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ABSTRACT

This paper is designed as an information guide for those persons responsible for rearing human infants from birth to 18 months. The author provides an extensive review of the literature and trends of research in this area noting that the current volumes of knowledge in this area are not yet dependable enough to provide reliable bases for practice. He notes that among the problems presented in the study of infants are (1) availability of subjects in natural environment, and (2) the lack of reliable measures for research. Provided is an enumeration, explanation and evaluation of kinds of studies and known information about infant development. Included are longitudinal studies, cross-sectional studies, and assessments of direct and indirect evidence. The author feels that practitioners should demand and support the production of more dependable knowledge by sponsoring field and basic research throughout infancy on the whole infant (rather than on his separate behaviors) as he functions in real life. White admonishes practitioners to accept the fact that, for the time being, child-rearing practices must be designed on an admitted best guess basis. An extensive bibliography is provided. (Author/AJ)

The role of experience in the behavioral development of human infants: Current status and recommendations*

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Preface

This chapter is concerned with infancy, or the age "without speech" and will deal therefore with the first eighteen months of life. Its purpose is to provide information to guide those responsible for rearing human infants. As such it is a sequel to an earlier report in this series of reviews of child development research (The effects of infant care. Caldwell, 1964). Caldwell's report seemed to me to deal more extensively with psychosocial and personality than with perceptual and intellectual functions. I have therefore tried to emphasize somewhat the latter topics and empirical work that has been reported in the intervening years.

Unfortunately for society, I do not believe that research on early development has yet produced enough dependable knowledge to provide a reliable basis for practice. After all, behavioral scientists in numbers have only very recently begun to study infants, and the task of understanding early human development is a most difficult one. Nonetheless, it is equally clear that those who are responsible for the rearing of very young children must have regular access to the best "educated guesses" academicians and researchers can provide. Since direct evidence on the many facets of infant development is in short supply, this chapter will also include several other kinds of evidence of relevance. I hope in doing so to aid the consumer of these ideas in judging the widely varying value of the assorted kinds of information available for those concerned with providing appropriate experiences for infants.

I. The Special Importance of Experience During Infancy

I think it is fair to say that interest in this topic is a very recent phenomenon. Throughout recorded history, concern for structuring the experiences of young children has been manifested almost exclusively for children six years of age and older. A handful of pioneers such as Comenius, Froebel, and Pestalozzi sponsored education for four-and five-year-olds during the 17th and 18th centuries (Cole 1959), but it was not until the work of Sigmund Freud (1905) that Western society was effectively urged to attend to the influence of experiences during infancy. Subsequently, the work of J. B. Watson, Irwin, Gesell and others has added to the interest in this earliest period of life. Probably the most potent spur to the present-day renewed concern with infancy has been the early work of Piaget (1952, 1954). Piaget's remarkable studies of the intellectual development of his own three children during infancy have inspired a substantial number of modern workers. Perhaps the most vigorous proponents of Piaget's work of infancy have been Hunt (1961) and Flavell (1963). Hunt, especially, has made explicit the possibility (indeed, he believes it to be a virtual certainty) that the experiences of the first two years of life are of very great importance for all that follows. Not everyone in academic circles shares Hunt's position (although I must say that I do). Many respected professionals have serious doubts about this thesis based in part on the frequently found low predictive value of developmental standing in infancy (Furfey and

Muhlerbium, 1932; Anderson, 1939; and N. Bayley, 1940).* That is, infants who appear precocious during infancy are, if anything, likely to score slightly below average on intelligence tests as adults.

At the same time that Piaget's work has been sparking a rebirth of interest in early intellectual development, a second line of inquiry into the effects of early experience has been undergoing a somewhat smaller but steadily growing renaissance. The question of the relationship of early experience to man's social and emotional behavior, which received a good deal of attention in the 1930's and 40's (probably as a result of the influence of Freud) is now being reexamined. The science of ethology, the study of various animal species in their natural habitats, is being employed along with Piagetian and Freudian ideas in a reconsideration of how humans develop their capacities to feel for and relate to each other (Bowlby, 1958).

There seems to be an increasing sense that a study of moment-to-moment experiences during the first two years of life has much to teach us about these developments. This belief seems to be one consequence of a large number of studies of the mother-child relation (e.g., Ainsworth, 1967; Moss, 1967, Caldwell, 1969; David, 1961) including studies of maternal deprivation (Spitz, 1945; Bowlby, 1951) and studies of early experience in other species (Harlow, 1962; Levine, 1957; Denenberg, 1967).

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* For an exception to this view see Knoblock and Pasamanick, 1960.

My personal view is that we have far too little evidence, collected with far too primitive measuring devices, to feel sanguine about any firm position on the importance of infant experience. Just as clearly, however, it is much too risky to assume that such experience is unimportant while waiting, perhaps for several decades, for sufficient evidence on the issue to accumulate.

If it should turn out that experience during infancy is of vital importance, it would probably have the following kinds of consequences. Highly respected students of development such as Freud, Adler, Sullivan, Erikson, Bowlby and Scott have all suggested that the social and emotional potential of any human may undergo serious irreversible damage during infancy. The emerging picture, though not based on a high compilation of direct evidence, suggests that the growth of the specific mother-child relationship begins sometime around the third month of life (Ambrose, 1961). This most fundamental human bond is said to undergo crucial development during the following months. Along with the specific mother-child relationship (and apparently directly dependent upon it) is the more general capacity to relate to others and to experience and express affect. The voluminous literature on maternal deprivation and related topics seems to indicate clearly that gross inadequacies in early interpersonal experience can cripple (socially and emotionally) a child for life. While mercifully, relatively few children undergo such extreme deprivation, it is further implied by this line of research that interpersonal experience during infancy is of especial importance in the formation of the basic structures which mediate social experience subsequently throughout life.

As for other areas of life, Hunt (1961, 1965) has argued persuasively that intellectual capacity and intrinsic motivation are especially vulnerable during infancy. Hunt is not alone in this position; Hebb (1949) and Robert White (1959) have both spoken eloquently on this topic. In the area of language development, which is broadly acknowledged to be of fundamental importance for educational success, most research has concentrated on post-infancy periods. On the other hand, though elaborate productive language is rare during infancy, it has long been known (McCarthy, 1954) that infants are capable of receptive language function during the second year of life. Few would doubt that the dramatic acquisitions in language during the third year of life depend significantly upon language experiences in infancy. This question is unfortunately all but unexplored.

The current Federal government sponsorship of Parent-Child Centers for infants is testimony to the growing belief in the real likelihood of the importance of infancy for such developmental processes. Again, spokesmen often address their remarks towards the prevention of serious harm to children. The more subtle but probably more common moderate deficiencies that large numbers of presumably "normal" children suffer are also worthy of our attention. It is quite conceivable that our current standards of "normalcy" for young children will some day come to be viewed as unacceptably low. It would genuinely surprise me if several decades from now we have not learned how to structure the experiences of infancy so as to assure a far more interesting, pleasurable and productive beginning for each child.

Man's study of his own kind has a history as old as civilization. Its most common expressions have been in literature and philosophy. Psychology, the scientific study of man, is comparatively new. Many psychologists date the onset of the field as 1879 when Wundt's laboratory was established in Germany. Infancy is a period of human development which has only recently attracted psychologists. Even today, considering how much there is to know, very little is actually known about the age range, six days to two-and-a-half-years.* This incredible fact is explained by another rather simple fact. Children in that age range are not readily accessible in groups. In the United States, once the newborn leaves his peers in the maternity ward at age 5 days, he doesn't roost with contemporaries again at least until he is 2-1/2 years old, at which time he may (but probably won't) attend a nursery school or day-care center. Since, therefore, infants are primarily available in their homes and only one at a time, studying them is expensive and inconvenient. This is probably the major reason why we are shamefully ignorant about infants. Clearly, however, if only out of sheer epistemic curiosity, the human race will not forever abide this curious gap in its knowledge of its own kind.

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* In a recent editorial in a leading journal, (Child Development) Alberta Siegel (1967) pointed out that during 1965 and 1966, of the 152 papers published in that journal only 15 reported data on subjects more than five days but less than a year old. Not a single paper published during that period concentrated on children one- to three-years of age.

II. Some Special Problems and Issues

A. The need for data on differential human development.

In this country, the most widely utilized source of information on the behavior of the human infant is probably the work of Arnold Gesell (1941). His schedules of development are at once widely used yardsticks for normal development and also outlines of development. Other infant behavior scales, such as those of Cattell (1940); Bühler and Hetzer (1935); and Bayley (1965); characteristically offer about the same degree of detail. The Griffiths scale (1954) is a considerably sounder instrument in terms of statistical test construction requirements but isn't founded on a significantly better body of normative data. These instruments are designed primarily for diagnostic screening purposes. They usually cover most major areas of behavior including intellectual or adaptive behavior, motor, social, and linguistic functions. Typically, an infant's status in all of these very large domains is assessed in less than one hour. The infant is tested on twenty to thirty items, including information the mother is asked to supply on habitual performances in language, etc. Considering the complexity of each of these areas, it is patently obvious that infant tests such as these do no more than make an arbitrary scratch on the surface of an extremely complex series of interwoven processes. A look at the analyses of modern linguists such as Brown and Bellugi (1964), or of cognitive theorists such as Piaget (1952, 1954), indicates the enormous difference between in-depth studies of infant capacity and typical screening practices. Furthermore, the in-depth assessments of infant capacity have

barely begun. An enormous amount of hard work awaits to be done in charting the development during infancy of the many sensory capacities, motor abilities, interests, etc., of infants. Traditional topics such as individual and sex differences, rates and ranges of development, etc., have as yet been dealt with only in the most preliminary fashion.

B. Problems we face in studying the effects of early experience on development.

It is only natural that the first focus of research in the growing field of infant development be on the various behaviors that infants exhibit. I have described in general terms the need for vast amounts of information on the rapidly changing abilities, interests, etc., of the human infant, but knowledge of how infants behave will not suffice. We cannot afford to assume that experience is only of minor importance for the course of development. As parents, psychologists, educators, child welfare professionals, etc., it is our responsibility to structure the environment of each child so as to maximize the likelihood of optimal development. In another publication (White et al., 1964), we suggested that so-called "normative" data on development can only be assumed to be normative for subjects reared under the same general conditions as the standardization sample. In our report on the ontogenesis of visually-directed reaching, institutionally-reared infants exhibited mature reaching at about five months of age. In a series of subsequent experiments (White, 1967), in which groups of infants were reared in especially designed environments, they learned to reach by three months of age. For a species where the course of development is largely determined by genetic factors,

perhaps the study of rearing conditions is of minor importance. For man, it is likely to be of profound importance.

To study rearing conditions means to study patterns of care-taking behavior, the physical surround, the social surround, the daily schedule, etc. Further, it means that these factors must be studied, as they change during the subject's development. The infant less than six months of age is crib-based and cannot locomote. The infant, 18 months old, lives in a radically different world. The older infant usually changes his locus of activity many times each day. The six month-old is considerably more a captive of a comparatively invariant set of physical conditions. Clearly, the study of the environment will be a much more complicated task than the study of child behavioral phenomena per se. This is not the end of the problem, however, for different environments may produce common experiences in children, whereas common environments may result in different experiences. As Thomas, et al., (1963) point out, experience is a function of both external conditions and the nature of the experiencing organism. We cannot rely on a specification of a static set of rearing conditions if we seek understanding of patterns of early experience and their effects.

An enormous amount of work must be done analyzing the course of experience throughout infancy. Existing examples of this kind of study are the baby biographies of the past (Preyer, Shinn, cited in Wright, 1960), the recent work of Church (1966) and especially the work of Piaget. Such work is so time-consuming and so laborious that few undertake it, and one is inclined to despair. It is my contention (and I believe it undeniable)

that to the extent that experience influences development, we must embark on many such studies.*

Even though we do not yet possess detailed knowledge about the fabric of infant experience, the topic of the effects of such experience has received attention from researchers for several decades. Indeed the hardiest perennial in the garden of psychological issues seems to be the nature - nurture or hereditary - environmental dispute. The topic is centuries old and has never been set aside for very long by either society or students of development. During this century we have seen the pendulum swing from an emphasis on what is inherited (Darwinianism, instinct theory) over to the mechanisms of learning e.g. (Pavlov, Thorndike, Watson, etc.) then back to the role of maturation e.g. (Gesell) then back to the plasticity of early development e.g. (Hunt, Project Headstart) etc. Currently, the issue seems characteristically alive and controversial, with rebutters to the environmentalists in the areas of education e.g. (Jensen, 1968) and ethology e.g. (E. K. Hess) and advocates in studies of learning e.g. (Gewirtz, Lipsitt), comparative studies e.g. (Denenberg) perceptual motor development e.g. (B. White) and social development e.g. (M. Ainsworth).

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* Recently, two techniques for the quantitative analysis of on-going experience have appeared (Caldwell, 1968, White, 1969 [c]).

III. What do we actually now know about infant development and the effects of early experience?

A. Normative information about infant development.

Information about infant behavior can be divided into two major categories. The most valuable data are indubitably from direct studies of human infants. It has become traditional to supplement such direct evidence with the findings from studies of other animal species. Few would deny the utility for understanding human sensory function, for example, from studies of vision in other mammals; nor, would anybody argue that valuable information about the developing central nervous system has not come from studies of creatures as far removed from man as the horseshoe crab (Hartline, 1949) or the frog (Lettvin, 1959). On the other hand, certain cautions are necessary. Clearly, some topics such as the acquisition of language are explorable for all intents and purposes only through human subjects. In addition, though mammals share many common characteristics, one is always risking when extrapolating across species. All such indirect evidence should therefore be treated as tentative until such time as direct confirmation on human infants is obtained. The same caveat is necessary when evaluating evidence attained in studies of humans older than infants. The classic example is, of course, the Freudian theory of infantile sexuality which has had enormous influence but was constructed out of studies of adults. It has never been extensively confirmed by direct studies of infants. This distinction between direct and indirect evidence is quite important for the consumer of

knowledge about infant development. Except for Piaget's theory of the ontogenesis of intelligence (1952) and Gesell's concept of "reciprocal interweaving," none of the existent theories of infant development are rooted in studies of human infants. A case in point is learning theory as espoused by followers of Pavlov, Skinner and Spence, etc. Classical, operant and instrumental conditioning are commonly claimed to constitute the primary modes of learning in infancy, but this conception is based mainly on studies of adult humans, dogs, cats, and pigeons. Very few learning theorists have made serious investments in an unprejudiced view of learning phenomena in infancy as a prelude to their expositions.

1. Direct evidence on infant behavior

a. Longitudinal studies

1) Screening studies - characterized by brief overall examinations of large numbers of infants. Examples of such work are the studies of Bayley, Buhler, Gesell and Griffiths. In each case, these researchers have produced monthly age norms from tests which can be administered to infants in less than an hour. A child's performance on any of these tests can be used to determine his general developmental progress. Characteristically, it cannot be used to predict performance in grade school or on standard I.Q. tests.*

2) Intensive studies of specific developmental processes - characterized by small numbers of subjects and bi-weekly observations and examinations of the same children over several months of life. To my

* But see Knoblock and Pasamanick, 1960 for a contrary view.

knowledge, only three studies of human infants fit this decription: Piaget's work on sensorimotor intelligence (1952), Thomas, et al., on temperament (1966), and our own work on visual motor development (1964, 1967).

3) Large sample, broad scope studies - examples include the Berkeley Growth study and the Fels study. All such major American longitudinal studies have been succinctly described by Kagan (1964). These studies are the least intensive in dealing with individual infants and rearing conditions. Many of these studies gathered no data on infancy other than retrospective material. Those that did attempt to study infancy directly usually sampled the situation briefly once or twice a year. The procedure in the Fels study, for example, involved the administration of the Gesell test and brief observations of mother-child interactions at six month intervals. Clearly, such studies have their primary value in other directions than a thorough understanding of the innumerable interactions of experience and development during infancy.

b. Cross-sectional studies

1) Perception - characterized by high precision, small sample size, and restricted scope. Most commonly, an individual researcher has studied isolated perceptual phenomena such as visual orientation (attention), (e.g. Fantz, 1962, 1964; White, 1967; Lewis, 1967; Koopman and Ames, 1967; etc.); convergence (Wicklegren, 1966); depth perception

(Fantz, 1961; Bower, 1964; Polak, 1964); form discrimination (Ling, 1942; Hershensen, 1964, 1965, Salatapek, 1965); shape constancy (Bower, 1966) etc., as it is influenced by various stimulus characteristics such as density of contour or brightness. Vision is by far the most frequently studied sensory modality. Very little has been done in audition (Eisenberg, 1966), and almost no work has been executed in touch, taste and other perceptual realms. Furthermore, the first 18 months of life have not received equal attention. The vast majority of work has been done on the child less than one week of age (Siegel, 1967), although within the last year or two the situation has been improving. A few researchers have attempted to trace the development of certain perceptual phenomena over several months during infancy (Fantz, 1967, White, 1967), but these are the exceptions rather than the rule. In summary, a major proportion of our research effort is currently devoted to molecular studies of perceptual function during very early infancy.

2) Learning - characterized by high precision, small sample size and restricted scope. Many investigators in this field believe that the only important kind of learning that infants are capable of is one or another form of conditioning. A major purpose of their efforts over the last several decades has been to demonstrate that infants can be conditioned at birth or soon after (Marquis, 1941; Lipsitt, 1963, 1966, 1967; Papousek, 1961; Kaye, 1965; Siqueland, 1964; Lintz, 1967; Fitzgerald, 1967). Indeed, there have been attempts to condition infants in the womb (Spelt, 1938). Apparently, the goal is to prove that infants normally learn through conditioning.

Russian investigators have been at this effort longer than anyone else, probably because of the pervasive influence of Pavlov on their studies of human function. In general, they have had little success with newborns. (Brackbill, 1962). It is not until the third month of life that they have been able to establish discriminative responses (i.e., positive responses to one previously neutral stimulus and in the same test situation, negative responses to a related neutral stimulus). The ability to establish such responses is potentially of great importance for the study of sensory capacities, a line of inquiry which I believe is sorely needed by the field.

As it is, we now know (Gollin, 1967; Horowitz, 1968; Lipsitt, (1967) that with enormous care and effort, under rigidly controlled laboratory conditions, short-lived conditioned responses can be established in newborns. This achievement is an important accomplishment from a technical point of view, but I doubt that it has taught us much about the conditions of learning in infancy. Few would doubt that infants learn an incredible number of things in the first two years of life; and it is quite unlikely that the kinds of circumstances demanded by the conditioning paradigm occur often enough in the life of any child to account for even a small amount of what is mastered. It appears that research in this tradition has two other potential values for the field. As mentioned earlier, it may develop a powerful tool for the study of sensory capacity in the pre-verbal child; and, second, it may prove useful in therapeutic situations where short-term changes in behavior are necessary.

As for the problem of understanding how infants learn, I believe we will have to look elsewhere.

3) Language - In spite of the fact that infants commonly acquire extensive receptive language skills during the second year of life and that the next year marks the sudden appearance of a variety of well-developed expressive language abilities, insufficient direct study of the development has been done during infancy (McCarthy, 1954). The acquisition of primary aspects of language such as the earliest spoken and understood vocabulary has been thoroughly documented, although not on a wide variety of subcultural groups. More sophisticated studies of language such as those of Brown and Bellugi (1964) have not dealt with the first eighteen months of life. Although expressive language ability is ordinarily negligible during infancy, a good deal of work needs to be done in the area of receptive ability. An example of such work is Friedlander's studies of infants' preferences and discriminative abilities (1965). By giving an eight month-old infant the opportunity to control his auditory feedback, he has, for example, been able to study the infant's ability to detect his mother's disguised voice. Receptive grammatical ability is another major topic that is as yet not thoroughly documented though some work is in process, e.g. Lillywhite at the University of Oregon and Ringwall at the State University of New York at Buffalo.

4) Personality - Again there have been comparatively few direct studies of personality development in infancy. The longitudinal studies of Thomas, et al., have been cited. P. Wolff has studied a small

number of newborns for manifestations of affect and volition (1959). Escalona has had a long standing interest in infant personality and was associated with the Menniger longitudinal study (1952, 1953). She and C. Heider have attempted (without much success) to predict adult characteristics from descriptions of infant personality (1959). Several years earlier Irwin (1930, 1931) and Fries and Woolf, (1953) had studied differences in activity levels of infants, also with an eye towards prediction of later behavior. Campbell (1967) has recently reported on the same topic. Birns (1965, 1966), Crowell (1965), and Korner (1966) have worked on the problem of responsivity of newborns. Aside from these few efforts, one might guess from the literature that all infants were equally gay or dour, outgoing or retiring, stubborn or easy, etc.

5) Social development - Studies of social development in infancy have concentrated on four topics: the smile, the mother-child interaction, fear of strangers, and attachment behavior. In fact, the first three are subsumable under the fourth, which has recently been receiving increasing attention. There have been numerous studies on the first three topics. Spitz (1946), Ahrens (1953), Ambrose (1961) and Polak, et al., (1964) have examined some of the stimuli that elicit the ubiquitous smile of the fourteen week-old and the onset of this primary social phenomenon. Ainsworth (1967), Moss (1967) and a host of others have studied the mother-child relationship, long a favored area of inquiry. Spitz and others have documented the "stranger anxiety" responses of the seven-to ten-month-old (1965). Finally a provocative article by

Bowlby (1958) and the general effect of the growing field of ethology has helped stimulate renewed interest in attachment behavior such as the work of Schaeffer and Emerson (1964).

6) Other - A variety of relatively isolated but interesting studies of infancy should be noted. Prechtl has provided a good deal of information on instinct-like behavior patterns such as the rooting reflex in neonates (1958, 1965). Twitchell, a student of Denny-Brown, has studied the grasp responses in infancy for many years (1965). Graham, following a classic line of investigation has done impressive work on orienting and attending reflexes in newborns (1966). In fact, there have been many high quality molecular-scoped studies of infant (usually neonatal) function. Pratt (1954) and Peiper (1961) are two excellent sources of such facts. Of course, space does not permit extensive citing of work in this field, but in the next section I shall try to summarize where we stand today on the subject of what infants are like, on the basis of direct evidence on the problem.

c. Summary and assessment of direct evidence on infant behavioral development.

What then do we know about infant behavior on the basis of direct evidence? I should say we know a great many things and yet only a small fraction of what needs to be known. Some important generalizations can now be stated with confidence. Infancy, for example, is a period of very rapid change. Not only is the behavior of the newborn quite unlike that

of the eighteen month-old child, it is also clearly unlike that of the twelve, six, three and two month-old; nor is this phenomenon restricted to the newborn. The behavior of the two month-old is strikingly different from each of the others, etc. It is not until the second half of the first year that a month's time doesn't bring major behavioral changes.

1) Perception - The most extensively studied modality is vision. Especially during the last decade no topic has been of more interest to students of infancy than vision. The current view stimulated by the work of Fantz (1961) is that the newborn human is capable of far more differentiated visual function than previously believed. The newborn when awake and alert (Wolff, 1959) will at times definitely gaze at stationary visible targets if they are constructed of thickly drawn highly contrasting contours (Fantz, 1962; Salatapek and Kessen, 1965). He will also exhibit a rudimentary capacity for visual motor pursuit (Dayton and Jones, 1964; Wolff and White, 1965). By six weeks flexible visual focusing begins and ability is fully developed by four months (Haynes and White, 1964). Bower reports evidence of depth perception and size constancy at two months (1964-1966). Fantz' data (1962) indicates an increase in acuity from about 20/400 at birth to 20/70 by six months. The development of visual alertness during the first five months has been plotted by White (1967).

Audition, the second most popular sense modality, has received very little attention over the years (Eisenberg, 1966). Recently, Eisenberg (1969), Bartoshuk (1962), and Friedlander (1965) have reported respectively on auditory function in the neonate and in the eight-month old.

The general picture is that, as in the case of vision, the newborn is able at birth to function in rudimentary fashion, although he is far less capable of making discriminations than adults.

The other sense modalities taste, smell, touch, the vestibular sense and kinesthesis have received little attention recently although Engen and Lipsitt (1965) using conditioning techniques reported that neonates can discriminate primary olfactory sensations. Additional information about perceptual function is available from older studies cited in Pratt (1954) and Peiper (1963). Such information is mostly in the form of reports of a highly technical character on neonatal function which do not markedly alter the picture of the neonate as a naive, primitively organized processor of sensory information. In contrast, by the end of the sixth month, the infant seems to have achieved functional use of most primary perceptual systems.

2) Learning - One could easily write several hundred pages on this topic, especially if the term in defined so as to include more than the results of conditioning studies. If there is anything that characterizes human infancy, it is learning. That the infant can be conditioned even as early as the first week of life no longer seems disputable. The work of Lipsitt and his colleagues seems to establish that point thoroughly. Gradually during the succeeding months, the range of responses and ease of conditioning increases as shown by the work of many, especially Papousek (1961), Brackbill (1967), Rheingold, et al., (1959), Gewirtz (in press), Lipsitt (1963), and Weisberg (1963).

The development of intelligence defined crudely as problem-solving capacity and it's related elements such as object permanence, causality, means-ends behavior, perception of time etc., has been studied most extensively by Piaget (1952, 1954).

Piaget's work has had enormous influences on modern work and during the next decades we shall unquestionably see hundreds of studies extending his work. In Piaget's view, the newborn is essentially non-intellectual, totally incapable of intelligent or purposeful (means-end) behavior, but he is designed to take in and be modified by experiences. At six months or so, the infant shows primitive intelligence in the form of means-end behavior but still does very little of what we call "thinking" or manipulation of ideas. By eighteen months, true ideation or mental representation begins to supplement and replace immediate action as the primary mode of coping with problems. Support for this view has been provided by some recent studies of sorting behavior by Ricciuti (1964, 1965). Infents twelve-to twenty-four-months of age when given the opportunity reveal classificatory behavior in the sequences with which they handle small objects, indicating that some sort of mental organization is guiding their play. A similarly important metamorphosis is characteristic of other cognitive developments such as the conception of causality, time, etc., during this comparatively brief period of infancy.

3) Language - Although expressive language in infancy has received a fair amount of attention, there isn't much of it to talk about (McCarthy, 1954). Newborns cry and gurgle; four month-olds babble and

play with sound utilizing their own saliva. The first meaningful word (for the types of children who have been studied) has commonly been found at any time from as early as seven or eight to as late as forty months of age, with twelve to eighteen months most frequent. If the eighteen-month-old has two-word sentences, he is considered to be doing well.

Receptive language on the other hand has been much less investigated. That the child can hear well enough to discriminate words and inflections by the time he is six months old is highly probable, though not well documented (Friedlander, 1965). In fact, in a recent survey Eisenberg (1966) has described auditory research in infancy as "a vast wasteland". If we grant the likelihood that the infant is listening to and processing language with increasing facility from six months on and juxtapose the fact that shortly after eighteen months they routinely reveal a surprisingly rapid acquisition of complicated expressive language skills, it strongly suggests an important learning period from six-to eighteen-months. It is a serious indictment of researchers in infancy that this is another largely unexplored domain.

4) Personality - Here again the picture we can portray contains little more than broad outlines. For various reasons there has never been a great deal of interest in the direct study of infant personality. All the leading theories of personality deal with infancy by a process of extrapolation from older subjects and speculation. Beginning with Freud and moving on through Adler, Jung, Sullivan and on to Erickson; no major theorist has had extensive direct evidence on the topic of

personality in infancy. Part of the problem lies in the difficulties of conceptualizing personality traits and problems for this age range. Additionally, there is the previously mentioned difficulty of obtaining subjects.

Though direct approaches have been very rare, the topic has been indirectly approached in various ways. Studies of maternal deprivation (Bowlby, 1951; Casler, 1961; Yarrow, 1961, 1964) indicate that rupturing the infant's maternal bond leads to expressions of loneliness and apathy in late infancy. Work on social development (see next section) hints at the special attractiveness to adult humans of infants especially associated with the first smiles (Spitz & Wolf, 1946; Ambrose, 1961, 1963), and also of the likelihood of apprehensiveness coincident with the "stranger anxiety" reactions at about eight months. (Morgan & Riccuiti, 1968).

Perhaps the most direct attack on the problem of personality development of infants is the work of Thomas, et al. (1964). In a long-term intensive longitudinal study some 130 infants are being followed from birth to well beyond infancy. Personality characteristics such as activity level, mood, persistance, etc. are being assessed at monthly intervals. From this study, information on individual differences, continuity of temperament and differential stimulus effects on parents of these children will be forthcoming. Aside from this one study, however, I know of no others except for the older longitudinal studies. As for the latter, because the investment in data collection for individual children has been extremely small for the period of infancy, they have not provided detailed

information on early personality development.

5) Social development - For the first four-to eight-weeks of life, the infant is essentially presocial. It is not until that time that the first easily elicitable smiles to the human face or voice are seen. Fortunately, most new mothers don't really notice this potentially depressing state of affairs. By the time the mother is emerging from the typical pleasant emotional haze of giving birth, the child has begun to smile regularly. Nor is she aware that there is apparently nothing personal in these early smiles. For many weeks infants smile indiscriminately. It is not until the fourth month that there are modest preferences exhibited for the mother's face and voice (Ambrose, 1961). It is an interesting fact that of several hundred primarily institutionally-reared four-month-old infants I have observed, all but two or three could be counted on to smile readily to the gradual appearance of any human face at a distance of about 12 inches (except of course when sleeping or very distressed). This is but one symptom of general positive mood that characterizes infants of this age. It makes them very pleasant to have around and very desirable as subjects for behavioral research. At seven-to nine-months, the classical stranger reaction usually (but not always) appears (Ricciuti, 1968 [illegible]gen and Ricciuti, 1968). Bowlby (1958) has suggested that this phenomenon signals the end of the "catholic" phase of social function and the beginning of a solidification of primary family ties. Little is known about social behavior in the second year of life, but my guess is that a great deal of

social learning is taking place during that time. Piaget has suggested that, through innumerable explorations of objects and their attributes, the infant is learning the "me, not me" distinction. This cognitive achievement along with the emergence of conceptions of permanent objects with existences of their own must be extremely important for social development (Decarie, 1965). In addition to such related factors, infants of this age appear to be very much interested in people, their gross actions, and the nuances of their different facial and vocal expressions. The primary object of this interest is ordinarily the mother probably because she spends more time with him by far than anyone else.

6) Other

(a) Curiosity - An example of a topic of fundamental importance for human development is the development of curiosity. A synonym for curiosity is "intrinsic interest in learning." When phrased this way, it is clear that an understanding of how this human attribute develops would be most desirable. Very little direct study of the process has been undertaken.

Infants normally first exhibit what may be labelled curiosity at about two months of age. Along about this time, the infant becomes considerably more interested in his surroundings than in the first month of life (Gesell, 1960; White, 1967). In his interest in the nearby scene, in human faces, and most strikingly in his own hands, he first shows what looks like either curiosity or a clear precursor. At about eight months, the infant exhibits a particular interest in tiny particles (Schwarting,

1954). Again, when it comes to the details of the development of curiosity, especially after the first half year of life, with the exception of some new work on the five to nineteen-month-old by Charlesworth (1963, 1965), there is virtually no evidence. Recent observations strongly suggest that there is no more interested creature alive than the eighteen-month-old infant (White, 1969 [c]). Perhaps if psychologists knew more about this period, we might be able to help more infants maintain this apparently normal enthusiasm for learning that clearly is commonly diminished in so many children by the time they reach school age. I doubt if a more important educational problem exists.

(b) General behavioral development

In Developmental Diagnosis (1949), Gesell provides a series of valuable brief characterizations of infants as they develop during infancy.* These descriptions are based largely on the performance of 107 infants on the Gesell screening test. Though they are informative, they are limited by the nature of the Gesell test. This test, called the Gesell Developmental Schedules, consists of 20 to 30 items designed to cover all major phases of behavior; partly because of its broad purposes, it does so in a necessarily superficial fashion. For example, there is no comparing the sophistication of the Hunt-Uzgiris' scales for assessing cognitive development (1966) with the four to six items

*Another source of such information is the work of C. Buhler, et al., (1930).

utilized by Gesell for the purpose. Nevertheless, the Gesell descriptions are about the best we have in the way of longitudinal ethological data of infancy.

This brief summary cannot, of course, be complete in such a short paper. Several important topics have been left untreated. (In part, I believe Caldwell's paper (1964) fills in much of what is missing.) For that matter, no topic has been treated in great detail, although more will be said in following sections. The fact is that the human infant, though simpler than an adult, is a very complex organism; and no single document such as this could possibly be complete.

2. Indirect Evidence

a. Related studies of adult humans

1) Motivation and personality - For most of its existence the field of infancy has been significantly influenced by the work of Freud, his followers (e.g., Ferenczi, Abraham) and opponents (e.g., Adler, Jung) and their descendents (e.g., Sullivan, Erikson). In 1905 Freud published his theory of infantile sexuality. This paper described the psychosexual stages of the first years of life. Infancy, for example, was described as the "oral" period, the mouth being the prime locus of activity through which the sexual instinct found satisfaction. Ferenczi (1924) and Abraham (1921) elaborated on these conceptions; and up until the emergence of the influence of Piaget in this decade, no ideas were as influential as Freud's in shaping research and practice in infancy. A fundamental flaw in this situation was that the ideas were not rooted

in studies of infants. The course of early development of specie-survival factors such as the urge to procreate is still largely unknown. Its newer form seems to be the study of attachment behavior (e.g., Bowlby, Ainsworth, Emerson and Shaeffer). Few people now believe that either recollections of neurotic adults or exclusively theoretical approaches are likely to shed much light on infant development. The concept of phylogenetic continuity on the other hand has survived and led to empirical comparisons of infancy in various species (Scott, 1968; Newton and Levine, 1968).

2) Perception - In a series of ingenious experiments (1961), Held has attempted to generate a theory of perceptual-motor development in man based largely on studies of adult human function. Recently he has studied development in kittens (1963) and monkeys, but the primary basis for his theory has been his earlier work. Held has induced adults to re-learn perceptual-motor skills by systematically altering the feedback consequences of limb and body movements. He has found that it is easier to lose and re-acquire eye-hand accuracy than eye-body coordination. He has therefore concluded that the latter is more fundamental, with eye-hand coordinations mapped on to eye-body space in original acquisition. Unfortunately for the theory however, though human infants cannot locomote until the second half of the first year, they can visually guide their hands to nearby objects quite accurately as early as two months of age (White, et al., 1964). I have taken the trouble to describe this disagreement, not because Held's theory has yet been very influential in the field but rather to demonstrate the questionable limited

generalizibility of theory which isn't derived from direct studies of the phenomena in question.

Another case in point concerns current adultomorphic assumptions about the exclusively social meaning of the first smiles. Piaget noted that his infants often smiled at toys and their own hands as well as at faces (1952). In our work we, too, have often observed smiling at such objects. These and other observations restrict speculation and suggest more promising interpretations, such as Piaget's notion that the first smiles are at least, in part, a sign of recognition.

b. Related studies of other species

A synonym for the title to this section is "comparative studies". Some treatment of these topics is necessary because a) such studies have influenced and will continue to influence the field of human infancy and b) few would deny the principle of phylogenetic continuity. Of course, the field is far too large to be discussed in detail in this paper; I will therefore treat only the most important points of contact with work on humans.

1) Social development - imprinting and maternal relations. There are several good summaries available on the extensive research on these topics (Newton and Levine, 1968; Eibl-Eibesfeldt, 1967; Moltz, 1960: Gray, 1958; Hinde, 1966: Ambrose, 1963). Imprinting or the early exclusive social attachment to another creature (usually the mother) has been a popular topic for study for several decades. In general, most researchers seem to agree that the human infant goes through some process similar to the imprinting seen in birds and dogs. This process, which may be

completed in a matter of hours in geese, apparently takes many months in man. The first easily visible manifestations are in the indiscriminant smiling of the three-month-old (Ambrose, 1961). The other major indications are the stranger reactions of the last half of the first year (Morgan and Ricciuti, 1968) and the tendency to cling to the mother especially in strange circumstances during the first half of the second year. It seems likely that Bowlby (1958) and others are correct when they claim that this process is of fundamental importance for future social function and emotional health. Since much of the attachment process presumably takes place between six and eighteen months however, we have very little direct evidence on the topic as yet. A solid beginning effort has been made by Ainsworth (1967) and Schaeffer and Emerson (1964) in particular.

2) Motivation, instincts, drives and curiosity - The provocative work of the ethologists, Lorenz (1965), Tinbergen (1968), Hinde (1952), Mason (1962), etc., on the other species, especially on instinctive behavior, is a constant reminder that man probably does not come into postnatal existence in a totally unformed state. So far the search for complicated invariant motor sequences in human infancy parallel to nest-building and web-weaving in other species, has been brief and unsuccessful (Tinbergen, 1968). I frankly doubt if we will ever find in humans more than vestigial remains of elaborate instinctual motor patterns, such as the rooting, smile and grasp responses of early months of life. Few would deny, however, the probable relevance of

ethological ideas in the prime survival areas of man's existence such as procreation and survival. In retrospect, Freud's early attempt to use comparative ideas to explain infant behavior in terms of the sexual instinct seem less appropriate than Bowlby's attempt to integrate notions from ethology, psychoanalysis, and Piaget (1958).

In general then, we are left with the notion that the exploratory tendencies of the human infant, noted by Piaget (1952), Gesell (1960), Fantz (1964), and B. White (1967), are indeed consistent with results of studies of numerous other species (R. White, 1959). About the so-called "primary" drives there has never been any doubt that much of infant behavior is motivated by hunger, thirst, avoidance of pa[illegible], etc.

Over the last several decades, much has been learned about the structure and function of the sensory system from studies of other species (Granit, 1947; Kuffler, 1957). Recently, pioneering work by Hubel and Wiesel (1962) and Lettvin (1959) has provided interesting suggestions for example about the way vision may operate in man, as a result of their studies of retinal activity in the eye of the cat and the frog. In general, while such researchers rarely claim that human function is identical to that of other species, few would deny the value of such work for increased understanding of human function.

c. Summary and assessment of indirect evidence in infant behavioral development

The fact of phylogenetic continuity must be reckoned within any study of human development. At the beginning of this century, in a wave of enthusiasm for Darwinian ideas perhaps, the influence of

comparative ideas was very strong. In the work of MacDougall, for example, the concept of instinct was used to "explain" a great deal of human behavior. Freud and Lorenz, in particular, have had a very large influence on studies of human development. This early enthusiasm waned, however, and in such ideas as those of John B. Watson, (1917) the pendulum seemed to have swung the other way during the twenties and thirties. Since then, with the help of increasing amounts of direct evidence on infant behavior, we seem to be undergoing a rapprochement, with the influence of comparative studies assuming a more moderate level. The modern view seems to be that man is an unfinished creature at birth, with many fragments of instinct-like behavior and basic drives which are biologically guaranteed but are subsequently molded and differentiated by experience.

B. The effects of early experience on human development

Information on the effects of early experience on infant development is variegated and sparse. In the early stages of a science, attention is necessarily focused on outcome phenomena (or dependent variables, to use the technical term). There have been more studies, for example, of the abilities of infants than there have been of their experiences or rearing conditions. Partly due to the logic of inquiry which stipulates that you identify the diverse manifestations of the topic of interest and then investigate causal factors, and partly due to the earlier de-emphasis of the importance of learning, surprisingly few studies of early human experience have actually been executed.

1. Direct evidence

a. Natural experimental (correlational) studies - There are

three major types of studies of this kind. Although they are not commonly labelled natural experiments, it seems to me that this label helps to place them in perspective.

1) Screening studies - The greatest investment of talent and funds has been in longitudinal studies of the large sample, long-term variety cited earlier. Generalizations about the valve for good human development of accepting, democratic mothers, for example, are the kind of information generated by such studies. An intensive analysis of these studies is reported in a recent provocative book by Bloom (1965) which claims that early experience, especially during infancy, is of vital importance for development. In a widely quoted passage (p. 68), Bloom states that 50 percent of intelligence, as commonly measured at age 17, is achieved by age four. This simple statement has captured the imagination of many readers. By and large the thesis of this chapter is sympathetic to this general position, but it must be noted that any implication that we are currently able to measure human intelligence with precision is unfortunate. To talk about 50 percent of something presupposes its accurate identification, which has not yet been done for the "intelligence" of infants and young children. Further, it assumes that the half of "intelligence" mastered by the four-year-old is equal to the half acquired throughout the rest of life. This assumption is clearly misleading.

In the same book an attempt is cited (Wolf, p. 78) to characterize the major environmental factors in early development. Thirteen process variables are listed which presumably cover the topic of environmental

influences on the development of intelligence. One such "variable" is the "availability of books;" another is the "emphasis on .. use of language in a variety of situations," etc. Such analytical efforts require a great expenditure of energy in digesting the voluminous results of the longitudinal studies. They are not without merit, but they should not be taken as indications that we are generally knowledgeable about early experience and developmental processes. The fact is that the longitudinal studies on which the analysis rests heavily were not designed to provide detailed information on the processes of development. The Fels study, for example, made the following investment in infancy:

i. Gesell tests at 6, 12, 18, and 24 months.

ii. Interviews with the mother, annually from birth.

iii. Two-to four-hour observations of mother-child interactions every six months from birth.

This data base is about average for the infancy period for the longitudinal studies. Contrast this investment of less than thirty hours an infant for the first two years of life for all behavioral development with the several thousand hours of effort by Piaget in trying to understand intellectual development during infancy. Clearly, the longitudinal studies provide only the barest outlines of knowledge about environmental influences on infant development.

2) The second class of natural experimental data is the deprivation study. A large number of such studies evaluating the effects of the absence of the mother during the early years have been summarized by Bowlby (1951), Casler (1961) and Yarrow (1961, 1964). Although the

scientific quality of the studies is highly variable and often open to serious criticism, the weight of the evidence overwhelmingly suggests that the absence of the mother for more than three months during infancy (beginning after the first six months) has serious negative consequences for social and emotional development. The question of the irreversability of the effects, is largely unexplored at this time.

What it is about the mother's absence that is important is a matter of some debate. Spitz who wrote the pioneering article on the topic (1945) claimed that the cause of the problem was the serious disturbance of the developing mother-child libidinal bond. This position stemmed directly from Freudian notions about the development of the sexual instinct in infancy. If the two major motivational forces in infancy are the sexual and aggressive instincts, and if the mother is seen as a central link in the chain of discharge of sexual energy, then clearly her removal is catastrophic. Yarrow and Casler, on the other hand, impressed by the literature from studies of other species emphasize that maternal deprivation also usually means a drastic reduction in opportunities for learning and exposure to varied stimulation. Their view is more consistent with that of Hunt (1961) who points out that even if the mother is present throughout infancy, a child may be severely deprived if the opportunity to confront appropriate variations in circumstances is not provided. Somewhat in contradiction to the aforementioned point of view, are the findings of an early study by Dennis (1941). In an experiment which probably could not be performed today, the Dennises reared a pair of fraternal twins

from the end of the first to the end of the fourteenth month of life under conditions of "restricted practice and minimum social stimulation." With very few exceptions the behavioral development of these infants was largely unaffected by what appeared to be a significant degree of long-term deprivation. The Dennises also reported (1940) that severe restrictions on motor practice in early infancy produced by the cradling practices of the Hopi did not seem to retard the onset of walking. Dennis and Sayegh and Dennis' more recent work (1957, 1965) with larger samples in an institution for infants in the Middle East has tended to provide more support, however, for the environmentalist's position.

In my view, the mother could be absent in the first three or four months of life with no harmful after effects, if suitably designed non-social experiences were made available to the infant. Of course, the mother's presence is potentially a much more human and efficient way of meeting the child's needs (as any father of a breast-fed child will testify).

3) The third type of natural-experimental study of environmental effects is the cross-cultural study. The work of Erikson (1950) is one example of such research. In such work various national characteristics have been attributed to patterns of child rearing. At this point in history, very little in the way of useful detailed knowledge about experience in infancy has come from such studies. They do hold much promise for future work.

b. Experimental work on the effects of early experience

Studies of this kind fall into two distinct categories: those that manipulate infant experience over periods of less than an hour

and those that cover longer periods of time. Short-term studies are far more common for several reasons: among which a) they are less expensive to execute, b) rigorous experimental control over human experience is feasible only for such brief periods, and c) society is quite ambivalent about scientific "tampering" with human experience, especially that of helpless and possibly vulnerable infants. Unfortunately, though they are far more numerous than long-term experiments, it is highly questionable whether one can generalize extensively the findings from brief, laboratory-like teaching sessions to the issue of the complex cumulative effects of experience in real life.

1) Short-term studies - Examples of short-term manipulations of experience are the studies of Rheingold, et al., (1959) and Lipsitt, et al., (1967). The former have performed one study to determine whether responsiveness by an adult to the vocalizations of three-month-old infants could affect the frequency and distribution of those vocalizations. Infants were given operant conditioning training for 27 minutes for each of two days, and it was clearly shown that vocal output could be made contingent upon social reinforcement (smiling, touching and vocalization by the experimentor). In a follow-up study (1959), Rheingold and Bayley tested fourteen of the original sample of sixteen children some twelve months after their experimental experience to determine whether there were any lasting social effects. In brief, they found no evidence of carryover effects. They also point out, however, that in spite of their early institutional experience (X duration = 9.2 months) the infants

appeared to be developing normally. Lipsitt, et al., (1966, 1967) have performed a series of conditioning studies which have indicated that the sucking and head-turning behavior of neonates and various behaviors of older infants can be conditioned to previously neutral stimuli. Their studies feature very careful control over test circumstances to ensure that no extraneous stimulus is likely to interfere with the effect of the conditioned stimulus, e.g., a pure tone. With great technical skill they have demonstrated that this form of learning is within the infant's capacity. Unless reinforced trials continue, however, the effects are very short-lived. However, nothing very close to the experimental conditions is likely to occur with regularity in the ordinary life of an infant. Therefore, it is more likely that such studies will find their primary value in problem areas such as diagnosis and short-term behavioral control than in the analysis of long-term experience and development. As cited earlier, extensive reviews of this type of study are available.

2) Long-term studies - Studies of this sort are still in short supply. Ourth and Brown gave neonates 300 extra minutes of handling during the first four days of life (1961). They were hoping to lessen the shock of transition from the womb, where the child regularly experienced movement through space and various vibrations from the mother's body, to the crib where the infant is mostly immobile, etc. They found virtually no effect of extra handling on crying patterns (the primary post-experimental behavior examined). Salk (1960), too, performed a study aimed at easing the neonate's transition from inter-uterine to post-natal

existence. He exposed 102 newborn infants to a taped, loud (85 DB) heartbeat sound (72 beats/minute) for 24 hours a day during weeks 1-4 and 9-12. He reports that experimental babies gained significantly more weight during the first four days of life and cried considerably less than control infants (n = 112) during periods when the heartbeat sound was provided.

Rheingold (1956) provided individual mothering (from 9-4, 5 days/week) for a group of eight, six-month-old institutionally-reared infants for an eight-week period. She found evidence of social attachment for the experimental mother but no evidence of increased "stranger anxiety" in the experimental group. Neither did she find significant improvement in postural, "adaptive" or "intellectual" behavior in post-test performance.

That some form of learning can occur during the first week of life has been demonstrated by the teaching experiments of Lipsitt, et al., (1967). That some of learning does occur was demonstrated by Marquis (1941). Eighteen neonates were put on a four-hour feeding schedule. Sixteen other infants were put on a three-hour schedule. At day nine the three-hour group was changed to a four-hour schedule. Measures of motor activity showed that the three-hour group had adapted to the three-hour schedule. Casler (1965) provided small extra amounts of tactile stimulation to a group of eight institutional infants (stroking the middle part of the body) for twenty minutes each day from week twenty-two to week thirty-two and found modest general developmental acceleration (according to Gesell test scores) to be a consequence. Casler performed a parallel study with the same design where the experimental treatment was a sober,

continuous repetition of number recitation to the infant's midsection (i.e., one, two, three, four, five, one, two, etc.). Ten weeks of such "enrichment" produced no detectable effects. Fantz (1967) suspended one of two small colored objects over each of the cribs of ten home-reared and ten institutionally-reared infants from three- to twenty-four weeks of age. The familiar object was paired with a novel target and a twenty-second test of the infant's preference was made each week from three- to ten-weeks and twice monthly from sixteen- to twenty-four weeks. No significant experiential effects were found.

My colleagues and I have performed a series of related enrichment studies over a period of eight years (White, 1967, 1969 [b]). This research, which included four experimental and two control groups (average number of subjects: fifteen) featured the special arrangement of physical circumstances and activities in which the infant lived, 24 hours a day, from birth to four-and-a-half-months of age. Enrichment procedures included: extra handling, practices designed to increase head-rearing, swiping at appropriate objects, visual exploration and prehension, the provision of interesting and developmentally appropriate forms and objects in the infant's immediate surround, and the provision of red and white striped mitts designed to make the infant's hands more perceivable. [See below (1)] The consequences of these various procedures have

(1) The various experimental conditions or enrichment procedures in this series of studies were designed primarily on the basis of several years of observational work with similar infants, the results of each of the experiments and a general intent to provide environmental conditions that would mesh with the emerging interests and rapidly changing abilities of such infants.

repeatedly supported the idea that experience can play an important role in early development. Primary sensorimotor developments such as visual exploration, hand regard, and visually-directed reaching, appeared to be very sensitive to such changes in rearing conditions. Even rudimentary cognitive foundations seem quite open to influence from such apparently innocuous environmental factors (White, 1969 [a]).

Greenberg, et al., (1968) following up on this work reports acceleration of the blink response to changes in visible stimulation as a consequence of continuous exposure to objects somewhat similar to those utilized in the work of White, et al. Ten home-reared babies were provided with stabiles over their cribs from their sixth to their fourteenth week of life. The visually-based blink response subsequently came in at about eight weeks as opposed to eleven weeks for controls.

Earlier it was noted that Dennis and Dennis had reported that minimal social nurturance and opportunities for practicing emerging skills seemed to produce surprisingly little retardation of infant development. Dennis, et al., have subsequently reported two studies on infants reared in an institution in Lebanon. In the first of these studies (1957) various infants were tested throughout the two- to twelve-months-age range with the Cattell scale. In addition a group of four-and-a-half- to six-year-old children who had been reared in apparently similar ways in the same institution were tested with the Goodenough draw - a man, Knox cube and Porteus maze tests. Serious retardation was found increasingly throughout the first year but the older group

was only slightly inferior to a comparison home-reared group. While not denying the likelihood of deficits in language-related areas in the older children, the writers point out that the fairly serious retardation of the first year apparently did not lead to parallel serious deficits four years later.

In a second study, Sayegh and Dennis (1965) tested the hypothesis that the deficits seen in the institutional population during the first year of life were attributable to inadequate learning opportunities. Five, seven- to twelve-month-old infants, were given one hour of supplementary practice to accustom them to the upright position, to encourage interest in objects and to develop manual skills for fifteen days. Their rate of development (measured by scores on the Cattell test) was four times that of controls although they were still severely retarded. Furthermore, when supplementary training ceased, so too did the developmental enhancement.

c. Field experiments

Both the short- and long-term experimental studies cited in the preceeding sections can be characterized as intervention research. What they featured, despite varying styles, was control over some segment of the infant's history of experience. In each case control involved a careful designation of the experimental treatment and the rationale for its design. In addition control meant that the experimentor monitored the study himself either by applying the experimental treatment or by closely supervising the situation. In each case the number of subjects

was quite small except where the experimental treatment was very simple as in the Salk study (i.e. the provision of a recorded heartbeat). Another kind of intervention study should also be discussed. Here I refer to two older studies and a handful of newer projects sponsored by the recent anti-poverty social action programs. Though it might be argued that this group of studies is not clearly different generically from the last, I would like to see the distinction made for reasons which should become clear in the discussion that follows. The most extensive and advanced projects of this type are the recent studies of Gordon at Florida State University (1969) and Schaeffer in Washington (1969). Other studies of this kind are the infant projects of Weikart at Ypsilanti and Caldwell at Syracuse. The older studies are those of Irwin (1960) on the effects of reading stories to infants, and of Skeels (1966) on the rearing of institutional infants by retarded women.

Irwin (1960) had working-class mothers read stories to their infants (in their own homes) for twenty minutes a day from the time the infants were thirteen until they were thirty months of age. These children showed significant increases in produced speech sounds, both tokens and types.

Skeels reported in 1956 on the later development of a group of thirteen subjects who as young infants had undergone institutional rearing; and beginning at about eighteen months of age (range 7.1 to 35.9 months), had spent an average of 18.9 months in an "enriched" atmosphere. The enrichment consisted of living as "house guests" in a home for retarded women rather than in the conventional orphanage. Most of the experimental

group was placed into adoptive homes shortly after the experiment ended. Follow up studies were conducted two-and-a-half and twenty-one years later. Though the age at first admission and length of stay at the orphanage in early infancy was quite variable, all experimental subjects appeared retarded ($\bar{X}$ I.Q. = 64.3). At the end of the enrichment period their development had accelerated dramatically ($\bar{X}$ I.Q. = 91.8) in contrast to controls ($\bar{X}$ I.Q. = 60.5). Two-and-a-half years later their improvement had increased ($\bar{X}$ I.Q. = 95.9) and twenty-one years later the group was grossly normal, in sharp contrast to the control subjects. In the author's opinion, within the general enrichment situation, the intense one-to-one relationship which most of the experimental infants formed with the retarded women was the core factor underlying the positive results.

The newer projects attempt to preclude poor early development by providing a broad heterogeneous pattern of enrichment experiences to home-reared low income infants. As such they are at once directly relevant to the concerns of readers of this volume and simultaneously less controllable and interpretable than the more conventional experimental work. If they produce excellent results and if they record, in detail, how they did it, society can reproduce their efforts. On the other hand, since it is impossible to exercise a great deal of control over the many experiential factors involved, it is most difficult to determine the varying degrees of effectiveness of the numerous intended or unintended enrichment factors. (The Skeels study is, in many respects, similarly constituted; and Skeels points out that his pinpointing of the personal

relationship factor can only be considered as a strong hunch.)

Schaeffer trained eight full-time college-educated women to tutor low-income negro infants in their homes. For a twenty-one month period, beginning at fourteen months of age, each of these tutors averaged just under four, one-hour a day private sessions a week with each of twenty infants. They concentrated on verbal stimulation using books, toys and anything available to maintain the infant's interest. The experimental treatment was frankly opportunistic and evolutionary. The effects on development were striking. Average I.Q. gains (at thirty-six months) over controls were seventeen points. Equally significant results were obtained on measures of linguistic and perceptual development. In spite of the expense, the results seemed well worth the effort.

Gordon's project has been even more ambitious. He has aimed at more than affecting infant development. His goal was to produce a recipe for intervention that would be economically viable. He, therefore, trained low-income women with modest educational backgrounds to tutor mothers of infants who ordinarily would develop very poorly. Gordon's program featured a series of "learning games" for mothers to play with their infants beginning in the first months of life and continuing throughout infancy. These games were designed on the basis of whatever ideas seemed reasonable in the light of general modern psychological thinking. For example, Piaget's sensorimotor theory (1952, 1954) and its application in the work of Uzgiris and Hunt (1966) and Escalona and Corman (1968) was the basis for many of the games. General ideas

about the virtue of extensive exposures to words as labels and as cues to physical differences among objects were the basis for other games. Finally, certain items from standard infant tests were utilized. These ideas plus any others (e.g. the pat-a-cake game) were used to provide the means whereby mothers would become more sensitive to infant development and would be encouraged to devote considerable time to training and presumably enjoying their infants. Preliminary results are encouraging, especially for female subjects. Scores on the Griffiths' infant scale indicate about a six-point overall gain for girls and a non-significant 1-1/2 point gain for boys. Sub scores in the areas of hearing and speech and eye-hand activity were the most substantial.

Gordon seems to trade impact on infant development for parent involvement and feasibility. As for experimental control, one cannot expect such an action-oriented program to resemble for example, the laboratory-based studies of vocalization rates.

Two other studies should be cited. Caldwell at Syracuse has recently operated a small-experimental day-care center for low-income families. Home-reared infants received a general pattern of supportive, personal treatment from the time they were six months old for at least twenty-four months during work hours. An attempt to measure the effect on the development of mother-child attachment behavior indicated no differences as compared with a home-reared non-day-care group. This finding was interpreted as supportive of the general feasibility of the day-care remedial experience in that the bond between mother and infant

was not weakened by such experience.

In Ypsilanti, Michigan, Weikart has been engaged in intervention research with three- to six-year-old low-income children for some seven years. Recent findings have stimulated him to begin work in infant enrichment. Although no written reports are yet available, I have cited his work because of the extraordinarily high quality of his work with older children. I would recommend that those interested in infant care practices for such children request information directly from Weikart.

The opportunity to perform long-term controlled interventions is quite rare. Further, such studies, of necessity, cannot be nearly as rigorously controlled as short-term studies. They are, however, obviously directly focused on the questions those responsible for rearing infants want answered. I believe much more work of this kind should and can be done.

d. Summary and assessment

The volume of direct, detailed knowledge of the role of experience in the development of the human infant is almost negligible. What American behavioral science has so far invested in the problem represents a bare scratching of the surface of a few facets of a very complicated and extremely important scientific and social problem. I respect the studies of brief experiences of infants as legitimate and valuable scientific inquiries, but I do not believe that they can substitute for a direct attack on the larger issues. I believe a new methodology is needed to deal even in a preliminary way with the study

of early experience, and I have tried to describe such an approach (White, 1969 [b]). I do not believe that extensions of the short-term approach which feature chaining of discrete stimuli with singular responses will ever lead us to an unravelling of the interrelationships among the many stimuli simultaneously impinging on an infant at each moment, the cumulative effects of the multitudinous sequences of such moment-to-moment experiences, minute after minute, hour after hour, etc., and the numerous developmental processes simultaneously being affected by such stimuli. I truly despair of an atomistic approach to such a complex. In sum, we have barely begun the scientific investigation of the problem of the effects of early experience in human development.

2. Indirect evidence

a. Related studies of adult humans

In an indirect manner, the work of Freud and Sullivan and their descendents has influenced our views of the role of experience in early development. Concepts such as "birth trauma" (O. Rank) and the resultant hypersensitivity of some psychiatrists, pediatricians and parents to the special short-lived but all-determining early experience seem to have had a widespread influence. The vital importance of the mother's behavior vis-a-vis the establishment of healthy psychosexual behavior has likewise had enormous popular effect. Aside from such generalizations, however, the psychoanalytically inspired literature has taught us little about specific relationships between early experiences and developments.

In the area of perceptual development, however, several researchers have proposed explanations of specific experience-development relationships. As yet, these extrapolations from studies of other species have produced conflicting views of perceptual development. Held (1961) argues vigorously for the importance of early motor experiences within figured sensory surrounds, claiming that neither an interesting world nor self-induced movement, by themselves, are sufficient for optimal development. Riesen (1958) also recommends (though for different reasons) motor behavior in the presence of a variety of visible stimuli. Fantz, on the other hand, has been impressed (1964) along with Bower (1964) by how much human infants are capable of perceiving about their visual worlds prior to extensive experience.

At present, there is no overriding, consistent message on large issues of perceptual or perceptual-motor development in human infants from studies of other species. It is, however, a very popular research area, and we can expect important results from this field in future years.

b. Related studies of other species.

Numerous students of animal development have contributed to our thinking about the role of early experience in human development. They can be divided into two groups, those who believe that genetic factors are very important, and those who assign such factors relatively minor causal significance. Of the former group, the ethologists such as Lorenz and Tinbergen and the comparative psychologists such as J. P. Scott are good examples. Among the latter group are the descendents of Pavlov,

Thorndike, J. B. Watson, Hull and Spence such as Gewirtz, Lipsitt, and Siqueland (Associationists) and various other researchers such as S. Levine, Harlow, Held and Hein.

1) The ethologist's position - Lorenz has argued most forcefully for increased concentration on the genetic contributions to human behavior (1965). He, like Piaget, has shown much less interest and, in fact, some contempt for the topic of early experience. Clearly, it would be foolish to ignore the virtual certainty that some portion of the human behavioral repertoire is genetically guaranteed. Still the evidence for complicated invariant motor sequence is quite sparse (Tinbergen, 1968). We are left, then, with a reminder that at the very least we are likely to find some portions of early development essentially non-malleable by environment manipulation. Beyond this statement there is little to say until someone with the ethological orientation uncovers dependable evidence of instinctive behavior in infancy which goes beyond the well-known instinct fragments like rooting, grasping and stereotyped smiling.

Aside from the declaration that much of behavior is genetically determined and relatively impervious to experience, this group of researchers does suggest that certain rearing conditions are at least instrumental to the "normal" development of innately programmed processes. The ethological concept of the "critical period" which has received a great deal of attention (Scott, 1968; Newton and Levine, 1968; Ambrose, 1963) has important ramifications for child-rearing practices. I have already cited

Bowlby's analysis of the development of "attachment" during infancy. A necessary conclusion from this ethologically rooted line of inquiry is that child-rearing practices, out of respect for the fundamental requirements for human, social and sexual development must insure that adequate attachment behavior is encouraged in the first two years of life. The many studies of mother-child relations during infancy are relevant here, even though most were inspired more by Freudian than ethological ideas (Ainsworth, 1967; Caldwell, 1963; David 1961; Shaeffer and Emerson, 1964).

2) The associationistic position - Research in this tradition has been extremely popular throughout this century, both here and abroad. Its primary message, as best exemplified in the work of Gewirtz (in press), is that the key to the understanding of how an infant develops lies in the analysis of the environmental reinforcements which are contingent upon the infant's behavior. Gewirtz has therefore carefully studied caretaking practices in different cultures trying to identify the patterns of reinforcement which account for the likelihood of certain infant behaviors being increased while that of others is reduced. This concentrated focus on environmentally-based reinforcement is only interrupted in such research by the necessity to identify some of the behavior repertoire of the child and at least a few of his needs or interests in order to have the essential prerequisite information for conditioning studies. Very little attention is paid to the possibility of genetically determined specie characteristics, or to the inter-relationship

among experiences, or any idiosyncratically developing mental structures of the kind Piaget calls "schemas."

So far, serious attempts within this tradition to deal with more than an hour of highly controlled experience have not been attempted for infancy except by Gewirtz. Repeated episodes of shaping behavior of older children and of psychotics have produced encouraging therapeutic results, but to show that behavior can be altered by concentrated intermittent training does not prove that infants ordinarily or primarily learn in the same fashion.

3) Other related studies - Certainly the literature on the effects of extra "handling" on laboratory-reared mice, kittens and monkeys has relevance for the subject of early experience in man. Levine, Denenberg and others have repeatedly shown that small extra amounts of handling of infant mice have surprisingly general and significant beneficial effects (Reisen, 1961; Denenberg, 1967). The implication here is that previous views that the human infant should be touched as little as possible in early infancy for fear of traumatizing him may be in error. The few studies of the effects of handling human infants (Ourth and Brown, 1961; Casler, 1965; White and Castle, 1964) seem to support the notion that benefits are more likely to accrue than serious damage from the natural impulse of mothers to cuddle their young infants. The results of the well-known work of Harlow on Rhesus monkeys are also consistent with this conclusion (1962). Similar results have also been found with Siamese kittens (Meier, 1961).

Finally, Held and Hein have performed an ingenious study to assess the role of self-induced movements in structured visible surrounds on perceptual-motor developments in kittens (Held and Hein, 1963). Although the study was only done on a small number of kittens and no replications have been attempted, the results suggest that efforts to facilitate motor activity within interesting environments would be developmentally beneficial for human infants.

c. Summary and assessment

Studies of adult humans have yielded relatively little detailed information to guide child-rearing practices. Scholars interested in social and personality development have provided provocative statements mostly in the form of caveats, such as the idea that the infant is establishing primary libidinal bonds and one should be quite careful to insure that this process is not seriously disturbed, or that the infant is establishing a basic sense of trust or mistrust, etc. It is quite likely that there is a good deal of truth in statements such as these, but until now I believe they have produced more anxiety in child rearers than guidance.

Studies of adult perceptual function have produced conflicting views on the role of experience in early development, although even those who feel that innate factors should be given greater emphasis would not recommend that you desist from providing for sensorimotor experiences for infants.

Studies of other species have offered considerably more specific

recommendations for infant experience. The work of the ethologists, though again devaluing the role of experience in general, does indicate that those who rear children should at least not inadvertently get in the way of the playing out of genetically preordained patterns of development. They warn of the danger of not providing adequate environmental conditions (at the proper time) for common mammalian survival functions such as social attachment to proceed adequately.

The associationistic tradition, stemming from the pioneer conditioning studies of Pavlov and Thorndike, seems to me to provide at least one primary idea of direct relevance to child-rearing practice. That idea is that consequences of an infant's behavior that occur with regularity are likely to exert an influence on the particular behavior in question. If, for example, a mother systematically ignored a baby's crying over several weeks, especially after the first few months, one could expect the child to be gradually less inclined to seek attention. Likewise, if only the shrillest cries were attended to (over many such instances) one would expect the child to gradually develop a tendency to more rapidly increase the loudness of his cries in subsequent states of need, etc. Again, I should like to emphasize the notion that redundancy, the repetition of many consistent experiences, seems to me necessary in order for important effects to result. The occasional or once in a lifetime experience is probably quite inconsequential ninety-nine times out of a hundred.

The thrust of the other cited studies of non-human animals seems to

be quite consistent with Hunt's thesis that the best way to rear an infant is to be knowledgeable about his rapidly changing abilities and interests and to arrange his environment and schedule so as to provide sequences of experiences that are suitably matched to those developing characteristics, starting immediately at birth.

IV. What should be done by those with responsibility for rearing children?

Practitioners should demand and support the production of more dependable knowledge. They should sponsor:

Field research, such as the work of Painter (1968), Weikart at Ypsilanti, Schaeffer at NIMH, Gordon at Florida State and Caldwell at Syracuse, where very able people translate out best hunches into actual attempts to improve the development of groups of infants, than upgrade their programs through repeated evaluations.

Basic research on infant development and the effects of early experience, especially studies which feature the following characteristics:

(1) Investigation of the infant throughout infancy rather than primarily during the first week of life when he may be conveniently studied in maternity wards.

(2) Investigation of the whole infant functioning as he does in real life, rather than an exclusive orientation to the molecular behaviors such as the eyeblink, the rooting response, or the direction of gaze.

(3) Investigation of the varieties of patterns of experience that infants undergo.

(4) Investigation of the cumulative effects of those experiences throughout infancy rather than conventional concentration on the short-lived consequences of ten- to thirty-minute experimental treatments.

Practitioners should accept the fact that for the time being child-rearing practices must be designed on an admitted best guess "basis."

Psychologically, it is much more comfortable for the professional counsellor to be able to give advice and act with conviction and assurance, especially in such an important area as infant care. It is also tempting for the psychologist to make authoritative statements to the consumer. I don't believe the current state of knowledge allows us either of such luxuries.

Finally, if the picture of available knowledge that I have described is fairly accurate, then it clearly behooves those with responsibility for rearing infants to proceed with caution. No "expert," including this author, should be relied upon exclusively. A heavier burden of good judgment and restraint falls upon the practitioner when a science is in a primitive stage and the stakes are high, and this is certainly the current case when it comes to the rearing of human infants.

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