Toward an Experimental Ecology of Human Development

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ABSTRACT: *A broader approach to research in human development is proposed that focuses on the progressive accommodation, throughout the life span, between the growing human organism and the changing environments in which it actually lives and grows. The latter include not only the immediate settings containing the developing person but also the larger social contexts, both formal and informal, in which these settings are embedded. In terms of method, the approach emphasizes the use of rigorously designed experiments, both naturalistic and contrived, beginning in the early stages of the research process. The changing relation between person and environment is conceived in systems terms. These systems properties are set forth in a series of propositions, each illustrated by concrete research examples.*

This article delineates certain scientific limitations in prevailing approaches to research on human development and suggests broader perspectives in theory, method, and substance. The point of departure for this undertaking is the view that, especially in recent decades, research in human development has pursued a divided course, with each direction tangential to genuine scientific progress. To corrupt a contemporary metaphor, we risk being caught between a rock and a *soft* place. The rock is *rigor,* and the soft place *relevance.* As I have argued elsewhere (Bronfenbrenner, 1974; Note 1), 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. From this perspective, it can be said that much of contemporary developmental psychology is *the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time.*[1]

Partially in reaction to such shortcomings, other workers have stressed the need for social relevance in research, but often with indifference to or open rejection of rigor. In its more extreme manifestations, this trend has taken the form of excluding the scientists themselves from the research process. For example, one major foundation has recently stated as its new policy that, henceforth, grants for research will be awarded only to persons who are themselves the victims of social injustice. Other, less radical expressions of this trend involve reliance on existential approaches in which "experience" takes the place of observation and analysis is foregone in favor of a more personalized and direct "understanding" gained through intimate involvement in the field situation. More common, and more scientifically defensible, is an emphasis on naturalistic observation, but with the stipulation that it be unguided by any hypotheses formulated in advance and uncontaminated by structured experimental designs imposed prior to data collection.

This article represents a synthesis and further development of ideas originally presented by the author in two addresses at successive annual meetings of the American Psychological Association. The first was a presidential address to the Division of Personality and Social Psychology in 1974; the second was an invited Master Lecture in 1975.

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[1] In a recent survey of all studies in child development ($N = 902$) published between 1972 and 1974 in three prominent research journals (*Child Development, Developmental Psychology, Journal of Genetic Psychology*), Larson (Note 2) found that 76% of all the investigations had employed the experimental laboratory paradigm; the next highest category was research using pencil-and-paper techniques (17%); observational studies were in lowest place (8%).

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. Specifically, it rejects as spurious the argument that, because naturalistic observation preceded experimentation in both the physical and biological sciences, this progression is necessarily the strategy of choice in the study of human behavior and development. Such an interpretation mistakes a historical sequence for a causal one and represents yet another instance of the logical pitfalls inherent in the ever-seductive *post hoc, propter hoc* inference. In my view, 20th-century science possesses research strategies that, had they been available to the 19th-century naturalists, would have enabled them to leapfrog years of painstaking, exhaustive description in arriving at a formulation of biographical principles and laws. This is not to imply that taxonomy is not an essential scientific task but only to assert that a phase of comprehensive observation, recording, and classification may not be a necessary condition for making progress in the understanding of process, and that the early application of experimental paradigms may in fact lead to more appropriate taxonomies for achieving the requisite work of systematic description.

There is yet another restriction unnecessarily imposed on the strategy of naturalistic observation, particularly as applied to the human case by its principal advocates—the ethologists (Jones, 1972; McGrew, 1972) and the psychological ecologists of the Kansas school (Barker & Schoggen, 1973; Barker & Wright, 1954). Both groups have adapted to the study of human behavior a model originally developed for the observation of subhuman species. Implicit in this model is a concept of the environment that may be quite adequate for the study of behavior in animals but that is hardly sufficient for the human case. Specifically, it is limited to the immediate, concrete setting containing the living creature and focuses on the observation of the behavior of one or, at most, two beings at a time in only one setting. As I shall argue below, the understanding of human development demands going beyond the direct observation of behavior on the part of one or two persons in the same place; it requires examination of multiperson systems of interaction not limited to a single setting and must take into account aspects of the environment beyond the immediate situation containing the subject.

Specifically, in this essay, I propose first an expansion and then a convergence of both the naturalistic and the experimental approaches—more precisely, an expansion and convergence in the theoretical conceptions of the environment that underlie each of them. I refer to this evolving scientific perspective as the *ecology of human development*. The major dimensions of this perspective are outlined below.

Terms of Reference

Let us begin with some definitions of focus, context, and method.

DEFINITION 1. *The* ecology of human development *is the scientific study of the progressive, mutual accommodation, throughout the life span, between a growing human organism and the changing immediate environments in which it lives, as this process is affected by relations obtaining within and between these immediate settings, as well as the larger social contexts, both formal and informal, in which the settings are embedded.*

The conception of the environment implicit in the foregoing definition is considerably broader and more differentiated than that found in psychology in general and in developmental psychology in particular. Specifically:

DEFINITION 2. *The* ecological environment *is conceived topologically as a nested arrangement of structures, each contained within the next.* (For the purpose of describing these successive levels, I shall employ a terminology adapted from Brim [1975].)

1. *A* microsystem *is the complex of relations between the developing person and environment in an immediate setting containing that person (e.g., home, school, workplace, etc.). A* setting *is defined as a place with particular* physical features *in which the* participants *engage in particular* activities *in particular* roles *(e.g., daughter, parent, teacher, employee, etc.) for particular periods of* time. *The factors of place, time, physical features, activity, participant, and role constitute the* elements *of a setting.*

In psychological research, especially in the laboratory, these elements are often given short shrift. In particular, roles other than those of experimenter and subject that might in fact be operative

for the participants are disregarded, and behavior is examined primarily in terms of process (e.g., modes of interaction, reinforcement schedules, response rates) rather than content (e.g., the nature and purpose of the task). So that this substantive aspect is not overlooked, I use the term *activity* rather than *behavior* to identify this essential feature of the microsystem.

2. *A mesosystem comprises the interrelations among major settings containing the developing person at a particular point in his or her life. Thus, for an American 12-year-old, the mesosystem typically encompasses interactions among family, school, and peer group; for some children, it might also include church, camp, or workplace, although the last would be less common in the United States than in some other societies. In sum, stated succinctly, a mesosystem is a system of microsystems.*

3. *An exosystem is an extension of the mesosystem embracing other specific social structures, both formal and informal, that do not themselves contain the developing person but impinge upon or encompass the immediate settings in which that person is found, and thereby influence, delimit, or even determine what goes on there. These structures include the major institutions of the society, both deliberately structured and spontaneously evolving, as they operate at a concrete local level. They encompass, among other structures, the world of work, the neighborhood, the mass media, agencies of government (local, state, and national), the distribution of goods and services, communication and transportation facilities, and informal social networks.*

A *macrosystem* differs in a fundamental way from the preceding forms in that it refers not to the specific contexts affecting the life of a particular person but to general prototypes, existing in the culture or subculture, that set the pattern for the structures and activities occurring at the concrete level. Thus, within a given society, one school classroom looks and functions much like another. The same holds true for other settings and institutions, both informal and formal. It is as if all were constructed from the same blueprints. These "blueprints" are the macrosystems. Some actually exist in explicit form as recorded laws, regulations, and rules. But most macrosystems are informal and implicit—carried, often unwittingly, in the minds of the society's members as ideology made manifest through custom and practice in everyday life. To give a formal definition:

4. *A macrosystem refers to the overarching institutional patterns of the culture or subculture, such as the economic, social, educational, legal, and political systems, of which micro-, meso-, and exosystems are the concrete manifestations. Macrosystems are conceived and examined not only in structural terms but as carriers of information and ideology that, both explicitly and implicitly, endow meaning and motivation to particular agencies, social networks, roles, activities, and their interrelations. What place or priority children and those responsible for their care have in such macrosystems is of special importance in determining how a child and his or her caretakers are treated and interact with each other in different types of settings.*

Especially in its formal properties, the foregoing conception of the environment, as well as the dynamic relation between person and situation implied in the definition of the ecology of human development, draws heavily on the theories of Kurt Lewin (1935, 1936, 1948, 1951). Indeed, this article may be viewed as an attempt to provide psychological and sociological substance to Lewin's brilliantly conceived topological territories.

Having outlined the structure of the ecological environment, we are in a position to examine a construct often alluded to in recent discussions of developmental research—*ecological validity*. Although this term, as yet, has no accepted definition, one can infer from discussions of the topic a common underlying conception: An investigation is regarded as ecologically valid if it is carried out in a naturalistic setting and involves objects and activities from everyday life. Although originally attracted to this notion, upon reflection I have come to view it not only as too simplistic but as scientifically unsound on several counts. First, while I agree wholeheartedly with the desirability of extending research activities beyond the laboratory, I question the seemingly automatic grant of scientific legitimacy to a research effort merely on the basis of its being conducted in a real-life situation. Even more arbitrary, however, is the converse implication that any investigation carried out in a nonnaturalistic setting is necessarily ecologically invalid, and thereby scientifically suspect on purely a priori grounds. Surely, this is to prejudge the issue. Moreover, the term *ecological validity* as it is currently used has no logical relation to the classical definition of validity—namely,

the extent to which a research procedure measures what it is supposed to measure. Indeed, there is a basic conflict in the theoretical assumptions underlying the two definitions. In the classical conception, validity is ultimately determined by the nature of the problem under investigation. In contrast, ecological validity, as presently defined, is apparently determined once and for all by the setting in which the study is being conducted, without regard to the question being investigated. Surely, in any research endeavor this last consideration must be the most decisive in assessing validity of whatever kind.

At the same time, implicit in current concerns with ecological validity is another principle that can no longer be disregarded in the light of available evidence. This is the proposition that the properties of the environmental context in which research is carried out influence the processes that take place within that context and thereby affect the interpretation and generalizability of the research findings.

I have therefore sought to formulate a definition of ecological validity that takes both of these principles into account. Once this task became clear, it was not difficult to achieve. All that was required was a logical extension of the classical definition of validity. As traditionally formulated, this definition is limited in focus, applying only to the measurement procedures employed in research operations. The definition of ecological validity proposed here expands the scope of the original concept to include the environmental context in which the research is conducted.

DEFINITION 3. Ecological validity *refers to the extent to which the environment experienced by the subjects in a scientific investigation has the properties it is supposed or assumed to have by the investigator.*

Two features of the foregoing definition deserve special comment. First, the relevant features of the environment include not only its objective properties but also the way in which it is perceived by the research subjects. This stipulation takes cognizance of perhaps the only proposition in social science that approaches the status of an immutable law—W. I. Thomas's inexorable dictum: "If men define situations as real, they are real in their consequences" (Thomas & Thomas, 1928, p. 572).

Second, note that Definition 3 does not designate any particular kind of research setting as valid or invalid on a priori grounds. Thus, depending on the problem, the laboratory may be an altogether appropriate setting for an investigation and certain real-life environments may be highly inappropriate. Suppose, for example, one is interested in studying the interaction between mother and child when the child is placed in a strange and unfamiliar situation. Clearly the laboratory approximates this condition far better than the home. Conversely, if the focus of inquiry is the modal pattern of parent–child activity prevailing in the family, observations confined to the laboratory can be misleading. As I have documented elsewhere in greater detail (Bronfenbrenner, in press), patterns of parent–child interaction in the laboratory are substantially and systematically different than those in the home. Specifically, so far as young children are concerned, the results indicate that the strangeness of the laboratory situation tends to increase anxiety and other negative feeling states and to decrease manifestations of social competence (Lamb, 1976b; Ross, Kagan, Zelazo, & Kotelchuck, 1975; Lamb, Note 3). Possibly in response to this reaction of the child, parents tend to exhibit more positive interactions toward their children in the laboratory than in the home (Schlieper, 1975; Shalock, 1956; Belsky, Note 4). In addition, Lamb (1976b; Note 3) reported that the tendency of the infant at home to display more affiliative behaviors (e.g., looking, smiling, reaching, vocalizing) toward the father than the mother was reversed in the laboratory. Moreover, consistent with the arguments of Sroufe (1970) and Tulkin (1972) that the laboratory is especially likely to be an anxiety-arousing situation for lower-class families, Lamb found socioeconomic differences in father–infant interaction favoring the middle class in the laboratory, whereas such differences had not been present in the home.

Again, the fact that research results obtained in the laboratory differ from those observed in the home cannot be interpreted as evidence for the superiority of one setting over the other, except in relation to a specific research question. At the very least, such differences serve to illuminate the special properties of the laboratory as an ecological context. More importantly, they illustrate the as-yet-unexploited power of the laboratory as an ecological contrast for highlighting the distinctive features of other types of settings as they affect behavior and development. From this point of view, an ecological orientation increases rather

than reduces opportunities for laboratory research by pointing to new knowledge that can be achieved through close and continuing articulation between laboratory and field.

At a more general level, the comparison of results obtained in laboratory and real-life settings provides an illustration of the basic strategy through which ecological validity can be demonstrated or found wanting. As in the case of the definition of the concept, the method represents an extension of the procedures employed for investigating validity in its classical form. Essentially, the process is one of establishing construct validity (Cronbach & Meehl, 1955), in this instance by testing the ecological theory underlying the research operations—that is, the assumptions being made about the nature and generalizability of the environment in which the research is being conducted. For example, when a laboratory study is regarded as representative of behavior elsewhere, evidence must be provided of an empirical relation to similar activities in the other setting—in other words, validation against an external *ecological* criterion, *with the possibility of systematic divergence explicitly taken into account.* It should be recognized, moreover, that such divergence may take the form not merely of differences in average response, but in the *total pattern of relationships, and in the underlying processes that they are presumed to reflect.* Some examples of substantial shifts in pattern and process from one ecological context to another are cited further on in this article.

The foregoing discussion of ecological validity leads directly to the principal methodological thesis of this exposition. As should be true of any scientific endeavor, decisions on research design are dictated by theoretical considerations. Thus, in the present instance, given the complex conception of the ecological environment in terms of interdependent, nested systems, the question arises as to how these interdependencies can be investigated empirically. I shall argue that a strategy especially well suited for this purpose, from the earliest stages of research forward, is an *ecological experiment,* defined as follows:

DEFINITION 4. *An* ecological experiment *is an effort to investigate the progressive accommodation between the growing human organism and its environment through a systematic contrast between two or more environmental systems or their structural components, with a careful attempt to control other sources of influence either by random assignment (contrived experiment) or by matching (natural experiment).*

I deliberately eschew the term *quasi-experiment,* typically employed in the research literature, because it suggests a lower level of methodological rigor, an implication I regard as unwarranted on strictly scientific grounds. As I shall endeavor to show, there are instances in which a design exploiting an experiment of nature provides a more critical contrast, insures greater objectivity, and permits more precise and theoretically significant inferences—in short, is more elegant and constitutes "harder" science—than the best possible contrived experiment addressed to the same research question.

In other respects, of course, the definition has a familiar ring. In keeping with the commitment to rigor affirmed at the outset, the main body of the definition is a restatement of the basic logic of the experimental method. What may be challenged about this formulation is not the procedure advocated but the timing and the target of its application. Specifically, I am proposing that experiments be employed in the very first phases of scientific inquiry, not for the usual objective of testing hypotheses (although this device is used as a means to an end) but for *heuristic purposes*—namely, to analyze systematically the nature of the existing accommodation between the person and the surrounding milieu.

The need for early experimentation derives from the nature of the problem under investigation. The "accommodation" or "fit" between person and environment is not an easy phenomenon to recognize. Here, looking is usually not enough. As Goethe wrote with his poet's prescience: "Was ist das Schwerste von allem? Was dir das Leichteste dünket, mit den Augen zu sehen, was vor den Augen dir liegt." (What is the most difficult of all? That which seems to you the easiest, to see with one's eyes what is lying before them.)

If looking is not enough, what is one to do? How can the observer quicken his or her sensitivity to the critical features of the observed? The answer to this question was given me more than 30 years ago, long before I was ready to appreciate it, by my first mentor in graduate school, Walter Fenno Dearborn. In his quiet, crisp New England accent, he once remarked: "Bronfenbrenner, if you want to understand something, try to change it." And whether one studies change by

deliberately altering conditions in a contrived experiment or by systematically exploiting an "experiment of nature," the scientific purpose and effect are the same: To maximize one's sensitivity to phenomena through the juxtaposition of the similar but different constitutes the core of the experimental method and creates its magnifying power.

The case presented here for early and continuing application of experimental paradigms should not be misinterpreted as an argument against the use of other methods, such as ethnographic description, naturalistic observation, case studies, field surveys, etc. Such strategies can provide invaluable scientific information and insights. The point being made is a positive one—namely, that the experiment plays a critical role in ecological investigation not only for testing hypotheses but, at prior stages, for detecting and analyzing systems properties within the immediate setting and beyond. The special suitability of the experiment for this purpose is highlighted by an adaptation of Dearborn's dictum to the ecological realm: *If you wish to understand the relation between the developing person and some aspect of his or her environment, try to budge the one, and see what happens to the other.* Implicit in this injunction is the recognition that the relation between person and environment has the properties of a system with a momentum of its own; the only way to discover the nature of this inertia and its interdependencies is to try to disturb the existing balance.

It is from this perspective that the primary purpose of the ecological experiment becomes not hypothesis testing but *discovery*—the identification of those systems properties and processes that affect, and are affected by, the behavior and development of the human being. Moreover, if the objective is the identification of systems properties, then *it is essential that such systems properties not be excluded from the research design before the fact by restricting observation to only one setting, one variable, and one subject at a time.* Human environments and—even more so—the capacities of human beings to adapt and restructure these environments are so complex in their basic organization that they are not likely to be captured, let alone comprehended, through simplistic unidimensional research models that make no provision for assessing ecological structure and variation. Accordingly, in contrast to the classical laboratory experiment in which one focuses on a single variable at a time and attempts to "control out" all others, in ecological research the investigator seeks to "control in" as many theoretically relevant ecological contrasts as possible within the constraints of practical feasibility and rigorous experimental design. For only in this way can one assess the generalizability of a phenomenon beyond a specific ecological situation and, equally significant from a developmental perspective, identify the processes of mutual accommodation between a growing organism and its changing surround. For instance, in studying socialization strategies, one might do well to stratify the sample not only, as is commonly done, by social class, but also by family structure and/or child-care setting (home versus day care). Such stratification in terms of two or more ecological dimensions serves the scientifically useful function of providing a systematically differentiated and thereby potentially sensitive grid that makes possible the detection and description of patterns of organism–environment interactions across a range of ecological contexts. Moreover, given the extraordinary capacity of the species *homo sapiens* to adapt to its milieu, these patterns are more likely to be complex than simple. To corrupt, only slightly, the terminology of experimental design: *In ecological research, the principal main effects are likely to be interactions.*

This brings us to the final and most challenging requirement of a research model for investigating the ecology of human development: Namely, *environmental structures, and the processes taking place within and between them, must be viewed as interdependent and must be analyzed in systems terms.* The specification of these interdependencies constitutes a major task of the proposed approach. The rest of this article represents a beginning effort in this direction in the form of a series of propositions outlining the requirements of an ecological model for research at each of the four successive levels stipulated in the conceptual framework of the environment. Each proposition is accompanied by one or more examples of concrete investigations—actual when available, hypothetical when not—to illustrate the given requirement, either by demonstration or default.

The reference to illustration by default reflects the fact that for reasons already indicated, well-designed, ecological experiments are, as yet, not easy to find. In an effort to alter this state of affairs, I was fortunate in enlisting the support of the Foundation for Child Development (FCD) in

initiating a small-scale program of research grants and career development awards in the ecology of human development. The aim of the program is to encourage scientific work and training in the systematic study of "the behavior and development of children, and those who care for them, in the enduring environments in which they live." A number of ecological experiments cited in this article were supported by grants from the FCD program.[2]

Properties of the Microsystem

RECIPROCITY

It is a sign of some progress that the first systems property to which I call attention is one that many readers will recognize and applaud. In the classical, psychological research model, whether in the laboratory or in the field, there were, and often still are, only two parties—an experimenter, identified solely, and apparently still acceptably, as *E*, and another person equally informatively described as *S*, the subject. The term *subject* is apt, for it reflects the fact that with few exceptions, the process operating between *E* and *S* has been viewed as unidirectional; the experimenter presents the stimulus, and the subject gives the response. Nowadays, we all know that the process goes both ways. In more formal terms:

PROPOSITION 1. *In contrast to the traditional, unidirectional research model typically employed in the laboratory, an ecological experiment must allow for reciprocal processes; that is, not only the effect of A on B, but also the effect of B on A. This is the requirement of* reciprocity.

While the thesis that most behavior in social situations is reciprocal is generally accepted in principle, it is often disregarded in practice. As a striking case in point, we may consider a series of ingenious ecological experiments and follow-up studies conducted by a group of investigators from the Department of Pediatrics at Case Western Reserve University (Kennell et al., 1974; Klaus, Kennell, Plumb, & Zuehlke, 1970; Klaus et al., 1972; Ringler, Kennell, Jarvella, Navojosky, & Klaus, 1975; Hales, Note 5). Taking as their point of departure observations on animals revealing complex, species-specific patterns of mother–neonate interaction immediately after delivery (Rheingold, 1963), the investigators undertook to explore this phenomenon in the human case. Noting that prevailing hospital practices resulted in minimal opportunities for contact between mother and newborn, the researchers modified the established procedures so as to permit mothers to have their naked infants with them for about an hour shortly after delivery and for several hours daily thereafter. Randomly assigned control groups experienced the usual routine in American hospitals —"a glance at their baby shortly after birth, a short visit six to 12 hours after birth for identification purposes, and then 20- to 30-minute visits for feeding every four hours during the day" (Kennell et al., 1974, p. 173).

The reported results of these experiments strain the credulity of the reader. One month after the brief extended contact at birth, the mothers in the experimental group were more attentive and affectionate toward their babies and more solicitous about their welfare (Klaus et al., 1972). Not only were these differences still in evidence at the end of the 1st year, but 2 years later the mothers, in speaking to their children, used significantly more questions, adjectives, and words per proposition and fewer commands and content words than did the control mothers.

Finally, the most recent experiment in the series (Hales, Note 5) not only provides a much-needed replication of the initial studies in a larger sample ($N = 60$) but does so in a different cultural context (Guatemala) and with a more rigorous experimental design that permits pinning down the heretofore unresolved issue of whether there exists a critical period of susceptibility to extended contact between mother and infant. Hales clarified this issue by introducing two early-contact groups: one limited to 45 minutes immediately after delivery and the other to an equal interval but beginning 12 hours after the infant's birth. The results were unequivocal. Only the mothers in the immediate contact group were affected.

RECOGNIZING THE FUNCTIONAL SOCIAL SYSTEM

From an ecological perspective, even more remarkable than the dramatic results reported in this series of experiments are the data they omit. In none of the papers cited is there a single word

[2] Information about the program may be obtained by writing to Joyce Brainard, Administrative Aide, Program on the Ecology of Human Development, Department of Human Development and Family Studies, Cornell University, Ithaca, New York 14853.

about the behavior of the infants, and all of the experimental effects are attributed entirely to the mothers. Thus the investigators refer repeatedly to a "maternal sensitive period" or "a special attachment period existing in the human mother" (Klaus et al., 1972, p. 463; Kennell et al., 1974, p. 173). The principle of reciprocity, of course, raises the question of whether the distinctive behavior of the mothers in the experimental group might not have occurred, at least in part, as a response to a sequence of activities initiated by the developing infant and reciprocated by the mother in a progressively evolving pattern of social interaction. Regrettably, the possibility remains unexplored. In keeping with the classical experimental model, the focus of scientific attention in these studies was limited to the subjects of the research, who, in this instance, were not the children but the mothers. The omission is all the more remarkable given the fact that the infants were always present in the research situation and, what is more, that all of the mothers' behavior being observed was directed toward them.

Taken as a whole, this series of experiments on the effects of early, extended mother–infant contact provides an excellent illustration of several defining properties of an ecological research model, both by demonstration and default. On the one hand, the work constitutes a clear instance of ecologically valid experimentation focused directly on developmental processes. Moreover, it presents an example par excellence of how experimental intervention can bring to light critical features of an ecological process hardly likely to be identified through straightforward naturalistic observation in the unaltered, existing setting. On the other hand, the research represents a striking case of failure to take into account the total social system actually functioning in the given situation.

This dramatic lacuna in an otherwise impressive series of studies gives rise to the next proposition.

PROPOSITION 2. *An ecological experiment requires recognition of the social system actually operative in the research setting. This system will typically involve all of the participants present, not excluding the experimenter. This is the requirement of recognizing the* totality of the functional social system *in the setting.*

This proposition becomes increasingly important as one moves on to a consideration of systems involving more than two persons.

BEYOND THE DYAD

The Case Western Reserve University experiments reflect the influence of the traditional laboratory paradigm in still one other respect; they are limited to a two-person model. As previously noted, the classical psychological experiment allows for only two participants: *E* and *S*. Even in those researches that take into account the activities of more than two persons in differing roles, the behavior of each is usually analyzed separately and interpreted as an independent effect. As a case in point, we may consider recent work on father–infant interaction.[3] Much of this research treats the behavior of the father, and any reaction it may evoke in the child, in exclusively class-theoretical terms (Lewin, 1935) as attributable entirely to the father, without regard to the possibility that both the father's action and the child's responses may be influenced by the mother—her presence or absence and the possible effect of her behavior on the interaction of the father with the child. I refer to this kind of indirect influence as a *second-order effect*. To state the issue in propositional form:

PROPOSITION 3. *In contrast to the conventional dyadic research model, which is limited to assessing the* direct *effect of two agents on each other, the design of an ecological experiment must take into account the existence in the setting of systems that include more than two persons* (N + *2 systems*). *Such larger systems must be analyzed in terms of all possible subsystems* (*i.e., dyads, triads, etc.*) *and the potential second- and higher order effects associated with them.*

It will be observed that this proposition represents, in effect, an extension and further specification of Proposition 2 as applied to a system involving more than two persons. To illustrate the application of the principle, let us turn to three recent studies of parent–child interaction that, explicitly or implicitly, employed a three-person model. Parke (1976) and his co-workers observed both parents with their newborns in a hospital setting to determine what effect each parent had on the other's interactions with the infant. In each case,

> The presence of the spouse significantly altered the behavior of the other parent, specifically, both father and mother expressed more positive affect (smiling) toward

[3] For a comprehensive review of this literature, see Lamb (1975, 1976c).

their infant and showed a negative level of expectation when the other parent was present . . . . These results indicate that parent–infant interaction patterns are modified by the presence of another adult; in turn, the implication is that we have assumed prematurely that parent–infant interaction can be understood by our sole focus on the parent–infant dyad alone. (Parke, 1976, pp. 33–34)

Support for Parke's conclusion comes from a study by Pederson (Note 6), in which the second-order effect is somewhat more remote but equally, if not more, consequential. This investigator examined the influence of the husband–wife relationship (assessed through interview) on mother–infant interaction in a feeding context (as observed in the home). His results are summarized as follows:

The husband–wife relationship was linked to the mother–infant unit. When the father was supportive of the mother . . . she was more effective in feeding the baby . . . . High tension and conflict in the marriage was associated with more inept feeding on the part of the mother. (Pederson, Note 6, p. 6)

Pederson also found that the developmental status of the infant, as measured on the Brazelton scale, was inversely related to the degree of tension and conflict in the marriage. Consistent with the present Proposition 1, he notes appropriately that the causal direction could go both ways.[4]

Pederson's results indicate that this second-order effect can have inhibitory as well as facilitative impact. Indeed, Lamb (1976a) suggests, on the basis of experimental findings, that as the infant gets older (i.e., 18 months) the presence of the second parent may reduce rather than increase parent–child interaction. The experiment, however, was carried out in the laboratory. As previously noted, a number of comparative studies (including one by Lamb) have shown that both parents and children behave rather differently in laboratory and real-life situations; hence it would be important to replicate Lamb's experiment in a home setting.

When interpreted in an ecological perspective, however, the results of laboratory studies provide an important complement to research carried out in real-life environments. For example, if the laboratory is viewed as what it almost invariably is for a young child—namely, a "strange situation" (Ainsworth & Bell, 1970)—it clearly reveals the role of the parent as a source of security for the child and, in terms of a three-person model, as a catalyst for the child's interaction with the environment, including other, unfamiliar persons. Thus, in all the "strange-situation" experiments, the mother's presence in the laboratory reduces the child's anxiety and resistance to the "stranger." Indeed, especially when the experiments are carried out in the home (e.g., Lamb, 1976b; Note 3), infants in the company of their parents look and smile at the stranger more often than at their mothers.

The mother–father–child triad is of course not the only three-person system of developmental importance within a family. Other common combinations include two siblings and a parent; parent, child, and grandparent, aunt, or uncle, etc. I have been able to find only one study of the effect of the impending arrival of a second child on the parental treatment of the first, that done by a prescient leader in the field over a quarter of a century ago (Baldwin, 1947). Other triadic combinations in the family apparently remain wholly unexplored and hence constitute a promising ecological domain for developmental research.

The application of a three-person model to a developmental context outside the home is likewise a rarity. There does exist one elegant study, however, documenting a second-order effect in a classroom setting. Seaver (1973) ingeniously exploited an "experiment of nature" to investigate the controversial phenomenon of induced teacher expectancies (Rosenthal & Jacobson, 1968). Seaver examined differences in the academic achievement of elementary-school pupils with older siblings who had had the same teacher and had performed either exceptionally well or exceptionally poorly. Children taught by teachers who had not instructed the older siblings served as controls. In contrast to earlier studies, which had produced inconsistent, weak, or questionable effects, the results of Seaver's natural experiment gave substantial support to the teacher expectancy hypothesis. As Seaver himself acknowledged, however, it was not clear who was the mediator of the observed effect. Were the teacher's expectations changed because of her prior experience with the older sibling, or did the younger sibling evoke a different response from the teacher because of the younger child's expectations created by the older sibling or by the parents (based on their previous acquaintance with the teacher), or both? The remaining ambiguity in interpretation testifies to the

[4] The reciprocal interaction between the marital and the parent–child dyads in a three-person system is demonstrated even more dramatically in Hetherington's (Note 7) comparative study of divorced versus two-parent families.

importance of analyzing subsystems and higher order effects as stipulated in Proposition 3.

The involvement of parents as intermediaries in a process already involving two siblings and a teacher would of course escalate the system from a triad to a quintet, or, more generally, an $N + 3$ system. To my knowledge, no studies utilizing such a model have been carried out within a single setting, despite the fact that the modal American family with two parents and two children constitutes a readily available example. The wide prevalence of this structure raises the question of the optimal size and form of systems for fostering human development.

The evidence cited above suggests that as one moves beyond the dyad, the resulting structures may offer possibilities for greater stability, mutual assistance, complementarity, spelling each other off, and reinforcement, both directly and indirectly through third parties. Although the power of an $N + 3$ system within a single context such as the home or school remains unknown, the paradigm can be applied to some researches that have been carried out in multiple settings. Before turning to a consideration of this topic, however, we must take note of yet another source of higher order effects.

INDIRECT IMPACT OF PHYSICAL FACTORS

Environmental influences on development are of course not limited to human beings. However, in keeping with the classic two-element research model, these influences are usually thought of as acting directly on the subject; the possibility of higher order effects operating indirectly has been overlooked. The following are two examples.

The first is provided by an elegant ecological study of the influence of apartment noise on human development (Cohen, Glass, & Singer, 1973). The investigators found that children living on the lower floors of 32-story buildings near noisy traffic showed greater impairment of auditory discrimination and reading achievement than a matched sample living in higher floor apartments. Cohen et al. viewed their study as a real-life counterpart to laboratory experiments demonstrating degradation of task performance as a direct aftereffect of exposure to noise. The two situations are not analogous, however, since the real-life setting included other persons besides the children selected as the subjects of the study. Moreover, these other persons—the children's parents and other members of their families—were also exposed to traffic noise and, in all likelihood, affected by it. If so, the possibility remains that the impairment of the children's auditory discrimination and verbal skills might have come about not only as a function of their own difficulties in hearing or sustaining attention in a noisy environment, but also because others around them were similarly affected and engaged less frequently in conversations, in reading aloud, or in correcting their children's verbal utterances. No data are available to demonstrate or disconfirm the existence of such a second-order effect, but relevant information could have readily been obtained had the other participants in the setting been included in the research design.

Similar considerations apply to research on the effects of television. Almost all investigations in this area have been concerned with the direct impact of the program viewed by the child on his or her knowledge, attitudes, and behavior; indirect influences through the modification of patterns of family life have scarcely been mentioned, let alone investigated. In a review of research literature bearing on this issue, Garbarino (1975) was able to identify only one investigation that dealt with the question explicitly and systematically. In a field survey, Maccoby (1951) found that 78% of the respondents indicated no conversation occurred during viewing, except at specified times such as commercials, and that 60% reported that no activity was engaged in while watching. On the basis of her findings, Maccoby concluded:

> The television atmosphere in most households is one of quiet absorption on the part of family members who are present. The nature of the family social life during a program could be described as "parallel" rather than interactive, and the set does seem quite clearly to dominate family life when it is on. (p. 428)

It is noteworthy that Maccoby's study was published a quarter of a century ago and that, apparently, no further research has been done on the problem since that time. With the rapid growth of television, and the television culture, in the intervening years, the impact of the medium on family life has, in all probability, become both more pervasive and profound. The question of how any resulting change in family patterns has, in turn, affected the behavior and development of children (i.e., the second-order effect) remains completely unexplored.

These and related studies lead to the following proposition: