

## Early Experience, Relative Plasticity, and Social Development

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This paper examines the roles of early experience and relative plasticity in the development of social behavior in animals and humans. It is concluded that (1) long-term effects of early experience variables can be found in the animal and human literature; (2) there are age differences in the relative susceptibility to environmental influences during development; and (3) the power of environmental events and the buffering ability of the organism are crucial variables affecting the outcome of organism-environment interactions. © 1985 Academic Press, Inc.

The theory of sensitive periods during behavioral development postulates that age-based periods are optimal or most vulnerable to environmental stimulation (Bateson, 1979; Immelmann & Suomi, 1981; Scott, 1979). This theory has guided much research but has come under fire recently from a variety of directions, especially regarding human development (Cairns, 1979; Clarke & Clarke, 1976; Kagan, Kearsley, & Zelazo, 1978; Sameroff, 1975; Scarr & McCartney, 1983). This paper is a review of data and theory relevant to the proper status of this concept in our views of human and animal social development.

### *Sensitive Periods*

The concept of a sensitive period hypothesizes age-based periods during which the organism is most vulnerable to environmental stimulation. Bateson (1979) points out that a large variety of terms have been used to describe basically the same phenomenon and that no term has received general adoption. The basic phenomenon is nicely summed up by Bateson (1979) as "the conviction that experience can exert a greater influence at some times of life than others" (p. 470). I will use the term "sensitive period," or speak of relative plasticity, i.e., relative susceptibility to environmental influences. The latter terminology seems appropriate in cases where there is no sharply delimited period of susceptibility to environmental influences, but rather a gradual decline in sensitivity.

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This model appears best suited to most of the data on early experience covered in this paper.

Although this general description applies to instances of sensitive periods, the term usually refers to behavioral systems in which there is at least some internal control, in the sense of Bateson (1976), over the relative sensitivity to the environment at different ages. For example, Bateson (1976) shows that both internal and external factors are implicated in influencing the onset of the sensitive period for filial imprinting in birds. There is presumably wide variation in the degree of internal and external control of sensitive period phenomena, and different mechanisms in different species for achieving this control (Bateson, 1976; Gollin, 1981). This suggests that there is no rigid distinction between sensitive periods resulting from differences in developmental level and those due to internal maturational change, but rather a continuum from greater to lesser environmental control. For example, an infant's cognitive level may mediate its reaction to verbal stimulation (Uzgiris, 1980) and in turn affect whether stimulation at a particular age has any effect on development. The infant's cognitive level may in turn be influenced by a variety of internal and external events, just as in the case of imprinting in birds.

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However, if differential sensitivity to environmental stimuli is controlled completely externally, there would be age specificity (Wachs & Gruen, 1982) but not a true sensitive period. As a possible example of age specificity, Wachs and Gruen (1982) summarize data showing that parental restriction of exploration between 12 and 48 months of age is negatively related to cognitive performance, but there are no effects prior to age 1 or after age 4. The authors note that the lack of effect after age 4 may simply indicate that home restrictiveness becomes less critical as the child gets older and can leave home. Thus finding an effect of an environmental variable between ages 1 and 4 may be due simply to the cultural practice of allowing older children outside the home more often.

Despite the fact that the mechanisms and degree of internal control underlying sensitive periods may differ, there may be some general aspects of sensitive periods which are capable of providing some insights into these phenomena. In particular, I will be concerned with what may loosely be termed the intensity of the environmental stimulus and how this dimension interacts with differential plasticity. Schnierla (1957) was the first to emphasize the importance of the intensity of the stimulus as a general dimension in producing approach-withdrawal reactions. A paradigmatic example relating intensity of stimulus to the notion of sensitive periods comes from work on early handling of rodents. Denenberg (1968) reported data showing that handling or shocking rats with 0.2 mA at 2 days of age was ineffective in raising avoidance learning scores of adult

rats, while such stimulation at 4 days was effective. However, if the level of shock is increased to 0.5 mA, an effect is found at 2 days of age. Moreover, handling, a less intense stimulus, is more effective on days 1–10 than on days 11–20. This leads naturally to an “intensity hypothesis” according to which the effect depends on the intensity of the stimulus and the age of the animal, results highly congruent with the notion of a sensitive period as described above. Henderson (1980) points out that the relation between intensity of stimulus and the effect on the organism is curvilinear in the case of early handling, with very high levels of stimulation being associated with deleterious effects on the animal. (See also Hutchings, 1962.)

Another example comes from the imprinting literature. Immelmann (1972) found a sensitive period for sexual imprinting lasting from 13 to 40 days of age for the zebra finch. ~~Birds housed with the foster species during the sensitive period and subsequently housed with conspecifics still preferred the foster species when mating.~~ Immelmann and Suomi (1981) point out that sexual imprinting is reversible but that the degree of reversibility depends on the age at social contact with the bird's own species as well as the duration of the contact. If only 3 or 7 days of contact are provided, the effects of cross fostering are irreversible up to the 40th day of life, but 30 or 60 days are effective as late as 57 or 71 days of age. These results indicate that the intensity of appropriate stimulation, in this case the duration of exposure to conspecifics, is a crucial parameter in reversing the effects of early experience.

As an example of the generality of this phenomenon, intensity of stimulus appears to be a basic feature of social behavior in humans. Early parent–child social interactions involve the regulation of affective arousal. Stern (1977) and Brazelton, Koslowski, and Main (1974) document the fluctuating, cyclic nature of early mother–infant interaction. Interactions typically build to a peak of excitement followed by a period of gaze aversion or withdrawal on the part of the infant when the interaction becomes too intense. Stern states that there is an optimal range for the intensity of social stimulation:

[T]he stimulus events cannot be too weak, or too powerful, or too simple or too complex, or too familiar or too novel. Successive events cannot be too repetitive or attention is lost and excitement falls below the optimal range, and affect becomes neutral. On the other hand, successive stimuli cannot be too drastically dissimilar or the infant will not be able to engage them cognitively. (p. 72).

This passage emphasizes the fact that in addition to intensity, social ~~stimuli may have other properties which affect their ability to result in affective arousal and thus also quite possibly their impact upon the recipient.~~ Berlyne (1960, 1966), in developing a general theory of arousal,

noted that, besides the intensity of the stimulus, such attributes of the stimulus as novelty, surprisingness, incongruity, complexity, and uncertainty affect ability to arouse the recipient. There appears to be a general trend in development for the child to be able to control and modulate higher levels of arousal, i.e., he/she develops an increasing capacity for more intense levels of affectively arousing social stimulation (Sroufe, 1979). Thus, father-child physical play with 3- to 4-year-old children often involves stimulation that would be far too intense for infants (MacDonald & Parke, 1984). Arousal-modulating ability appears to be a fundamental aspect of social behavior. Recently Zentall and Zentall (1983) have proposed that childhood behavior disorders involve deficiencies in arousal-regulating mechanisms and Zuckerman, Buchsbaum, and Murphy (1980) have argued for a general biological trait corresponding to individual differences in arousal due to novel stimuli.

Bateson (1983) gives several examples in which stimuli that are particularly effective in altering behavior can be interpreted as involving the manipulation of the intensity of a stimulus, quite possibly mediated by the emotional effect of the stimulus. Wild horses can be made submissive in as little as 15 min by means of drastic strangulation of the horse with a rope around its neck, and he describes anecdotal cases where similarly severe methods have been used successfully to socialize dogs. Bateson also discusses evidence that brainwashing, religious conversion, and psychotherapy appear to be facilitated by states of arousal brought about by the manipulation of emotionally charged stimuli, and evidence is presented that these effects could be mediated by noradrenergic systems in the brain.

It should be stressed that it is the intensity or duration of an ecologically relevant stimulus that is important. The findings that high levels of noise in the home are negatively related to IQ (Wachs, 1979) does not mean that higher levels of stimulation are in general deleterious, but may only mean that the stimulation must be comprehensible to the child and attended to by the child.

Finally, the concept of a sensitive period can be considered to imply differences in the buffering ability of the organism at different ages. As will be seen below, however, some behaviors appear to develop in a wide variety of normal environments, and it is necessary to develop a notion of buffering. A behavioral system is well buffered if and only if there are no environmental events which attune or induce the behavior in the language of Gottlieb (1976) and Aslin (1981). (See also Gollin, 1981.) Following Scarr (1976) the application of the well-buffered model is restricted to normal environmental variation. However, if it can be shown that rearing in even highly abnormal environments results in essentially normal behavior, then the well-buffered model also applies. An example

fitting this model comes from Scarr (1976) who argues that sensorimotor intelligence is well buffered since it occurs in a very wide range of human cultures and rearing environments. In addition, some cognitive abilities in monkeys occur even after social isolation (Gluck, Harlow, & Schlitz, 1973).

In this essay I am concerned with evidence for or against the existence of long-range effects of particular early environmental variables and evidence for or against age-based changes in susceptibility to environmental effects. In addition, I discuss aspects of the stimulus that appear important in reversing the effects of early experience and present data showing that some aspects of social behavior are well buffered in the above-defined sense.

#### SOCIAL BEHAVIOR IN NONHUMAN PRIMATES AND CANIDS

Harlow's group pioneered the investigation of long-term effects of various rearing paradigms in rhesus monkeys. Monkeys reared with peers (together-together) and subsequently housed singly showed several differences in behavior at 7 years of age from monkeys raised with mother and peer contact (Chamove, Rosenblum, & Harlow, 1973). The differences included highly abnormal infant-directed aggression as well as "suicidal" aggression toward adults and juveniles. Monkeys raised with the mother alone for 8 months are described as fairly normal, but with more extreme scores on bodily contact, affection, and aggression than mother-peer raised monkeys (Harlow & Harlow, 1969). The well-known isolation paradigm produces a host of highly abnormal effects in rhesus monkeys, including social indifference with vacant staring, stereotypical movements, self-clutching, aggression, and inadequate mothering (Harlow & Harlow, 1969). The effects of isolation vary between different species of monkeys, indicating variation in the degree of buffering of social behavior. Sackett, Ruppenthal, Fahrenbruch, Hold, and Greenough (1981) found that isolated crab-eating macaques showed a degree of social behavior comparable to nonisolated controls even though in isolation they exhibited behavior typical of the isolation syndrome. Pigtailed macaques were intermediate to the rhesus and crab-eating macaques in showing normal social behavior after isolation.

Long-term effects of separation have been found by Spencer-Booth & Hinde (1971) and Stevenson-Hinde, Zunz, and Stillwell-Barnes (1980) in rhesus monkeys. These effects are species specific, with bonnet macaques showing no signs of behavioral disturbance during or after separation (Kaufman & Rosenblum, 1969). As with the isolation paradigm with monkeys, there are clear indications of species differences in the buffering abilities of the organism.

These data indicate long-term effects of some differences in rearing

environments. Other major alterations are consistent with quite normal social behavior, and are examples of well-buffered behavioral systems. For example, Suomi and Harlow (1975) have found normal social behavior in monkeys raised with surrogate mothers but given 2-h periods of interaction with peers 5 days per week (surrogate-peer rearing condition). As another example, Ruppenthal, Arling, Harlow, Sackett, and Suomi (1976) found that although many aspects of maternal behavior were adversely affected by isolation during development, some aspects of maternal behavior occurred even without the motherless mothers being reared by conspecifics or ever seeing the birth of an infant, indicating that these aspects of maternal behavior are buffered against even very extreme environmental disruptions. (Further examples of well-buffered behaviors are given below.)

The candid data using the isolation paradigm of rearing without adults suggest considerably more buffering than is the case with rhesus monkeys. Wolf cubs reared without parents show all the normal behavior of the species (Rabb, Woolpy, & Ginsburg, 1967). Fuller (1967) and Fuller and Clark (1966a, 1966b) isolated beagles and wirehaired terriers from 3 to 16 weeks and then subjected them to four 7-min arena tests each week until week 19. Comparison to controls showed a diminution of treatment effects over the testing period for beagles, with wirehaired terriers completely unaffected by isolation. Handling the animals gently before the arena tests resulted in almost completely normal behavior for the beagles, suggesting that behavioral deficits were the result of stress consequent to emerging into a strange environment rather than due to any basic behavioral deficit. Fox (1971) found that dogs reared with cats from 3½ to 16 weeks of age showed deficits in reacting to their own species, but showed recovery within 2 weeks, at which time socialization was complete. Cairns and Werboff (1967) also found normal mating behavior in 4 of 6 female dogs paired with a rabbit from 4 to 9 weeks of age. In a second experiment, Fox (1971) reported that dogs hand reared from birth and isolated from 3½ to 12 weeks of age tended to be deficient in play behavior with other dogs, but recovery was rapid, and deficits are described as occurring only early in the period of socialization. In addition, MacDonald and Ginsburg (1981) found that wolves with restricted rearing from 4 weeks of age to 24 weeks of age showed immediate cessation of stereotyped behaviors common during isolation as well as rapid occurrence of normal play behavior when paired with conspecifics. The buffering of behavioral development is not complete, however, since isolation of dogs from 4 weeks to between 8 and 24 months of age has been shown to result in persistent behavioral disturbances (Melzack & Thompson, 1956; Thompson & Heron, 1954), an effect possibly due to the length of the isolation treatment or breed differences in susceptibility to the effects

of isolation. In addition, several studies have shown that isolated dogs are subordinate to normals and less aggressive (Fisher, 1955; Fuller 1967), and MacDonald and Ginsburg (1981) found that isolated wolves tended to have exaggerated personalities compared to controls. Long-term effects on the socialization of dogs to humans have also been found (Freedman, King, & Elliot, 1961), and Pfaffenberger and Scott (1959) found long-term effects of early confinement in a kennel on later reaction to unfamiliar situations and ability to accept training.

There is considerable evidence that the age of the animal is a crucial interactant in whether long-range effects occur, although in several cases it cannot be concluded that there is differential sensitivity to the environment as a function of age. The effects of isolation in rhesus monkeys are more profound if isolation lasts until 12 months of age rather than only 6 months, and isolating the animals only for the first 3 months of life has no important long-range consequences (Harlow & Harlow, 1969). Although these results are consistent with a cumulative effect of isolation as proposed by Bloom (1964) for the effects of deprivation on cognitive development, isolation early in life presumably is far more devastating in its effects on social development than isolation of juveniles or adults. The age of peer separation is also crucial, with juvenile rhesus monkeys showing very little reaction to repeated peer separations (McKinney, Suomi, & Harlow, 1972), although if the animal shows strong attachments to the group from which it is separated, much more depressive behavior is observed (Suomi, Eisele, Grady, & Harlow, 1975). Ruppenthal et al. (1976) found that the effects of isolation rearing on maternal behavior showed an inverse relationship between age of initial introduction to conspecifics and the probability of adequate maternal behavior. Finally, a sensitive period for the effects of separation from the mother has been indicated but not rigorously delineated (McKinney, Kleise, Suomi, & Moran, 1973).

Freedman et al. (1961) demonstrated a sensitive period for the socialization of puppies to humans by showing that exposure to humans for 2-week periods was most effective between weeks 5 and 7 and relatively ineffective before or after this age. If animals were not exposed to humans prior to the 14th week, socialization did not occur despite continued handling. Fourteen weeks of age was also the cutoff point for producing the effects of the kennel dog syndrome (Pfaffenberger & Scott, 1959), and age is an important variable in socializing wolves (Woolpy & Ginsburg, 1967).

The evidence for long-term effects of early experience and age-dependent differential sensitivity to environmental effects does not, of course, preclude important interactions with later experience. In the case of well-buffered behavioral systems, as described above, simple restoration of

the normal environment is sufficient to result in normal behavior. However, the normal environment is not sufficient to alter the behavior of isolate-reared monkeys. Here intensive therapy over a 26-week period involving younger therapist monkeys resulted in essentially normal behavior in these animals (Novak, 1979; Suomi & Harlow, 1972). A follow-up study (Cummins & Suomi, 1976) found no differences between the rehabilitated isolates and mother-peer raised animals at 2½ years, except that the isolates still engaged in more self-clasping. Novak (1979) found that rehabilitated male monkeys failed to perform the double foot clasp mount essential to reproduction, but could interact normally in other ways with age-matched monkeys. Suomi, Delizio, and Harlow (1976) successfully rehabilitated separation-induced depressive disorders in rhesus monkeys by providing them with opportunities to interact with same-age monkeys. Finally, Woolpy and Ginsburg (1967) successfully socialized adult wolves long after the optimal age for socialization by a method of gradual habituation.

Two aspects of the stimulus situation appear to be relevant to producing interactions with later experience. First, the stimulus must be ecologically appropriate. Suomi and Harlow (1972) state that the success of the therapy of isolate-reared monkeys was because therapists at 3 months of age emitted appropriate behaviors—social clinging, primitive play, and lack of aggression—which the isolates need. In the peer-separation experiments, same age monkeys were appropriate therapists because the subjects already had a normal repertoire of social behavior.

Second, there is evidence that what one might broadly refer to as an intensity dimension, as described above, is relevant. Suomi et al. (1976) found that increasing the number of interaction sessions and the number of social partners was necessary to reverse separation-induced depressive disorders in rhesus monkeys. The method of Woolpy and Ginsburg (1967) involved the regulation of the affective state of the animal by ensuring that the animal was not overwhelmed by emotionally arousing stimuli. The goal of the therapist was to overcome the fear of the animal by gradually increasing the levels of social stimulation. The duration of the stimulus is also clearly important in producing the effects of isolation, since 12 months of isolation is far more devastating than 6 months (Harlow & Harlow, 1969) and is presumably a factor in successful therapy as well.

The animal data clearly do not result in any general principles regarding the importance of early experience in development. There are wide variations between species in the importance of early experience, later experience, and the degree of genetic buffering of the behavioral phenotype. Plotkin and Olding-Smee (1981) point out that all aspects of the developing phenotype, including the capacity to respond to particular stimuli

at particular ages and the relative buffering from environmental effects, are nested within the genetic level of analysis. This means that although the information gained by the organism via interactions with the environment is not passed on genetically, the capacity to do so must be. Plasticity itself must therefore be viewed as a biological adaptation with a genetic basis that has been subject to natural selection. Intraspecific and interspecific differences in plasticity resulting from genetic variation are to be expected. Behavioral plasticity is a two-edged sword: An organism with a high degree of plasticity is able to respond to environmental contingencies but is also susceptible to environmental variations that may be maladaptive. The adaptiveness of plasticity must ultimately depend on a general tendency for environmental programming of phenotypes to be a reliable route to adaptiveness. For example, the ethological theory of attachment proposes an "environment of evolutionary adaptedness" which resulted in the reliable production of adaptive phenotypes in children. However, since the system relies heavily on environmental contingencies, maladaptive environmental programming of phenotypes is an important possibility, especially in view of the massive changes in the social and economic environment that have occurred during the course of human evolution (MacDonald, 1984). Natural selection has apparently resulted in quite different degrees to which even the advanced social mammals require stimulation during development in order to develop normative phenotypes. Moreover, within a species some social behaviors, such as some aspects of maternal behavior in rhesus monkeys, may develop even in extremely abnormal circumstances while other aspects seem to be much more susceptible to environmental disruptions (Rupenthal et al., 1976). Finally, behavior genetic analysis has shown the potential importance of individual genetic differences in response to environmental input. Thus Ginsburg (1969) reported results showing that early handling during a sensitive period has major effects on some inbred mouse strains but not others. Individual genetic differences may well be one important reason for the wide range of outcomes reported in the human literature on early experience (see below).

In summary, the data for monkeys and canids suggest considerable buffering of normal social behavior from the effects of some types of behavior even in highly abnormal environments, but that for some species environmental influences can have long-range effects during sensitive periods, after which complete remediation is difficult and depends on the ecological appropriateness of the stimulus situation as well as on what has been described as an intensity dimension. The data show that natural selection has resulted in species differences in the importance of early experience, the extent of behavioral buffering, and the susceptibility of the organism to environmental influences during development.

## SOCIAL BEHAVIOR IN HUMANS

Much research on humans on the effects of early rearing experiences has focused on a proposed necessity for appropriate attachment behavior during the early years. This view was originally proposed by Bowlby (1951) and was based on data showing profound effects of rearing in certain orphanages. These early studies have been widely criticized on methodological grounds and as confounding a great many variables, particularly the conditions within the institution, repeated separations, and age at institutionalization (Bronfenbrenner, 1968; Casler, 1968; Clarke & Clarke, 1976; O'Conner, 1968). Casler (1968) suggests that long-term effects of institutionalization are due to stimulus deprivation. This would also indicate a pervasive effect of early experience. Nevertheless, recent data from studies of children in more adequate institutions suggest that long-range effects due to abnormal attachment may indeed occur.

These data derive primarily from studies of children who have been adopted or institutionalized and are in some ways far from ideal. Dependent measures are often of questionable reliability and validity, unlike the case with the attachment construct used in developmental research where major efforts have been undertaken to address these problems. (See for example Waters, Wippman, & Sroufe, 1979.) At present, research using the strange situation paradigm has not experimentally manipulated variables such as age and attachment experience in order to determine the relative plasticity of attachment classification at various ages, and long-term continuity of behavior may well be due to current rearing conditions rather than an early sensitive period (Lamb, Thompson, Gardner, Charnov, & Estes, 1984). The available data from studies of institutionalization and adoption have not been derived from the strange situation procedure, but the data are reasonably consistent and have been used to minimize the importance of early experience. (See, for example, Cairns, 1979; Clarke & Clarke, 1976; Kagan et al., 1978.) In the following section these studies are reviewed in order to show that the data are consistent with long-term effects of some early experience variables and differences in relative plasticity in development.

Wolkind (1974) found that admission to an institution prior to 2 years of age was significantly associated with disinhibition, "a mixture of superficial overfriendliness and inappropriate reaction" in an interview. Of 43 children admitted prior to 2 years of age, 17 showed disinhibition, while of 49 admitted after age 2, only 2 showed disinhibition. Antisocial behavior did not show this relationship, although rates of antisocial behavior were quite high for the sample as a whole. The author interprets the data as showing a long-range effect of lack of normal attachment prior to age 2.

Tizard (1978) studied children from an institution that discouraged close relationships with the adults, but was otherwise considered stimulating. At follow-up at age 8, about half of the sample of adopted children showed behavioral abnormalities, including a higher prevalence of indiscriminate affection and poorer ratings by teachers for socialization with other children, irritability, and restlessness. Many of the children had normal attachments with their adoptive parents and the parents were generally satisfied with the adoptions. These results are congruent with animal data, summarized by Cairns (1979), showing that attachments can develop quite late in life. The difficulties appeared to come more in relationships with other adults and with peers. The author concludes that the first 2 years of life may be critical in shaping normal attachment behavior, but it is not known to what extent the results are irreversible. A previous study based on the same data and sometimes cited to support the lack of long-range effects of abnormal attachment behavior (Clarke & Clarke, 1976) and performed by the same author (Tizard & Rees, 1975) in fact strongly suggested pathological effects of early institutionalization. The earlier data were interpreted as showing no differences in a total problem score between institutionalized children and working class controls. In fact, however, these two groups showed quite different types of problems, with the institutionalized children scoring higher on poor concentration, problems with peers, temper tantrums, and clinging. Attachment behavior was more immature in the institutionalized group, and the institutionalized children were described by nurses as having shallow affections. The authors also describe these children as showing the disinhibited behavior noted by Wolkind (1974): shallow, indiscriminate overfriendliness.

Recently these conclusions have been replicated by Dixon (unpublished; discussed in Rutter, 1982). This study is notable because it used many of the same measures as Tizard, used direct observations rather than ratings, and contrasted children raised by foster parents with children raised in residential nurseries. Both groups differed from normals, but children raised in the residential nurseries without the opportunity to form attachments were much more deviant.

Two studies suggest that early institutional rearing does not preclude good adjustment if the child has an adult figure with whom he/she can form a lasting and deep relationship. Wolins (1970) found that good adjustment in two orphanages was not generally associated with early versus late admission but was associated with a "warm, close relationship" with adults or older children inside the institution. Similarly Pringle and Bossio (1960) found that good results were associated with "a friend outside." All five children with an adult relationship were described as well adjusted. The authors concluded that the child who is rejected early

in life and remains unwanted is likely to become insecure, maladjusted, and educationally backward. Some such children were described as having "affectionless character" as noted in the studies of Tizard and Wolkind described above. These studies suggest that institution rearing is compatible with a good outcome if the emotional needs of the child are met in the institution but clearly cannot be used to argue that early attachment relationships are unimportant.

Moreover, if intervention is particularly intensive and ecologically appropriate, minimal maladjustment can be expected, results quite consistent with a theory of differential plasticity. Flint (1978) substantially reversed the decline in social behavior in a group of institutionalized children with a program emphasizing a very high child-staff ratio, a particular adult to whom the child was special, as well as a large number of professionals. Particularly noteworthy was the inclusion of relatively intense, affectively arousing physical styles of play into the intervention program. Recent research has shown physical play to be common between parents, particularly fathers, and children, and may well represent an important biological adaptation between parents and children (MacDonald, 1983, 1984). (See Parke & Suomi, 1981, for a review). Such play is extremely arousing and affectively salient to the child and has been found to be associated with social competence in children (MacDonald & Parke, 1984). This may well be a case in which increasing the intensity of social stimuli had therapeutic effects. Yet despite up to 2½ years of intensive intervention and subsequent adoption and follow-up support, the children showed lower Vineland Social Maturity scores at all ages up to age 15. Although this may have been the result of staff encouragement of dependency, case study data show continuing, long-term inadequate peer relations and maladjustment for some.

Adoption studies are often interpreted as involving separations from an established relationship or as involving multiple caretaking and hence as possibly involving abnormal attachment. Several studies often cited as showing the lack of effect of early experience in fact suggest lingering pathology in many cases. Rathbun, DiVirglio, and Waldfogel (1958) presented data showing considerable resiliency in foreign adoptees after being adopted in the United States: "With a few exceptions" they were described as not suffering from frozen affect or indiscriminate friendliness. Nevertheless, nothing was known of their previous history and the authors caution that the sample was nonrandom and that the children may have been selected on the basis of ability to cope with stressful conditions and the presence of good relations with people before adoption. A follow-up study (Rathbun, McLaughlin, Bennet, & Garland, 1965) reported the adjustment of 12 of 33 individuals was problematic or disturbed. Some children who were disturbed soon after adoption became

well adjusted, but the authors depict a second pattern in which older children with poor adjustment originally were rated as problematic on follow-up, suggesting less malleability in the older children.

A study by Kadushin (1970) is often cited as showing the resiliency of older adoptees. However, the criterion of success used was the satisfaction of the parents. The data do suggest the feasibility of later adoption but also indicate long-term effects of early adversity. For example, 60% of the parents believed their adopted children were set in their ways. Abnormal separation anxiety was often observed and several showed the shallow, indiscriminate affection noted in several studies discussed above. Moreover, the older the child at the time of placement, the greater the prospects of unfavorable outcome, data highly consistent with declining plasticity regarding the molding of social behavior. A recent study by Cadoret and Cain (1980) points out how very early breaks in caretaking can have long-range effects. These investigators found that multiple mothering during the first 3-6 months of life was associated with antisocial behavior at age 10-17. These infants were separated at birth from their mothers and reared at a university-run orphanage until adopted. During this period they were cared for by 17-30 students in 5-day rotation. This relationship between multiple mothering and later antisocial behavior remained when effects due to antisocial personality, alcoholism, and other psychiatric disorders in the biological and adoptive parents and adoptive siblings, as well as divorce or separation in the adoptive parents, were partialled out.

Earlier literature, summarized by Pringle (1966), gives overwhelming evidence that age of adoption is an important variable: Later adoptions have less favorable outcomes and children adopted late have increased risk of behavior disorders. A recent review (Hersov, 1977) also concludes that adopted children are more often represented in psychiatric populations and that the diagnosis of antisocial behavior or conduct disorder is often made. While experience prior to placement is merely one of several factors implicated in these results, the adoption data do support the conclusion that major breaks in caretaking may have long-range effects.

Long-term effects for separation due to long or repeated hospitalization during childhood have also been found. Douglas (1975) and Quinton and Rutter (1976) both studied large independent samples of children retrospectively. Douglas found an association between long or repeated hospitalization and troublesome behavior, poor reading, delinquency, and unstable job pattern during adolescence. Furthermore, a sensitive period for these effects between 6 months and 3 years of age was indicated. This time span fits well with data showing that strong attachments do not begin until the latter part of the first year (Bowlby, 1973). Quinton and Rutter found similar long-term effects, even after correcting for family discord,

a factor not included by Douglas. Both studies included several other variables, such as socioeconomic class, later hospitalization, and size of family, and both conclude that there is strong evidence for a causal relation between the outcome measures and early hospitalization.

The above studies indicate long-term effects of particular environments in many cases, but it is important to note that the effects are by no means universal. Less than half of the subjects in the Wolkind (1974) study were adversely affected, and in the Tizard (1978) study between 39 and 69% of the sample exhibited problem behaviors. In the studies of Douglas (1975) and Quinton and Rutter (1976) only about 40% of the subjects were adversely affected. These results suggest that other factors are involved in the outcome, and recent research on vulnerability (Werner & Smith, 1982) suggests that many factors affect resiliency. From the present perspective it is important to note that better outcomes were generally achieved depending on the early experience or early adjustment prior to adoption. Thus Kadushin (1970) points out that the natural mother's relationship to the adopted child, if warm and accepting, was positively related to outcome and he reviews other adoption studies showing that better outcome was invariably associated with less exposure to pathological early environments, suggesting a graded outcome depending on the severity of environmental disruptions, as predicted by the theory of sensitive periods described above. Tizard (1978) found that children who were well adjusted within the institution tended to be well adjusted later as well. Later experience is also important, as seen for example by the fact that in the Tizard study adoption generally resulted in improvement in problem behavior while restoring children to poor environments with their natural parents was associated with generally worse outcomes. The results of Wolins (1970), Pringle and Bossio (1960), and Flint (1978) all show that adequate relations with adults or older children can ameliorate or eliminate the effects of institutional rearing.

Further evidence for graded effects depending on the severity of the early stress comes from work on prenatal and perinatal stressors in humans. Werner and Smith (1982) found a variety of relationships between the severity of prenatal and perinatal risk factors and long-term outcome in the Kauai longitudinal study. Developmental examinations at 20 months revealed a direct relationship between the severity of perinatal stress and the proportion of children rated as below normal on physical, social, or intellectual development, a trend especially pronounced among the moderate and severely stressed children. At age 10 the differences between stressed and unstressed groups were attenuated but were still quite strong for the group of severely stressed infants. At age 18 four of the five surviving severely stressed infants had persistent physical, learning, or mental health problems. The group rated as moderately

stressed had three times the rate of serious mental problems, twice the rate of mental retardation, and, for girls, over twice the rate of teenage pregnancy. Sixty percent of the children in need of long-term mental health care at age 10 had moderate perinatal stress, low birthweight, congenital defects, or CNS dysfunctions. Seventy-five percent of these individuals contacted mental health agencies during adolescence, often for severe and persistent mental health problems. Only one third of them had improved by age 18. Graded effects on cognitive development depending on the severity of prenatal and perinatal stress have also been found by Sigman, Cohen, and Forsythe (1981), Broman (1979), and Winick, Meyer, and Harris (1975).

In summary, the human data on the consequences of failure to form early attachment relationships or the formation of defective early attachments support the existence of long-range effects and differential plasticity, although interaction with later environments undoubtedly can ameliorate the effects of these conditions. It is noteworthy that two studies (Tizard, 1978; Wolkind, 1974) found that age 2 was the cutoff point. Children who had not developed normal attachments by this age tended to be abnormal later, and in the case of Tizard (1978), this occurred despite removal to a normal environment. These results suggest that there is greater plasticity before age 2 than after, although there is no reason to suppose that there is no plasticity at all after this age, especially since Flint (1978) showed that considerable progress was possible with children after age 2, given an intensive therapeutic regimen. Nor does this imply that major breaks in attachments at very early ages cannot have long-range effects if later environments before or after age 2 do not alter the situation. A decrease in plasticity after age 2 is also consistent with the data reviewed by Lamb et al. (1984), indicating considerable instability of attachment classification associated with changing life circumstances in the second year of life. It is also noteworthy that Dennis (1973) found that age 2 marked a point after which removal of severely deprived children to better environments had less effect on cognitive development than removal before this age.

#### *Early Experience and Normal Social Development*

The above data indicate that (1) there are age-based differences in plasticity for human social behavior; (2) long-range effects of early experience variables can occur; (3) whether the long-range effects occur depends crucially on the appropriateness and intensity of the subsequent environments. It does not follow that these considerations are relevant for the understanding of behavior under normal circumstances. It could be argued that major breaks in caretaking, lack of attachment figures, and repeated hospitalizations represent extreme environments that are

not encountered by the great majority of humans and, although they are of considerable theoretical importance, they are of little importance in explaining normal variation in social behavior. Scarr and McCartney (1983) distinguish between inhumane, abusive environments and normal environments. The latter environments contribute importantly to development, but essentially everyone benefits from them, so that individual differences are the result of factors other than the caretaking environment. Early experience and differential plasticity depending on age may be important, but only for the relatively small number of individuals affected by these extreme environments.

Such a position is attractive from the point of view presented above, since the power of the environment is crucial in determining both the effects of early experience as well as the effects of subsequent environments. The extreme environments typical of the studies reviewed above are far more likely, therefore, to have long-range effects. Nevertheless, given that the data from these severe environmental stressors indicate declining plasticity at later ages, this declining plasticity may well have important effects on the stability of behavior within the normal range and therefore on the long-range effects of attachment classifications. Unfortunately, longitudinal studies of the effects of environmental stressors on attachment classification have not compared the effects of similar levels of stress on attachment classification, or on the variables associated with attachment classification, at different ages in order to rigorously test this hypothesis. (There is general agreement that attachment classification in the first 2 years of life tends to reflect current parent-child relationships and can be influenced by changes in these relationships (Lamb et al., 1984; Thompson, Lamb, & Estes, 1983; Waters, 1983). These relationships apparently show considerable plasticity in the first 2 years of life, but such data are consistent with the possibility of decreasing plasticity after age 2.) Such a theory would imply that attachment or its correlates assessed at later ages would be more likely to represent persistent traits of the individual, relatively immune from environmental disruptions. Decreasing plasticity would also predict an increasing stability of individual differences in longitudinal studies, and this has in fact been found (Moss & Susman, 1980). Attachment classification in the first 2 years of life would then be seen as providing a foundation for later development (Sroufe, 1984), subject to the proviso that relatively extreme environmental stressors occurring later in life could alter the child's behavior.

As was the case with the animal data, however, some aspects of human social behavior are most reasonably viewed as well buffered from environmental effects and thus do not vary in response to the normal range of environmental variation. For example, children reared in a very inadequate orphanage (Dennis, 1973) were nevertheless able to work well

at menial jobs, although marriage, especially for the women, was a rarity, and there was a high rate of psychiatric problems for these individuals. Unlike the study of cognition where stage conceptions are well accepted, there is no conceptualization of social behavior which would allow for the description of cross-cultural universals of social behavior which occur in a very wide range of human cultures and normal rearing environments. The study of social behavior has been far more concerned with dimensions which reflect individual differences than with emphasizing commonalities of social behavior. Central notions such as that of attachment are tools for assessing individual differences but even insecurely attached individuals possess a wide range of social skills. Just as everyone achieves sensorimotor intelligence in all normal human environments, the basic social tasks of infancy are mastered by all. A step in this direction has been taken by Kagan (1982), who notes that the development of self-concept occurs with pretty much the same timetable in all human cultures. The social environment may be necessary for its development, but there is no reason to suppose that important individual differences are the result of specific experiences, much as is the case with the visual system in which the eye requires patterned stimulation but any patterns are inadequate. As McCall (1979) has pointed out with respect to cognitive development, by emphasizing individual differences we may ignore developmental functions. These latter may not be dependent on specific environmental stimulation.

#### CONCLUSION

There is good evidence for differential plasticity depending on age in the animal and human data. The evidence indicates that, after the time of maximum plasticity, considerable time, intensity of appropriate stimulus, or both must be expended to reverse the effects of early experience. The organism is viewed as increasingly refractory to change from environmental sources. In some extreme cases reversal may be impossible. The importance of the intensity of appropriate stimulus should be emphasized since it is generally missing from discussions of reversibility. Instances where the intensity of appropriate stimulus is an important factor in predicting the effects of early experience and whether reversal occurs have been discussed above, and the intensity of the stimulus in conjunction with the age of the organism are clearly the most important variables affecting the outcome of organism-environment interactions. Since humans appear to retain significant plasticity throughout development, the intensity of appropriate stimulus becomes of immense practical importance, since it is far easier to manipulate than is the biological basis for declining plasticity. The appropriate model is one in which the anatomical and physiological structures underlying behavior are present re-

ardless of age, but these structures become increasingly refractory to stimulation so that in some cases reversal is not possible with the present technology. There is no support for the thesis that experience is necessary for producing the structures themselves so that after the sensitive period behavior would be irreversible. Such a theory would predict a complete lack of sensitivity to stimuli at later ages, not the gradually declining sensitivity actually found. The fact that social stimulation does vary in affective intensity suggests that this dimension may be important in reversing the effects of early experience. This conclusion is suggested by the work of Woolpy and Ginsburg (1967), Suomi et al. (1976), Flint (1978), as well as the cases discussed by Bateson (1983) and is consistent with a large body of literature indicating the importance of arousal regulation in social development (Zentall & Zentall, 1983; Zuckerman et al., 1980). Such findings suggest that affectively arousing styles of parent-child interaction such as those discussed by Stern (1977) and MacDonald and Parke (1984) may be central to social development. If indeed the affective systems are biological systems which provide graded responses depending on the intensity of social stimulation it would be expected that manipulating the affective environment of the organism could have important consequences on the social behavior of the organism. (See MacDonald, 1984, for a biological theory of affective development that emphasizes the effects of affective regulation during development.)

In conclusion, we have come a long way from supposing that behavior is absolutely fixed at an early age by genetic factors or that after a sensitive period it is impossible to change behavior. Nevertheless, there are too many data showing otherwise to reject the idea that there are important constraints on plasticity for human and animal behavior. This fact does not, of course, prevent us from finding ways to intervene with individuals who have suffered early environmental insults. Indeed, the theory of sensitive periods suggests that the intensity of an ecologically appropriate stimulus can, at least up to a point, overcome the organism's declining plasticity, and Lerner (1984) has emphasized the ultimate plasticity of all of life, including the genes themselves. The fact of declining plasticity merely indicates what we already know, that successful interventions are not at present easily come by.

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