions:

1. *Duration*. On average how long is the period of exposure? What is the length of the session?
2. *Frequency*. How often do sessions occur over time—hourly, daily, etc.?
3. *Interruption*. Does exposure occur on a predictable basis, or is it often interrupted?
4. *Timing* of interaction is critical. For example, in the case of an infant, the response of the parent has to occur soon enough for the baby to connect it with its own psychological state. As the child grows older, the timing of parental response can be delayed. Conversely, persistent mistiming of responsiveness can disrupt the development of self-regulatory behavior.
5. *Intensity* refers to the strength of the exposure. When exposure to proximal processes is brief, happens infrequently and does not take place on a predictable basis, developmentally-disruptive outcomes are more likely to occur.

The next Proposition specifies four interrelated elements that underlie the capacity of proximal processes to operate.

Proposition II

The form, power, content, and direction of the **proximal processes** producing development vary systematically as a joint function of the characteristics of the developing **person**, the environmental **context**—both immediate and more remote—in which the

processes are taking place, and the social continuities and changes occurring over *time* through the life course, and the historical period during which the person has lived; and, of course, the nature of the *developmental outcomes* under consideration.

Stated symbolically, Proposition II may be expressed as follows: $D_2 f PPCT_1$. Translated into words, this formulation reads as follows: A **developmental outcome** at a later point in time [D_2] is a joint function of a **process**¹; characteristics of the developing **person**; the nature of the immediate, 'face-to-face' environmental **context** in which the person lives; and of the length and frequency of the **time interval** [T_2-T_1] during which the developing person has been **exposed** to the particular process and to the environmental setting under consideration.

A comparison of the published versions of Propositions I and II reveals an interesting omission. Neither of them mentions the distinction between developmental outcomes of **Competence** vs **Dysfunction**. Does this mean that the two propositions are applicable to both?

The answer is a sobering one, because, in no small sense, we are left 'hoist by our own petard.' Even in its emerging fourth reformulation, the bioecological model has so far failed to address its most challenging questions. For example, does 'exposure' to 'progressively more complex interaction with persons objects and symbols over extended periods of time' necessarily produce an adult who is a good parent? And what about genetic inheritance, doesn't that make a big difference?

We do have at least a tentative answer to the latter question. In 1994, Bronfenbrenner and Ceci published an article that called into question the prevailing theoretical model and corresponding research design in *behavioral genetics* (e.g., Plomin, 1994). Our alternative formulations are summarized in the following abstract.

The authors propose an empirically testable model that (a) goes beyond and qualifies the established behavioral genetics paradigm by allowing for nonadditive synergistic effects, direct measures of the environment, and mechanisms of organism-environment interaction called *proximal processes*, through which genotypes are transformed into phenotypes; (b) hypothesizes that estimates of heritability (e.g., h^2) increase markedly with the magnitude of proximal processes; (c) demonstrates that heritability measures the proportion of variation in individual differences attributable only to *actualized* genetic potential, with the degree of *nonactualized* potential remaining unknown; (d) proposes that, by enhancing proximal processes and environment, it is possible to increase the extent of actualized genetic potentials for developmental competence. (Bronfenbrenner & Ceci, p. 568)

This alternative formulation, however, does not deny the utility of using h^2 as a measure of actualized potential. On the contrary, one of the research designs we recommend in the newly-emerging bioecological model is the wider use of heritability measures as a criterion for assessing the power of a given theoretical model. Such wider use becomes possible with the development of new mathematical models that permit estimating genetic components not only for developmental outcomes, but for all components of the theoretical model, plus the use of siblings rather than twins (see Jacobson & Rowe, 1999). The results will tell us which genetic potentials are being actualized, for better or for worse, under the given conditions of 'process, person, context and time'.

Developmental Challenge of the Future

In 1996, Bronfenbrenner and his colleagues published a volume documenting marked changes that had taken place over the preceding four decades in the lives of children

and youth growing up in the United States. The same pattern was paralleled to a lesser extent in other economically-developed nations. Two complementary trends reinforced each other over time. The first revealed what the authors referred to as ‘growing chaos’ (p. 122) in families, schools, unsupervised peer groups and other settings in which children and youth spend extended periods of time. The second documented progressive decline in measures of competence and character. Here are four examples from each domain (Bronfenbrenner & Morris, 1998, p. 1022, Table 17.1; for a more extended discussion, see Bronfenbrenner, in press):

- 1a. The United States stands in first place in the percentage of children growing up in single-parent families, which now include a quarter of all America’s children under 6 years of age.
- 1b. Schools have become one of the principal settings of violence in the United States (although the most recent evidence suggests that the percent of students who actually engage in such violence is decreasing).
- 1c. Two-thirds of children in poverty live in families with a working adult. Less than one-third of poor families with a young child rely solely on welfare.
- 1d. With more and more parents working, especially full time, there has been a steady decline in the direct participation of parents in care and activities with their children, with corresponding disruptive effects on the development of children and youth.
- 2a. Despite recent gains by youth from Black families, American high school students are still far behind those from other developed countries in academic achievement. This includes the top 10% of students in each nation.
- 2b. Over the past two decades, systematic studies based on nationally-representative samples document increased cynicism, distrust, and disillusionment among American adolescents.
- 2c. The participation of voters age 18–24 has been declining.
- 2d. In the United States, the young are not only among the major victims of murder, but they are also more likely to commit it. Youth and young adults (ages 18–25) now account for the majority of those arrested for homicide.

The developmental forces and outcomes that are documented in these cited sources relate primarily to developmental disarray not in cognitive nor emotional development, but in social development. Moreover, this statement applies to both sides of the developmental equation. The left hand side reveals a lack both of a common focus and of coordination between social systems at the micro-level of immediate settings (home, school, peer-group), and in the dynamic mesosystem relations between these settings (family and school; family and peer-group, school and peer-group). Correspondingly, on the right side of the equation are developmental outcomes in the form of both individual and group differences in social development, which we have defined broadly in positive terms as follows:

patterns of day-to-day behavior reflecting and conveying long-range commitment to the well-being of other persons, beginning with members of one’s immediate family and, as a child grows older, extending through the life course to other individuals, groups, and social settings in which one is a direct participant, such as child-care settings outside the family, school, the neighborhood and community in which one lives, the workplace, the relations between these settings, and, ultimately, the well-being of society as a whole.

By contrast, what the data we have analyzed for the United States and other developing countries over the past four decades reveal is the very opposite: **progressive decline over time in concern for the well-being of others—expressed primarily not in words but in actions.**

In the light of these data we conclude that the principal developmental challenge confronting contemporary societies as we enter the 21st century is the growing threat of a major breakdown specifically in the domain of **social development**. We have therefore undertaken what we saw as the necessary next scientific step: that of *developing both a theoretical model and corresponding research designs for the further scientific investigation of the effects of the increasing chaos and its mode of operation, as well as identifying potential counterforces for its reduction and possible reversal.*

Chaos and The Bioecological Model

Chaos integrates the various elements involved in exposure, and foreshadows its role in the bioecological model in terms of what is called 'chaotic systems'. Such systems are characterized by frenetic activity, lack of structure, unpredictability in everyday activities, and high levels of ambient stimulation. Background stimulation is high, and there is a general lack of routinization and structure in daily life. The environment is also a major source of interruption of proximal processes in the form of residential noise, crowding, and classroom design (e.g. open vs. traditional classrooms) (Evans, Hygge, & Bullinger, 1995; Evans Lepore, Shejwal, & Palsane 1998; Evans & Lovell 1979; Evans, Maxwell, & Hart, 1999; Matheny, Wachs, Ludwig, & Phillips, 1995).

Developmental consequences of objective chaos are illustrated in research by Ackerman and colleagues (1999). Chaotic environmental systems for disadvantaged preschoolers were operationalized as:

i. the number of residences the child had occupied; ii. the number of intimate relationships of the mother; iii. number of families with whom the child has lived; iv. chronic physical illnesses of the child; and v. negative life events of the mother (e.g. death or serious illness of family members or close friends, job or income loss, legal problems, family separation). As levels of instability rose, psychological distress was elevated for preschoolers of both genders.

To begin with the effects, chaos can interfere with proximal processes that engender competence as well as produce proximal processes that in and of themselves lead to dysfunction. Evans et al. (1998) found that crowding interfered with the development and maintenance of socially supportive relationships between parents and their elementary aged school children. These less supportive relationships operating as a proximal process, in turn, produced poorer behavioral adjustment at school and heightened vulnerability to learned helplessness. Chaotic home environments characterized by high levels of social and physical stimulation in conjunction with disorganization are associated with dysfunctional proximal processes such as less responsive parenting with preschool children (Matheny et al., 1995). Unresponsive parenting is a precursor to psychological distress and other negative social outcomes in children. Chaos has the potential to interfere with the development and maintenance of proximal processes that foster competence and character. Chaos can also directly lead to proximal processes that portend dysfunctional social development.

To be sure, ultimately the principal roots of social development—the ties that, over time involve and commit to action in behalf of the well-being of others beyond our own self-interest—lie even deeper, and, today, it is these are being placed at ever greater risk by the growing chaos. Our initial efforts to define these roots took the form of the following proposition. This ‘emerging’ formulation begins in a somewhat familiar way, but then ends up in a terrain with a warmer climate.

Proposition III

In order to develop—intellectually, emotionally, socially, and morally—a human being, whether child or adult, requires—for all of them—the same thing: active participation in progressively more complex reciprocal interaction with persons with whom he or she develops a strong, mutual, irrational attachment, and who, over time, become committed to each other’s well-being and development, preferably for life.

An elegant example of Proposition III in action is documented in a study by Crockenberg (1981). The investigator found that mothers with more social support from the father had more securely-attached infants.

However, upon further consideration in the light of our existing theoretical model and related research findings, it became clear to us that as a basis for social development, Proposition III, if taken by itself, was not only insufficient, but might also lead to some unwarranted assumptions. First of all, ‘a strong, mutual irrational attachment’ may also be a high road to psychological dependency. Second, our still-evolving theoretical model posits as a biologically-driven developmental transition moving beyond, but not apart from, the family. This intervening stage involves joint activities and friendship ties, typically with age-mates of the same gender, prior to the establishment of strong sexual ties (e.g., Maccoby, 1998). Moreover, in searching the literature, we are finding increasing empirical evidence that short-circuiting this transition, for whatever reasons, augurs ill for future effectiveness in a parental role (e.g., Bronfenbrenner & Ceci, 1994; Hetherington and Stanley-Hagen, 1999; Rowe, Almeida, & Jacobson, 1999; Rowe, Jacobson, & Van den Oord, 1999; Verschueren & Marcoen, 1999).

Finally, the principal shortcoming of Proposition III (not denying its role as a possible early foundation for social development) is the often tacit and unwarranted assumption that the main directions of future development in general are set in childhood, with no major changes occurring after that time. Regrettably, the clearest research examples to the contrary are still not well-known in the United States, because the work was done in the Soviet Union several decades ago during a period of little scientific contact. Here is a brief summary of one of the most telling examples:

In the early 1920s, A. S. Makarenko, a prominent Soviet educator, was given the assignment of setting up a rehabilitation program for some hundreds of homeless youth eighteen years of age with extensive court records of housebreaking, armed robbery, and manslaughter. Based on his experience and theoretical ideas, Makarenko established his rehabilitation center in some abandoned farm buildings in a remote, heavily-forested area known for its bitterly cold winters. For the first few months during the fall, Makarenko’s school served simply as the headquarters for the band of highwaymen who were his legal wards. But gradually, as the winter weather moved in, Makarenko, through application of his theoretical ideas and group-oriented discipline techniques, was able to develop a sense of group responsibility and commitment to the work program and code of conduct that he had laid out. Its basic principle: ‘The maximum of support with the maximum of demand.’ In the end, his ‘Gorky Colony’ became known throughout the Soviet Union for its high morale, for its discipline, and for the productivity of its fields, farms, and shops (Bronfenbrenner, 1960, p. 38).

Makarenko described his experiences, theories, and methods in an extensive series of semi-autobiographical novels and essays, which take up seven volumes in the 1957 edition of his works. In the West, his principal writings have been published in all major countries with the notable exception of the United States, where first translations did not begin to appear until the 1960s.

At about the same time, but apparently with no knowledge of Makarenko's earlier work, Muzafer Sherif and his colleagues (1961) carried out a somewhat analogous experiment in the United States. Best known by its subtitle, 'The Robbers Cave Experiment', the work is well-known in the field of social psychology, but its important implications for developmental science, both pro or con, have yet to be investigated. The nature of the still-unanswered questions becomes apparent from the following brief description of the experiment:

The subjects were 24 11-year old American, middle-class, Protestant, well-adjusted boys who were willing to go to an experimental camp . . . Sherif set out to demonstrate that within a space of a few weeks, he could bring about two sharply contrasting patterns of behavior in this sample of normal boys. First, he would transform them into hostile, destructive, antisocial gangs; then, within a few days, change them again, this time to become cooperative, constructive workers and friends concerned about and even ready to make sacrifices for each other and for the community as a whole. (Bronfenbrenner, 1979, p. 99)

The findings show is that this is exactly what happened. Indeed Phase I was so 'successful' that the investigators decided to cut it short, lest the hostile, destructive, anti-social behaviors go too far. Clearly, the experiment produced dramatic changes in social behavior. But were these also changes in social development, and if so, which of the treatments had the greater effect? Given that the order of treatments was not counter-balanced, one hopes it was the more recent turnaround.

This is, of course, the crucial question for developmental science, and is, of course, also best answered in a longitudinal study (which today would probably—and in our judgment, also properly—not be approved on ethical grounds). Perhaps it could still be answered with the original sample, if enough of the subjects are still alive but that is hardly likely, given that there were only 24 boys to start with.

Fortunately, there is additional evidence on this issue, not from 'experiments by design' but from what Bronfenbrenner (1979) has called 'experiments by nature'. Perhaps the most relevant of these are the work of the American sociologist Glen Elder, one of the founders and major contributors to the field now known as 'life course development' (for a summary of his principal theoretical formulations and empirical findings see Bronfenbrenner & Morris 1998, pp. 1020–1021). Especially relevant to subject matter of the present article are Elder's studies of the effects of voluntary military enlistment on young men from poverty backgrounds who had failed in civilian life (Elder, 1974). For them, military service was a re-casting experience that provided a bridge to greater opportunity and an impetus for developmental growth through the middle years and beyond.

But Elder would be the first to point out that today we are living in a different historical time. As already documented in this article, we are now in a period of growing chaos in the lives not only of families but in all the day-to-day environments of people of all ages. Re-creating social development is the principal challenge confronting contemporary societies as we enter the 21st century. The necessary theoretical model is now in the making. The corresponding research designs are our next task. As for the needed empirical findings, these still lie ahead.

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Note

1. Process is defined as an exchange of energy between the developing person and the environment for example, mother-infant interaction is a process.