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DEVELOPMENTAL MODELS AND EARLY EXPERIENCE

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This paper attempts to describe links between the transactional or dialectical and the mechanistic models of development and to provide a rationale for why both types are useful. Examples of data sets, deriving principally from the early experience literature, are provided which conform to both, and it is concluded that the applicability of the model for describing behavioral development is strongly influenced by where the individual stands on three empirical dimensions: (1) the relative power of the environments that the individual is exposed to; (2) the plasticity of the individual's behavior; and (3) the deviation of the individual from developmental norms. These factors crucially affect the degree of reciprocity found in organism–environment interactions, and the results suggest that differences between developmental models are reconcilable.

The recent interest in transactional or dialectical perspectives on development has stemmed from two quite different intellectual challenges. Sameroff (1975) proposed the transactional perspective in order to account for certain data sets deriving from the early experience literature. Whereas previous conceptions of early experience had focussed on powerful and lasting effects of particular early experience variables, Sameroff pointed out that there was often little predictability from early assessments of children subjected to environmental stressors without considering intervening environments. It was argued that in fact the child is an active participant in its own development since he/she has important effects on the environment. The now classic case of child abuse was discussed in this framework, since data indicated that characteristics of the child contributed to parental behavior. Any long-range effects of early environments would be due to the outcome of these transactional processes, not to the state of the child at some

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early period and not to later environments acting independently of the organism.

The other challenge to modeling appeared with the concern of many researchers in developing a life-span perspective. The point of departure for theorizing was a critical appraisal of the belief that the world views of mechanism and organicism were an exhaustive cataloging of the developmental landscape. Although the emerging theory was consistent with a synthetic, non-mechanistic framework of organicism, the teleological assumptions of organicism conflicted with data indicating change at all phases of the life span, so that continual change and the plasticity of behavior were emphasized (Lerner and Busch-Rossnagel 1981). The dialectical conceptualization of development that results emphasized reciprocal organism–environment interactions as a representation of change (Riegel 1976).

It is important to realize that it is an empirical question whether development should in general be characterized as involving organism–environment transactions. Thus Sameroff (1975) rejects the main effect and interactive models because of this belief that they do not fit the available data. This dependency of the applicability of the transactional or dialectical model on a fit with actual data suggests the possibility that other representations of organism–environment relationships may provide a better fit for particular data sets than the transactional model. The possibility that more than one model may be required to adequately represent developmental data has also been proposed by several authors in the life-span tradition (see, for example, Lerner and Ryff 1978; and Hultsch and Plemons 1979), and Reese and Overton (1970) and Hultsch and Hickey (1978) have emphasized the possibility of 'creative electricism' in which different models are used to explain the development of different behaviors in the same organism. Lerner (1978) argues that the different representations of organism–environment interactions may be useful at different levels of analysis and that there may be an intermeshing of discontinuous and continuous processes at different levels of organismic organization and at different points in the life span.

The present paper derives from the tradition of research associated with the early experience literature. Within this tradition the environment has been conceived of in a mechanistic manner for good reason. The organism was viewed as most susceptible to change at certain times, and at these times whatever environments were encountered had

maximum effects. Although organisms may be able to affect their environment, they certainly cannot control it completely, and there are many examples, some summarized below, in which there are long-range effects of early experience variables which were not elicited by the organism and in which intervening subsequent environments were not importantly affected by the organism (see MacDonald (1985, 1986) for reviews). These data provide the theoretical basis for viewing the environment as a potentially independent, manipulable force in development.

Nevertheless, the early experience tradition cannot reject the possibility that in many cases the environment does not act independently of the characteristics of the organism. Several ways of thinking about organism–environment relationships are necessary to provide a fit between our abstract representations of organism–environment relationships and the available data. The purpose of the present paper is to present several such models and to illustrate them with pertinent data sets. In addition, three dimensions of intra- and inter-individual differences which affect the applicability of a model to a particular data set will be discussed: (1) the relative power of environmental events affecting the individual; (2) individual differences in the ability of the organism to structure its environment; (3) age differences in the relative plasticity of the organism. Variations along these dimensions affect the applicability of the various models and together account, at least in part, for the fact that the different models are indeed useful as descriptions of particular data sets (Lerner and Ryff 1978; Hultsch and Plemons 1979). Rather than a creative eclecticism in which the development of different behaviors within individuals is best described by mutually incompatible models, the focus will be on the possibility that social or cognitive development in different individuals is best described by a variety of models depending on the unique set of individual characteristics and individually encountered environments which describe the individual.

Representations of organism–environment relationships: the main effect, interactive, transactional and well-buffered models

Developmental models useful in the discussion of early experience must necessarily link events occurring at one time with later assess-

ments of behavior and intervening environments. Different relationships between early and later events result in different representations of organism–environment relationships, but from a broader perspective both the main effect and interactive models discussed below are mechanistic models, since the locus of control of behavior is considered to be outside the organism.

The following definition of the main effect model will be used: an event has a main effect on later behavior if and only if the event is a causally necessary condition for the behavior and subsequent events occurring between the event and the behavior do no more than maintain, facilitate, or inhibit the later behavior. Facilitating events (Gottlieb 1976; Aslin 1981) speed up the development of a behavior but do not result in a higher or lower level of the behavior, whereas inhibiting events slow down the development of a behavior but, again, do not alter the ultimate level of the behavior achieved. Thus defined, the main effect model precludes a major role for intervening environments, since the ultimate level of the behavior is not affected.

The interactive model, as the term is used here [1] emphasizes the importance of environmental events occurring later in development. Lerner (1980) clearly distinguishes the interactive and the transactional models by noting that the interactive model ('moderate interaction' in Lerner's terms) presupposes that the relevant organism and nurture variables are 'independently existing and manipulable entities, whose respective quality and status remain unaltered by the other over the course of interaction' (1980: 68). The transactional or dialectical model, on the other hand, 'emphasizes that change processes among nature and nurture variables – reciprocal relations among changing entities (and not the entities themselves) – constitute the causal matrix of covariation providing the bases of behavior change processes.' The interactive model assumes that the environments occurring later in life have a strong effect on behavior (Gottlieb 1976; Aslin 1981). Moreover, these later environments have their effects, either positive or negative,

[1] The terminology used here for the main effect, interactive and transactional models derives from Sameroff (1975) and is a usage specialized for discussion of the early experience literature. Thus the interactive model is restricted to situations where some later environmental event has a demonstrable effect on the eventual impact of an earlier event, and does not include concurrent influences where the level of one variable affects the impact of another. Main effects are restricted to demonstrable effects of early events in cases where intervening environments have minimal effects.

independent of the characteristics of the individuals who experience them. In the transactional model on the other hand, the characteristics of the person who experiences the environments are also crucial, since these characteristics affect what environments are experienced. Whether one or the other is accepted as best describing the phenomena is entirely an empirical matter, but it is inappropriate to assume that one or the other is applicable without rigorous testing to show reciprocal effects.

The above representations of organism–environment relationships all assume a substantial effect of the environment on the organism. For completeness it is necessary to consider the situation where environmental variation has no important effect on the outcome. A behavioral system will be termed well buffered if and only if there are no environmental events within the normal range which affect the ultimate level of the behavior. Following Scarr (1976), we restrict the application of the well-buffered model to normal environmental variation. As used here, the concept of buffering is consistent with unidirectional or bi-directional relationships between organism and environment in the development of behavior. Whatever the actual mechanism, the environmental variation does not affect the phenotypic variation. Discussion of examples conforming to this model is important, since it is an implicit assumption of many dialectical or mechanistic theorists that environmental variation, either elicited or passively experienced, has important effects on phenotypic variation.

The main effect model

To establish that a main effect model is appropriate, one must clearly provide evidence not only for an association between the earlier event and the later event but also show that intervening environments have little to do with the eventual outcome. The best evidence for a main effect model would come from data which showed that there was a continuing effect of some event which was (a) unchanged by intervening environments and (b) occurred independently of the normal range of intervening environments. Paradigmatic cases would be examples of sensitive period phenomena. For example, monocular deprivation of kittens during the sensitive period of development results in abnormal binocular vision even after restoration to a wide range of normal later environments (Mitchell 1981). Degree of improvement in normal later

environments depended on the length of deprivation, suggesting that as the plasticity of the organism declines there is a tendency toward main effects, since the later environments had very little, if any, effect on animals with prolonged deprivation. In cases such as this it is difficult to argue that the results are due to the intervening environments since a wide range of normal environments are compatible with the same lack of observable effect on the behavior.

Whether or not the main effect model applies depends crucially on the plasticity of the organism during the time when the intervening environments occur. In a highly plastic organism normal environmental variation during the intervening period may result in significant variation in the outcome behavior studied. Since humans retain significant plasticity throughout development, examples of human data that conform to the main effect model are difficult to find. The findings of Tizard (1978) indicating prolonged effects of rearing in certain orphanages may illustrate a main effect as the term is used here, but adoption into normal homes may well have resulted in improved social behavior, thus conforming to the interactive or transactional models described below. Indeed, the fact that later adoption was associated with poorer outcomes suggests that intervening environments tended to have an ameliorative effect in many cases, but this may not have been the case with older adopted children. The findings of Dennis (1973) regarding the cognitive development of children reared in very deprived orphanages showed that later environments were invariably associated with improvement, although the degree of improvement again depended on the age of adoption.

The general implications of these findings are that main effects are likely to occur when the organism is exposed to very powerful environmental events, typically events outside the normal range of environmental variation. If such events occur during a period of maximal plasticity, reversal by subsequent environments during periods of declining plasticity is difficult. In the extreme case of a child reared for 13 years in an isolated and abusive environment (Curtiss 1978) there was no improvement at all in certain linguistic functions, although other abilities showed some improvement. Since improvement in this case resulted from intense professional intervention, there is reason to believe that placement in normal environments would have resulted in far less improvement, so that the study is best thought of as suggesting the possibility of main effects occurring in human development, al-

though congenital or genetic defects in this case cannot be ruled out. Skuse (1984a, b) points out that many cases of extreme neglect show rapid improvement shortly after intervention, and in the case of Koluchova (1972, 1976) completely normal functioning appears to have been achieved, suggesting that the interactive model may apply to many individuals exposed to extremely inadequate or abusive environments. Thus, although main effects are probably uncommon in human development, there are cases which are best described as implying main effects, so that this model must not be precluded a priori from discussions of the human data.

The interactional model

For a data set to conform to the Interactional Model there need be no assumption that the effects of the environment occur as a result of some unremediated early environmental influence, but the environmental influence is seen as acting independently of the characteristics of the organism. Many of the environments shown to be relevant to whether or not long-range effects of early experience occur have their effects independently of characteristics of the organism. For example, many studies have shown that socio-economic status can ameliorate the effects of early experience (Sameroff 1975). The effects of parental behaviors associated with SES may be little influenced by variations in child behavior so that for a broad class of normal and even initially abnormal children, good outcomes are achieved. Scarr and McCartney (1983) point out that enriched environments provided by special programs such as Head Start or adoption of lower SES children into upper SES homes affect the great majority of children in the same way, and the same can be said of deprived environments. These environments have their effects in large part independently of the characteristics of the child, although they may not wipe out individual differences in a group of individuals all of whom receive the same treatment. This makes excellent evolutionary sense. Many genetic systems, such as attachment and cognition, appear to be environment expectant in that they program for expected environmental stimulation. (See MacDonald (1984) for a discussion of this type of genetic system.) If individuals tended as a general rule to have radically different effects on their environments, it would be difficult to develop normative phenotypes. Not surprisingly, some of the best documented examples of the transac-

tional model (see below) involve highly deviant organisms and environments, such as those found in child abuse (Parke and Collmer 1975).

The generally beneficial or injurious effects of many environments are well documented. Scarr and Weinberg (1976) found that adoption of black children into white middle and upper-middle class homes resulted in a large average increment in IQ compared to that expected on the basis of the mothers' IQ, and similar results were found for adoption of white children into middle and upper-middle class environments (Scarr and Weinberg 1978). A study by Schiff, Duyme, Dumaret and Tomkiewicz (1982) found uniformly beneficial effects of rearing children in upper SES homes. Richardson (1976) and Winick, Meyer and Harris (1975) also found that SES of rearing affected the long-term results of early malnutrition, with all individuals tending to benefit from the adoptive environments. Elder (1974) found age-related general effects associated with deprivation during the Great Depression. These effects occurred as a result of events beyond the control of the individual families involved and affected broad sections of the population in a similar manner.

Some studies have assumed the applicability of the transactional model without adequate data. For example, Barrett, Radke-Yarrow and Klein (1982) found that malnutrition was associated with differences in social behavior, and attributed these effects as resulting in part from the poor eliciting abilities of the children. Nevertheless, there was no direct demonstration of reciprocal effects in the study and the results can be equally well explained by supposing an inadequate familial environment as well as direct effects of malnutrition on the brain. If parents were trained to stimulate their children and to modify their perceptions and attitudes so that they were independent of the responsiveness of the child, and the deficits in social behavior still occurred, there would be evidence for the main effect model. If the training resulted in improved behavior, there would be evidence for the interactive model. If untrained parents could be shown to act quite differently with normal children, there would be evidence for the transactional model.

Concerning the animal literature, rehabilitation of isolate reared rhesus monkeys (Novak and Harlow 1975) clearly involves some sort of interaction with later events. The key to successful therapy appears to be the fact that young monkeys cling to the older monkeys and are unaggressive, but the evidence described does not suggest that the

behavior of the infants is altered appreciably by their contact with the isolates. In the case of reversal of imprinting in birds (Immelmann and Suomi 1981) the new object of imprinting is quite passive and reversal depends largely on the length of exposure to the new stimulus.

In all of these cases a mechanistic account featuring powerful environments that act independently of the characteristics of the organism is the best representation of the data. MacDonald (1985, 1986) has emphasized the importance of the intensity and duration of stimulation as an important aspect of early experience and sensitive period phenomena. Such environments tend to be extremely effective either in producing deficits or as aspects of therapeutic environments. Thus, intensive enrichment is effective in reversing the effects of early experience, and extreme negative deviations from normally stimulating or emotionally secure environments tend to produce long-range deficits in behavior. A good example from the theoretical literature is the paper by Hultsch and Plemons (1979) who place the literature on the effects of stress in a mechanistic framework. The literature summarized indicates that environmental events act as discrete elements which combine in linear fashion to influence behavior. The model emphasizes a one-way causal view of behavior in which the event is viewed as external to the person and independent of the characteristics of the person. (Data are cited indicating there is no evidence that individuals with psychological problems create stressful life events. Rather, the life events create the stress.) MacDonald (1985, 1986) has emphasized the fact that these environments tend to be affectively arousing. This applies to many of the events which have been found to be stressors, such as marriage and divorce, social support factors and important changes in a person's life.

The transactional model: the importance of individual differences

In some cases there is more evidence that reciprocal interactions occur, and the thesis presented here is that such reciprocal interactions will be more important in cases where characteristics of the organism deviate significantly from the average. In such situations the child is expected to be able to influence his/her environment more than a normal child. For example, Goldberg (1978) has found that parents react to premature infants differently from normal infants by stimulating them more. In addition, the aversive cries and irritability of premature infants places them at greater than normal risk of child

abuse. Mothers of hyperactive children are more negative and directive than the mothers of normal children, an effect that appears to be a response to the child's extreme behavior (Barkley and Cunningham 1979). Thomas and Chess (1981; see also Chess and Thomas 1984) state that the nurturing of the temperamentally difficult child is particularly trying for parents: 'Depending on their own psychological characteristics and their attitudes toward child rearing, the irregular, negative, intense, and slowly adaptive responses of the child can stimulate a variety of disturbed reactions in the parents. These can include self-doubt, guilt, anxiety, and helplessness... The sense of helplessness may lead to intimidation and appeasement, the anger and sense of loss of control to punitive attitudes and behavior toward the child' (1981: 248). Thus temperamentally difficult children can have important effects on parents' behavior and contribute greatly to their own environment: there is evidence that child abuse is associated with difficulty of temperament. Easy children, on the other hand, may well reinforce their parents' sense of competence and sense of control rather than change their parents' behavior and their own environment, so that the goodness of fit between organism and environment (Thomas and Chess 1981) is facilitated in cases where the children are not extreme on some temperamental dimension.

As a further example showing individual differences in the ability to structure the environment, Scarr and McCartney (1983) point out that genetic differences often result in individuals choosing environments that are compatible with their genotypes and propose that this active genotype–environment interaction is more common as individuals get older and become free of their passively experienced early environments. Older individuals with their greater mobility and freedom of choice are much more able to structure their environments. Maccoby and Martin (1983) point out that parents are far more likely to affect the child's behavior than the reverse because of their greater power, competence, and, I would suggest, the greater plasticity of the child.

These results may be taken to indicate that the transactional model may be more appropriate as a model for older individuals. However, the applicability of such a representation is importantly influenced by the plasticity of the organism, since the effect on the organism of transactions with the environment will be expected to decrease with declining plasticity. There are good data from a variety of animal species showing age-dependent differences in the ability of the environ-

ment to influence development. The question of whether such phenomena occur in humans is controversial and the evidence cannot be reviewed here, but there is some evidence that this is the case (Lerner 1984; MacDonald 1985, 1986; see also Bronfenbrenner 1979; Clarke and Clarke 1976; Rutter 1980; Wachs and Gruen 1982). Such data indicate that at times of maximum plasticity the organism will be much more affected by environmental events than at times of minimal plasticity. Indeed, life-span differences in plasticity imply that at some ages there is relatively little reciprocity, since in such cases the environment can have only a minimal effect on the organism.

These considerations suggest that there is a dynamic between the organism and its environment such that very powerful environments tend to have effects on organisms independent of organism characteristics and certain characteristics of the organism are extremely effective in structuring environments. The environments elicited by the organism may be either very powerful in changing the organism, as in child abuse, or may simply maintain the organism's characteristics. In addition, life-span differences in the applicability of the various models are suggested.

The well-buffered model and organicism

The research findings discussed above have been collected in the service of explaining individual differences in behavior depending on variation in encountered or elicited environments. Environmental variation is thus crucial to the understanding of the behavior. However, there appear to be many examples of behaviors that are not importantly affected by environmental variation, i.e., examples of well-buffered behaviors as defined above.

Examples from the animal literature of well-buffered behaviors are easy to come by, especially in infra-mammalian organisms. (See Eibl-Eibesfeldt (1975) for a variety of cases of behaviors which occur despite a wide variety of normal and even abnormal environments.) Although the occurrence of normal behavior even after exposure to extreme environmental stress is not necessary to show that a behavior is well buffered, such data are sufficient to show that a behavior is highly buffered. Using this logic, the fact that many cognitive abilities in the rhesus monkey occur even when the animal is isolated (Gluck, Harlow and Schlitz 1973) shows that these behaviors are well buffered from

environmental effects. Concerning social behavior, the basic behavioral repertoire of dogs and wolves appears even in severely restricted environments, including isolation (Fox 1971; Fisher 1955; MacDonald and Ginsburg 1981). Regarding human behaviors, Scarr (1976) convincingly argues that sensorimotor intelligence is well buffered, since it occurs in all cultures and under a wide variety of rearing conditions, including many very abusive environments. A similar argument can be made that intelligence through the concrete operational stage is well buffered (MacDonald 1986), since again, it occurs in all human cultures and in a wide variety of rearing conditions (Dasen 1982). The study of Kagan and Klein (1973) also indicates that normal levels of cognitive functioning can occur even in environments that would be considered deprived by American middle-class standards. These examples suggest that the concept of well-buffered behaviors in humans may apply more to an analysis of species-typical developmental functions (McCall 1981) than to individual differences (MacDonald 1986).

In many respects the well-buffered model resembles the organismic model. The latter has emphasized teleology (Hultsch and Hickey 1968), the normal progression and universal achievements of development, and clearly the best examples of goal-directed development are the species-typical behaviors given as examples of the well-buffered model. In such examples the emphasis is not on individual differences but on commonalities: the predictable and universal achievements of normal development in unexceptional surroundings.

Conclusion

The above examples and generalizations indicate important links between mechanistic and transactional approaches to development and offer a rationale for why neither of these approaches can be viewed as the only useful theory of development. This result agrees well with several authors who have advocated conceptual and empirical pluralism in developmental science (Lerner and Ryff 1978; Hultsch and Plemons 1979; Reese and Overton 1970). This approach also agrees with that of Looft (1973) who describes the major dimensions along which models take positions as continua. In the present case, there are continua between mechanistic models featuring powerful environments acting independently of organism characteristics and dialectical models

in which characteristics of individuals determine environments. Thus, there are important individual differences as to which model best describes development depending on where an individual stands on these dimensions. Mechanistic and dialectical representations of development are not adequate descriptions of populations except in the sense that they may represent modal or average pathways of development. The view presented here is thus consistent with the idea that the transactional model is indeed the paradigmatic model of human development, in the sense that for the most part children do have some effect on their environment. However, this possibility should not make us lose sight of the important normative effects of the environment that occur independently of child characteristics.

The finding of important links between these two approaches is incompatible with viewing the mechanistic, dialectical and organismic approaches as fundamentally irreconcilable. Reese and Overton (1970) have argued that meta-theories, as represented here by the mechanistic and dialectical models, constitute differing world views in the sense of Kuhn (1969). The differences between these world views are irreconcilable and prevent full communication between them. Attempts at synthesis are futile and lead to a confused and confusing eclecticism.

However, the existence of empirical dimensions along which these models grade into each other must cast this view into considerable doubt. Moreover, Kuhn (1969) gives several examples where theories do not conflict with their predecessors. For example, the theory of energy conservation provides links between dynamics, electricity, optics, and thermal theory. Thus, although the history of the physical sciences may be generally characterized by the acceptance or rejection of fundamentally incompatible paradigms (Kuhn 1969), there are instances where compatibility and synthesis occur.

Finally, the fact that the need for several paradigms in developmental science has been recognized by several authors (see above) suggests that there are fundamental differences between the types of phenomena described by Kuhn as typical of the physical sciences and the relationships among mechanistic, organismic, and dialectical models. For Kuhn, different world views compete until one is displaced in the scientific community. Ptolemaic astronomy gave way to Copernican astronomy and Newtonian physics to Einsteinian physics. If the above arguments are correct, neither the mechanistic nor the dialectical conception can ever fully account for developmental phenomena. Conceptual and

methodological pluralism is not only an empirical necessity, due to the existence of data sets congruent with these models, but a conceptual necessity due to the links between these world views. As Lerner and Kauffman (1985) have shown regarding organicism and contextualism, syntheses need be neither confusing nor eclectic.

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