CURIOSITY IN EARLY CHILDHOOD:

A REVIEW OF LITERATURE

By

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CHAPTER I

INTRODUCTION

Purpose

The purpose of this study is to present a critical review of literature on curiosity and to bring into accurate focus the curiosity of the young child and its role in early learning and creativity.

Major areas of discussion include (1) the theoretical constructs of curiosity, (2) the behaviors that show curiosity in the young child, (3) the impersonal-material environments that stimulate and sustain curiosity, (4) the personal-social environments that stimulate and sustain curiosity, and (5) generalizations from the literature and implications for further study of curiosity in early childhood.

Problem

The rapid escalation in the rate of change which has taken place in our world during the past century has brought attention to those patterns of human behavior that facilitate adaptation to new situations. In a talk recorded by Sound Seminars, Margaret Mead commented on the need for people to be able to change.

> The number of people who are going to live under conditions in which they were not reared, who are going to have to cope with inventions that were not made when they were children, who are going to have to think about things that they weren't brought up to think about, is so great that if human beings cannot change and change rapidly. . . then we have perfectly good reason to be very worried about the state of the world. (Mead,Circa,1965).

There are certain behaviors that function in orienting to change and newness. In 1957, Berlyne wrote of these activities:

> There is currently a good deal of interest in certain sorts of behavior whose main function seems to be the provision of information. . . The behavior under discussion includes the "exploratory" activities that bring about opportunity to perceive objects more readily; the verbal activities, including asking questions, that elicit informative verbal behavior from other individuals; and the symbolic activities that allow thought processes to feed on information other than that supplied by the immediate environment. (Berlyne, 1957, p. 336).

The term curiosity is commonly used to refer to these information-providing behaviors. Berlyne (1957) called curiosity a response to uncertainty and ambiguity and accepted exploratory behavior as a characteristic of curiosity. Murphy (1958) described curiosity as the capacity to react vibrantly to new content, new relationships, new processes, new persons, and new aspects of oneself. McReynolds (1961) defined curiosity as a tendency to see novel percepts. Novelty has often been mentioned as a distinguishing mark of situations that provoke curiosity behaviors.

Curiosity is of value for man because of his need to deal with innovation in the modern world. Man must be stimulated and challenged by newness and change, meet them openly and eagerly, and deal with them knowledgeably and productively. Alfred North Whitehead (1936) defined the art of progress as the preservation of order amid change and the preservation of change amid order, and in this definition suggested the responsible and responsive climate which is needed for creativity in the world today.

The Curiosity of the Young Child

The baby and the young child are curious. No one seems to dispute this. Bruner (1966) noted this early curiosity.

> Studies of the behavior of three-year-olds, for example, indicate the degree to which they are dominated from the outside by the parade of vivid impressions that pass their way. They turn to this bright color, that sharp sound, that new shiny surface. . . They live by what psychologists have long called the laws of primary attention: attention dominated by vividness and change in the environment. (Bruner, 1966, p. 115).

Berlyne (1960) referred to the curiosity of the young child as perceptual curiosity--curiosity that is aroused by novel stimulation which is rewarding to the organism and is reduced by exposure to appropriate stimuli.

There has been much speculation about the function of this early and exhausting tempo of curiosity. Bruner (1966) described it as the child drinking in the world better to construct his neural models of the environment. So, surely an important function is served by the child's omnivorous capacity for new impressions. He is sorting the world, storing those things that have some recurrent regularity and require knowing, discriminating them from the parade of random impressions to which he is exposed. (Bruner, 1966).

Perceptual curiosity is gradually channeled into more powerful intellectual pursuits. To the receptive and episodic curiosity is added a sustained and subtle form of curiosity which Berlyne (1960) has called epistemic, from the Greek episteme, meaning knowledge. Epistemic curiosity is defined as that brand of arousal that motivates the quest for knowledge and is relieved when knowledge is procured; and knowledge in this instance refers to the highly

specialized information-gathering and information-storing processes dependent on symbolic processes. (Berlyne, 1960).

There is much that the preschool child wants to know. What, Why, and How questions follow one another in rapid succession. With language at his disposal, the young child begins to label objects and then to classify, order and explain the phenomena of the physical and social world. These verbal activities all tend to elicit informative verbal behavior from other individuals, and to this extent are evidence of curiosity, specifically epistemic curiosity. Later, but still during the preschool years, this epistemic curiosity is obvious in his drive to acquire number and reading skills.

Curiosity and Education

With regularity references to early curiosity are followed by regrets that it is lost as the child grows older. Torrance (1963) decried the premature restrictions that schools place on manipulativeness and curiosity. He felt these restrictions blocked the thinking process so necessary to creative change. Holt (1964) is another educator who holds a similar view.

> Children of one, two, or even three throw the whole of themselves into everything they do. They embrace life, and devour it; it is why they learn so fast, and are such good company. Listlessness, boredom, apathy--these all come later. Children come to school curious--within a few years most of that curiosity is dead, or at least silent. (Holt, 1964, p. 157).

The role of the school in stifling curiosity has long been on the minds of educators of children. But, until recently, their concern did not extend to babies and young children at home in the care of their families. The home was typically the middle-class home, a

beneficient place where the child enjoyed himself, played, was taught a few childlike things such as the alphabet and to count to ten, while he matured enough and lived enough years to be ready to learn.

As early as the 1930's, however, child development specialists were probing the effects of various environmental factors on the learning of the young child. Dennis and Dennis (1936) studied infants in an extremely impoverished environment and found retardation in visually-directed reaching, sitting alone and standing with support. Wellman (1940) carried on an extensive study of the consequences of nursery school attendance and found at least semi-permanent gains in IQ in children who had had nursery school education as compared to children who had not attended nursery school. Goldfarb (1943) focused on infants reared in the restrictive and relatively unresponsive environments of institutions, and found that these children were lower in intelligence and had more problems in interpersonal relations than children reared in foster homes. Spitz (1949) studied the effects of mothering on children in institutions. One group of infants in his sample were in the daily care of their own mothers; the other group were attended by overworked nursing personnel with as many as eight to 12 infants being cared for by one attendant. In the first group the IQ's of the infants remained relatively constant over the first year; in the second group the quotient steadily declined with age. Bruner (1959) recorded the deliterious effects of stimulus deprivation on infants. Dennis (1960) and White and Held (1966) sparked significant gains in physical development in institutional babies by increasing the environmental stimulation to which they could respond. Finally, the results of Piaget's long years of study of the cognitive

development of the child were recognized and his definitive theorizing left little doubt as to the importance of the early years in the child's learning. (Piaget, 1963).

As the studies of the influence of the environment on the child's mental development accumulated, our country was swept by tides of unrest and demands for social change. The spotlight was focused on the educational problems of the environmentally deprived and the culturally different. The nation was shocked by a realization of the drabness and starkness of the early environment of the poverty-stricken child and by the formal school's difficulties in sparking his interest in learning at five and six years of age. Study of the culturally different child showed that he was faced by a diversity of expectations. Discontinuities developed between the values, language, and even information gained during his early years and those of the middle-class culture into which he went to study and work. Frustration and hopelessness, brought on by his inability to understand these differences, often put a premature end to his efforts to learn. (Getzels, 1966).

The federal government's response to these problems was Project Headstart, a widespread attempt to meet the developmental needs of the impoverished and confused young. The popular appeal of Headstart encouraged private and community groups to initiate long-needed programs in day care. The communications media responded with Sesame Street, Misteroger's Neighborhood and numerous educational and public television programs meant to provide enrichment and information for the very young.

The scientific community has followed these activities with hope and concern. It has originated research and a number of experimental programs of its own in an attempt to evaluate the effectiveness of efforts to help children make up the learning deficits of the earliest years. (Fowler, 1965; Gray, Klaus, Miller, and Forester, 1966; Bereiter, 1966, 1967; Gordon, 1967; Lavatelli, 1968; Katz, 1969; and Nimnicht, 1969). It is not the intent of this paper to survey the various implementations now being tried and tested, but rather to lay the groundwork for further study and research in one area of concern for early childhood education -- the stimulating and sustaining of curiosity.

Curiosity is so closely tied to self-motivated, self-directed learning that it seems difficult to consider the one separate from the other. Bruner (1966) has cited curiosity as a prime motivator of the educative experience.

> Curiosity is almost a prototype of the intrinsic motive. . . The achievement of clarity, or merely the search for it is what satisfies. We would think it preposterous if somebody thought to reward us with praise or profit for having satisfied our curiosity. . . Insofar as one may count on this important human motive -- and it seems among the most reliable of the motives -- then it seems obvious that our artificial education can in fact be made less artificial from a motivational standpoint by relating it initially to the more surfacy forms of curiosity and attention, and then cultivating curiosity to more subtle and active expression. (Bruner, 1966, pp. 114 and 117).

The subtle and active curiosity must be sustained if the individual is to continue to react positively to new problems, to want to solve them in new and creative ways, and to initiate and follow through attempts to gain knowledge to bring to bear on them. It is this on-going, adaptive use of curiosity that is valuable in the new situations created by changing life patterns.

CHAPTER II

THEORETICAL CONSTRUCTS OF CURIOSITY

The fundamental theses in psychology prior to 1950 did not lend themselves to the study of exploratory behavior and curiosity, and it was not until the middle of the twentieth century that scientists began systematic research in this area. The work of the preceding thirty or forty years was dominated by two major theories of learning behavior -- the instinct theory and the drive theory. While inimical to concentration upon curiosity, each of these theories provided insights into it and modern theory has roots in both of these earlier conceptualizations.

Instinct Theory

Instinct theory had its beginnings in the arguments of Darwin (1859) for the biological continuity of man and lower animals. Animal behavior had long been thought to be directed by natural instincts. It was only a matter of time before scientists began to explore the instinctual causes of human behavior as well. By 1890, William James averred that man had more instincts than other animals, so many in fact that they tended to obscure one another.

McDougall (1923) thought instincts were the innate predisposers of purposive behavior -- that is, they were the native propensities that initiated man's behavior and directed him to particular ends or goals.

Accordingly, instincts were given the specific function of predisposing the individual (a) to perceive and attend to particular stimuli or stimulus objects, (b) to become emotionally aroused in their presence, and (c) to make specific acts directed toward these objects.

In writing of these predispositions, James (1915) commented on children's tendency to enjoy novelty and change.

> The native interests of children lie altogether in the sphere of sensation. Novel things to look at or novel sounds to hear, especially when they involve the spectacle of action of a violent sort, will always divert the attention from abstract conception of objects verbally taken in. (James, 1915, p. 92).

James (1915) postulated two kinds of attention -- the one, attention that is passive or spontaneous, and the other, attention that is deliberate and voluntary, attention with effort. He commented on the value of novelty in capturing voluntary attention.

> The subject must be made to show new aspects of itself; to prompt new questions; in a word, to change. . . It is an odd circumstance that neither the old, nor the new, by itself is interesting, the absolutely old is insipid; the absolutely new makes no appeal at all. The old in the new is what claims attention. (James, 1915, p. 103).

Curiosity was explicitly defined by James (1915) as the impulse toward better cognition in its full extent. The idea embodied in this definition was to lie fallow for forty years, and then reappear, in the 1960's as a full-blown theoretical construct of curiosity.

Drive Theory

Watsonian behaviorism gradually displaced the instinct theory in the 1920's. Instinct theory had emphasized the power of pain and pleasure as motivators of human behavior and saw the source of these affective states in the external stimuli of the environment.

Behaviorism advanced the thesis that behavior was dependent upon the animal's drive state. Two types of primary drives were postulated: one, the various forms of intense and painful external stimulation which, it was assumed, aroused an inner state of excitement; and the other, the internal biological disturbances that drove or forced the animal into activities that restored the natural balance or equilibrium of its internal state. Cannon (1932) gave the name homeostasis, to the drive to restore the natural balance of the organism. (Fowler, 1965).

The varied and complex actions of both men and animals seemed not to be explained, however, simply on the basis of primary drives. Much of their activity, a good case of which was exploration, apparently occured in the absence of these drives.

> For this reason, Dashiell (1928) suggested, as Tolman (1925) had earlier, that the drive conceptualization could be extended to include secondary or learned drives. Through the action of the stimulus substitution (classical conditioning), those neutral stimuli in the animal's environment that were constantly associated with primary drive states could come to elicit, independently, the energizing and directive forces that typically resulted from conditions of deprivation and intense external stimulation. As early workers in the field of curiosity and exploratory behavior, both Dashiell and Nissen (1930) felt that the drive state and the restless, seeking activity of a food deprived animal, for example, became conditioned to those novel or unfamiliar stimuli with which the animal was constantly brought into contact. Consequently, those novel stimuli served in and of themselves to arouse "a new type of drive behavior." (Fowler, 1965, p. 12).

The drive concept controlled the direction of most research in psychology for approximately thirty years.

> It (the drive theory) has been a conceptual edifice of large dimensions and of considerable detail. It has provided a plausible account of both personality development and social motives. The experimental facts of homeostasis and of conditioned drive and fear are sound. (Hunt, 1960, p. 492).

The Scientific Study of Curiosity

Immediately after World War II interest developed in the study of exploratory behavior.

> Two factors were of prominence in fostering. . . concern with exploration. First, many investigators came to recognize that a good portion of the organism's behavior, especially man's was characterized not so much by those activities that served to maintain its biological well-being, but rather by those pronounced and prominent tendencies that it had to explore, to investigate, or in general to seek out new forms of stimulation. In this respect, then, investigations of curiosity and exploratory behaviors were just as important as the intensive study that had earlier been given to "more basic" activities of seeking food and water or escaping from pain. A second, if not related, factor that prompted research in the area of exploration was the concern expressed by other investigators that any general theory of behavior that neglected curiosity and exploration would be seriously deficient. Indeed with preliminary analysis of these behaviors in the early fifties serious doubt was cast upon the adequacy of the concept and principles that formed the bulwark of contemporary theory, and, as investigation proceeded, the findings uncovered were of sufficient consequence to call for both the modification of existing theory and the development of new conceptualizations. (Fowler, 1965, pp. 3-4).

One of the first voices heard was that of Harry Harlow (1953). He believed that a drive reduction theory of learning was untenable; and he believed that curiosity was not a derived-drive conditioned upon hunger or some other drive.

> There are logical reasons why a drive-reduction theory of learning, a theory which emphasizes the role of internal, physiological-state motivation, is entirely untenable as a motivational theory of learning. . . Can anyone seriously believe that the insatiable curiosity-investigatory motivation of the child is a second-order or drive conditioned upon hunger or sex or any other internal drive? (Harlow, 1953, pp. 25 and 29).

Observations and experiments on monkeys had convinced Harlow that there was as much evidence to indicate that a strong drive state, such as hunger, inhibited learning as to indicate that it facilitated it. (Davis, Settlage and Harlow, 1950; Harlow, 1950; Harlow, Harlow and Meyer, 1950).

> The condition of strong drive is inimical to all but very limited aspects of learning -- the learning of ways to reduce the internal tension. The hungry child screams, closes his eyes, and is apparently oblivious to most of his environment. During this state he eliminates responses to most of those aspects of his environment around which all his important learned behaviors will be based. (Harlow, 1953, p. 25).

Modification of the Drive Theory

Exploratory-Drive Concept. -- Other psychologists were interested in exploratory behavior, and many of them did not reject the drive theory but adapted it in various ways. One group of theorists simply maintained that external forms of stimulation that were both mild and novel motivated the animal to explore and investigate these forms of stimulation. The animal became curious of the novel or unfamiliar stimuli and, hence, responded to them. (Fowler, 1965). The early work of Berlyne (1950) was based on the tenet that when a novel stimulus affected an organism's receptors, there would occur a drive-stimulus-producing response (curiosity). As the stimulus continued to affect an organism's receptors, curiosity would diminish. Montgomery (1951, 1952) held a similar belief; he hypothesized that a novel stimulus situation evoked in an organism an exploratory drive.

Boredom or Drive Motivational Concept. -- Other theorists approached curiosity from a different way; they saw curiosity as an attempt to escape boredom. Satiated with certain stimuli, the animal would respond to other, more novel stimuli, and thereby encounter additional stimulation; but this change in stimulation would reduce the drive that resulted from the stimuli with which the animal was satiated or bored. (Myers and Miller, 1954). A similar idea, though without the drive motive, was the stimulus satiation concept of Glanzer. (1953).

The Concept of Arousal

Another dimension was given the study of curiosity by the intensive studies of human brain function during and after World War II. Through these studies the neurophysiologists entered the field of learning theory. One of these scientists, D.E. Hebb of McGill University, studied the Conceptual Nervous System (CNS) and its operation in guiding behavior. He pointed to not one, but two, quite different neural effects of a sensory event on the CNS. One was the cue function or the guiding behavior in response to a sensory message; the other, less obvious but no less important, was the arousal or vigilance function -- keeping the organism awake but not requiring action. In order for learning to take place the organism must be alerted to a possible learning situation. "No arousal, no learning; and efficient learning is possible only in the waking, alert, responsive animal, in which the level of arousal is high." (Hebb, 1964, p. 26).

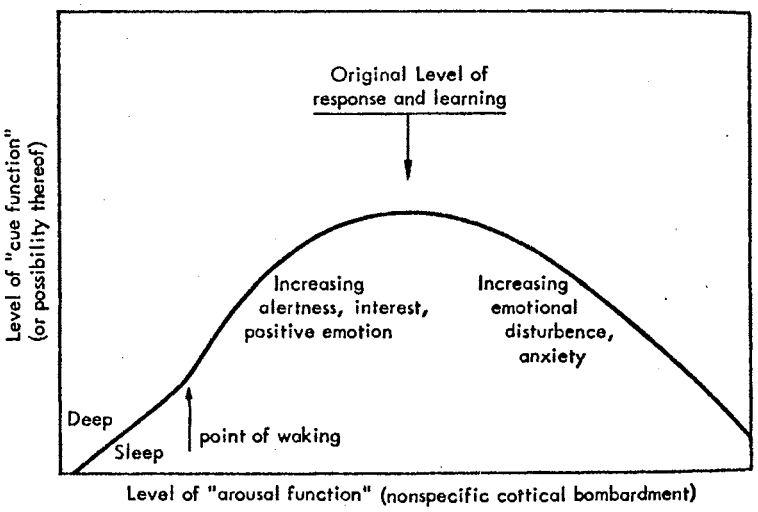

Figure 1. Diagram from Hebb (1964, p. 186).

The relationship between the level of cue function and the level of arousal function is shown in Figure 1. The behavioral conceptions deriving from this relationship, according to Hebb (1964) are that (1) stimulation in mild degree will attract, by prolonging the pattern of response that leads to this stimulation, and (2) the same stimulation will also repel, by disrupting the neural pattern and facilitating conflicting or alternative responses. Hebb pointed out that this relationship is one of greatest importance for understanding motivation.

> This is the positive attraction of risk-taking or mild fear, and problem-solving or mild frustration. Whiting and Mowrer (1943) and Berlyne (1950) have noted this relationship between fear and curiosity -- that is, a tendency to seek stimulation from fear-provoking objects, though at a safe distance. (Hebb, 1964, p. 26).

What evolved in the 1950's was a more active, dynamic model of the drive theory -- one not tied to homeostasis and anxiety, but including also the positive motivational possibilities of optimum levels of boredom, excitement, variety, mild fear and frustration, and problem solving. Pervasive difficulties, however, continued to plague scientists interested in presenting an inclusive theory of curiosity using the basic assumptions of the drive theory.

The Incongruity Concept of Motivation

Early in the 1950's there emerged another and entirely different kind of framework for conceptualizing the effect of events on behavior. Attneave (1954) pointed out the relevance of information theory to visual perception, and Berlyne (1957) perceived the importance of this relevance to curiosity.

An understanding of the relationship between information theory and the stimulus events that effect curiosity and exploratory

behaviors hinges on the unique meaning of the term information as posited in information theory.

> This term does not have reference to knowledge or understanding, or other commonly employed synonyms, but instead to a reduction of entropy or uncertainty in the organism (see Shannon and Weaver, 1949). This special meaning of the term is not so perplexing when we consider that the organism gains absolutely no "information" if it is certain of the sequence of events that it will experience -- for example, events that are redundant, repetitive, and completely organized (or as we might say in the context of exploration) unchanging and completely familiar. On the other hand, the organism gains considerable information when it experiences a sequence of events of which it is uncertain--for example, events that are varying, disorganized, or random in nature and order, or (again, as we might say) changing and unfamiliar. In the context of information theory, then, when the animal explores a novel surround, or unfamiliar pattern or object, it reduces its uncertainty of the sequence of stimulus events or elements that it experiences, and thus it gains information; and the more change or variation provided, the more information it gains. (Fowler, 1965, p. 71).

The idea of the positive motivational effects of uncertainty led Berlyne (1957) to experiment with and isolate other characteristics of stimuli which elicited visual exploration. His listing of such characteristics included complexity, novelty, uncertainty, surprisingness, and incongruity. Berlyne pointed to the ability of all such stimuli to produce conceptual conflict. He saw this conflict as a cognitive response to the difference between what was expected and what was perceived.

The incongruity concept of motivation, as this melding of information theory and motivational theory came to be called, was central to a number of formulations of motivation theory. (Rogers, 1951; Kelly, 1955; Festinger, 1967; and Abelson, 1958). Hebb (1949) explained the effect of conceptual conflict on learning behavior from the viewpoint of his knowledge of the organization of the physical brain.

> He (Hebb) conceives the residues of past inputs to be stored in semiautonomous, reverberating cerebral circuits which he terms cell assemblies. These cell assemblies are the neural analogue of concepts, and they get sequentially integrated into what he calls phase sequences. The sequential organization in time provides for the subjective phenomenon of expectation. When markedly incongruous receptor inputs disrupt his sequential organization, behavior is changed and the process is felt as unpleasant emotion. Slight degrees of incongruity, which can readily be accommodated, lend interest and may provide attractive problems, but the larger ones are repelling and perhaps even devastating. (Hunt, 1960, p. 499).

Piaget utilized very much the same incongruity notion to account for the development of intelligence and concepts in children.

> In his (Piaget's) system the child comes at birth with certain sensory-motor coordinations which he terms schemata. Variation in stimulus situations call for adaptive accommodations or changes in these schemata, which changes are assimilated or stored as residues. Piaget also finds limited incongruities between central schemata and receptor inputs to be interesting and facilitative of growth, but incongruities which extend beyond the child's capacity for accommodation instigate withdrawal or fear and even terror. In Piaget's theory gestalt-like conceptions of reality (space, time and number) are schemata which develop through a continuous process of accommodations and assimilations and become fixed or static only when the child's schemata come to correspond so well with reality that no further accommodations are required. (Hunt, 1960, p. 499).

Incongruity theory drew attention to the importance of the organism's interactional experiences with the environment. The standard by which the organism assesses the degree of incongruity of any given stimulus is established by past experience. This standard determines the expectation and acts as a "conceptual thermostat" with which to evaluate the stimulus and determine whether or not it is incongruous and how much or how little incongruity it possesses. (Miller, Galanter and Pribram, 1960). The decision to approach the stimulus, or withdraw from it, is made in terms of this evaluation and a reading of the total present environmental situation.

> If there is too little incongruity the organism approaches sources of incongruity, but if there is too much incongruity,

> the organism withdraws from sources of incongruous inputs. . . These facts appear to mean that there is an optimum incongruity which is continually sought. It is the basis of continuous cognitive growth with joy. It also justifies the older notions that children have a spontaneous interest in learning. (Hunt, 1968, p. 116).

Optimum Incongruity: The Problem of the Match

The notion of an optimum of incongruity, coupled with the notion that the standard upon which incongruity is based derives from the individual's own experience, gives rise to what Hunt (1968) has termed the problem of the match. The problem of the match concerns the difficulty of fitting new educational experiences to the past learning of the child. Hunt recognizes the lack of measures by which the past learning of a child can be adequately assessed.

> This "problem of the match" implies that if the circumstances encountered are to be attractive and interesting and are yet to be challenging enough to call forth those accommodative changes within the structure of central processes that presumably constitute learning, they must be properly matched to those "standards" which the child has already developed in the course of his past experience. The status of our knowledge about these matters is entirely inadequate for us to arrange such matches entirely from the outside. It would appear that the child must have some opportunity to follow his own bent. Thus, we come to the importance of that liberty emphasized by the Rousseau-Pestalozzi-Froebel tradition and by Montessori. (Hunt, 1968, p. 116).

Competency Motivation

Surveying the experimental work in motivation done in the 1950's, White (1959) felt there was no longer a compelling reason to identify either pleasure or reinforcement with drive reduction, or to think of motivation as requiring a source of energy external to the nervous system. He saw the possibility of a more inclusive theory of motivation

> This opens the way for considering in their own right those aspects of animal and human behavior in which stimulation and contact with the environment seem to be sought and welcomed, in which raised tension and even mild excitement seem to be cherished, and in which novelty and variety seem to be enjoyed for their own sake. . . This behavior includes visual exploration, grasping, crawling and walking, attention and perception, language and thinking, exploring novel objects and places, manipulating the surroundings, and producing effective changes in the environment. The thesis is then proposed that all these behaviors have a common biological significance; they all form part of the process whereby the animal or child learns to interact effectively with his environment. The word competence is chosen as suitable to indicate this common property. . . In spite of its sober biological purpose, (competency) motivation shows itself most unambiguously in the playful and investigatory behavior of young animals and children. Typically (these behaviors) involve continuous chains of events which include stimulation, cognition, action, effect on the environment, new stimulation, etc. They are carried on with considerable persistence and with selective emphasis on parts of the environment which provide changing and interesting feedback in connection with effort expended. Their significance is destroyed if we break into the circle arbitrarily and declare that one part of it, such as cognition alone, or active effort alone, is the real point, the goal, or the special seat of satisfaction. (Competency) motivation must be conceived to involve satisfaction--a feeling of efficacy--in transactions in which behavior has an exploratory, varying, experimental character and produces changes in the stimulus field. Having this character leads the organism to find out how the environment can be changed and what consequences flow from these changes. (White, 1959, pp. 328-329).

Summary

Two principle tenets emerge from the progression of attempts to fit theoretical constructs to the phenomena of curiosity. (Fowler, 1965). Through either high drive or high arousal, the organism is motivated by exposure to homogeneous, simple, restricted and/or redundant stimulation; and correspondingly, the organism will respond to and learn to work for stimulation that reduces its drive or arousal -- that is, stimulation that is novel, unfamiliar, complex and/or changing.

> If we are to summarize these two tenets in a few words, or with a single picture, then that picture is one of the organism needing, seeking, and processing information, not in the sense of receiving signals or stimulus input, but in the full theoretical sense of the word. (Fowler, 1965, p. 73).

It seems evident that the phenomena we call curiosity are found at all levels of function, neural and behavioral; and that virtually all responses possess an exploratory function to some degree. Where learning is concerned, it seems that there are optimum levels of internal arousal and optimum degrees of external stimulation. The effective balancing of these factors involve the evaluation of incoming information with standards based on information already coded and stored within the cerebrum.

CHAPTER III

REVIEW OF CURIOSITY RESEARCH

Curiosity studies reviewed in this chapter will include (1) research in behaviors that maintain the opportunity to explore and examine, (2) characteristics of stimuli that elicit exploratory and examining behaviors, (3) vocalization and question-asking, (4) impersonal-material environments that stimulate and sustain curiosity and (5) personal-social environments that stimulate and sustain curiosity.

Behaviors that Maintain the Opportunity to Explore and Examine

Persistence in examining and exploring stimuli in order to know more about them is one of the behaviors that exhibit curiosity in elementary-aged children. (Maw and Maw, 1961). This behavior would seem equally applicable to very young children for whom exploring and examining activities are one of the principal modes of learning. Common ways of operationalizing this behavior are by (1) noting the fixation time, i.e., the length of time the subject maintains visual contact with the stimulus, and (2) noting the frequency and duration of manipulatory activities.

Visual fixation time has frequently been used as an index of curiosity. Berlyne (1958) and Moffatt (1969) studied the visual

fixation time of infants when exposed to varying patterns or configurations. Charlesworth (1966) studied the frequency of visual fixations and head turnings of infants by using a movie camera to record the infants' behavior during a peek-a-boo game. Kagan (1969) in his studies of attention in infants, used both visual fixation and vocalization as indicators of arousal and interest. Burgess (1956) studied the frequency of visual fixations (five-second viewing contacts) of five-year-old children who operated the press bar of a tachistoscope to view a series of cards.

A more precise recording of the duration of sensory contact in infants is possible with the measurement of cardiac deceleration. Lewis, Kagan, Campbell and Kalafat (1966) demonstrated that cardiac deceleration accompanies attention in infancy. They used young infants (24 weeks old) and showed that the degree of cardiac deceleration is directly related to visual fixation time. They suggested that fixation time combined with cardiac deceleration may furnish a more reliable measure of intensity level of attention than is revealed by fixation time alone. Also, cardiac deceleration provides a measure for responses to auditory, olfactory and gustatory stimuli, for which there is no reliable response index.

If the duration of fixation is a concommitant of interest value, then cardiac rate might be used as a partial index of the interest value of a stimulus. McCall and Melson (1969) used cardiac deceleration as a measure of the interest value of varying patterns.

The frequency and duration of manipulatory activities has also been used as an index of the interest value of stimuli. Mendel (1965) used the frequency of manipulatory activities as an index in a study

of curiosity; and Medinnus and Lowe (1965) used both frequency and duration. They considered that these measures combined to give a highly reliable measure of curiosity. There were some indications that time spent in manipulation might be a more reliable measure than the number of manipulations.

Characteristics of Stimuli that Elicit Exploratory and Examining Behaviors

Certain characteristics of a stimulus object tend to elicit exploratory and examining behaviors. Berlyne (1960) listed these characteristics as complexity, novelty, uncertainty, surprisingness and incongruity. Sufficient research has been done on three of these variables to consider them in this review: Complex Stimuli, Novel Stimuli and Incongruous Stimuli. Kagan (1969) considered meaningfulness to be a characteristic of stimuli which sustains the attention of infants, and therefore, Meaningful Stimuli are also discussed in this review.

Complex Stimuli

A number of researchers have found that newborns and young infants are more attentive to complex stimuli. Fantz (1961) found that infants preferred a bull's eye pattern when presented with a pattern of horizontal stripes of the same color, and preferred a red and white checker-board design when presented with a plain red square. Spears (1962) attempted to quantify physically the amount of complexity of stimulus objects, and found that infants paid the most attention to a bull's eye pattern. Neither lack of symmetry nor a redundant pattern, provided any significant amount of complexity for the

infants. Cantor (1963) in a review of the research literature in this field, concluded that the infant is capable of making form distinctions, but that his preferences for varying degrees of complexity are not clearly understood. More recently Kagan (1969) suggested a theory of contour contrast to explain the responses of young infants to complex stimuli.

> During the first 6-8 weeks the infant has an unlearned disposition to fixate events that have a high rate of change in their physical parameters. Movement and contour contrast possess high rates of change, and newborns are dramatically more attentive to moving lights than to static ones, to stimuli with a high degree of black-white contour than to stimuli with minimal contour contrast. (Kagan, 1969, p. 1123).

Children of preschool age have also shown a preference for complexity of design. (May, 1962; Cantor, Cantor and Ditriche, 1963). Cantor (1963) commented on the need for an intensive study of a few relatively simple and rigorously delimited stimuli properties to supplant the vague notions of complexity which were prevalent. He also saw the need for replicative research using the best of the stimulus presentations and response measures that had been developed. Hutt and McGrew (1969) gave older children, five to eleven years of age, a choice between simple and complex patterns. Viewing time generally decreased with age, and there was an interaction between age and complexity. This interaction seemed to be the result of interestingness and pleasingness of the patterns. The five-year-olds preferred the simple patterns and the eleven-year-olds preferred the complex patterns.

Novel Stimuli

The degree of novelty of a stimulus object depends upon the experiential background of the subject who perceives it. (Berlyne, 1957b). Something can be either relatively novel, in the sense that it has never been encountered before in its present context, or absolutely novel in the sense that it has never been encountered at all. It would seem that what exists in the consideration of novelty is a continuum that extends with infinite gradations, dictated by the nature of the subject and his experiential background, from absolute novelty, through regressing degrees of relative novelty to absolute familiarity. In this configuration any one stimulus object or situation possesses a unique degree of novelty for each subject, as no two subjects are alike in individuality or in experiential background. An additional meaning of novelty has to do with the organism's recent experience; that is, a stimulus may be considered novel because it has not been encountered for a period of days, months, or years (long-term novelty) or because it has not been perceived for a period of minutes or hours (short-term novelty).

> The difficulties inherent in the task of obtaining firm knowledge of the human subject's history of experience with stimulation have led. . . to the general practice in experimental situations of familiarizing the subject with one set or class of stimuli, and then providing a choice between these stimuli and ones not previously encountered in that situation. The assumption is made that the latter stimuli are "novel" in comparison with those seen during the familiarization period. (Cantor, 1963, p.5).

Cantor and Cantor (1964) used this method of controlling for novel and familiar stimuli in a study of kindergarten children. They also attempted to determine long and short term novelty by differing the length of time between the familiarization and test sequences of

the experiment. Two sets of black and white line drawings which ranged from familiar geometric forms to complex and abstract shaded figures were used. One set was used in a familiarization phase in which the pictures were shown in various presentations to each child. After a time interval of five minutes for one group of children and two days for the other group, the children were allowed to view the familiar set and an alternate set of stimuli for as long as they wished. The results showed that the average amount of time spent in viewing the novel stimuli remained essentially stable throughout the testing sequence whereas the time for the familiar stimuli decreased. The time lapse factor did not affect the novelty-familiarity variable though children who were given the test phase two days after familiarization viewed the stimuli as a whole longer than the children tested after a time lapse of only five minutes. Cantor and Kubose (1969), using a modified method of controlling for novelty, asked preschool children to respond to pairs of familiarized and non-familiarized stimuli by pointing to the one they liked best. Results indicated that the children showed a preference for the non-familiarized over the familiarized stimuli.

A somewhat different approach was used by Smock and Holt (1962). They asked subjects to rank 25 toys in order of preference. Each subject was then given opportunities to choose between two boxes containing different toys. Each time before making his choice the subject observed the experimenter hide one of the toys under one box, but he was not allowed to see the toy being hidden under the other box. Thus, when told to choose the box containing the toy he most wanted to play with, he was choosing between a known toy and an

unknown toy. The value of the paired toys was predetermined so that for every child the paired toys were of equal preference value approximately half of the time. The results of this study indicated that the children chose the unknown toys more frequently than could be expected by chance.

Gilmore (1965) used a modification of the Cantor and Cantor research design in studying preschool children's preference for the novel. The stimulus materials were paired abstract designs, and these were selected so that the two designs in each pair were equally attractive to young children. A familiarization period was provided during which one design from each pair was shown and the child was encouraged to study and talk about it. Subsequently the child made his choice between the familiar and the novel design in each pair. As each child made his choices, he was given a copy of the designs that he chose. The results showed that these children chose the novel design significantly more often than the familiar design. There were no sex differences in preference for the novel, but there was a tendency toward an age difference. The older children chose the novel design more frequently than the younger children. Also, novel designs were chosen much more frequently by the children who made many verbal contributions during the familiarization phase of the experiment.

Mendel (1965) studied preschool children's preference for varying dgreees of novelty. The children in her study were individually familiarized to an array of eight small toys. Following this, each child was shown five arrays of eight toys each and was asked to choose one for further play. The five arrays represented a series which was graduated from completely familiar to completely novel. The first

array contained all of the familiar toys; the second contained six familiar and two novel; etc. The results of this study indicated that, for the total group of children, the preference value of a toy array increased as a direct function of its degree of novelty. Also there were significant age and sex differences. Older children and boys preferred greater novelty than did the younger children and girls. In this same study Mendel found that children of low anxiety preferred the novel more frequently than children of high anxiety.

Incongruous Stimuli

Incongruity, and discrepancy (a term used almost synonymously with incongruity), refer to those characteristics of stimuli which are changed or different. If a stimulus is somewhat familiar but has a degree of novelty (discrepancy or incongruity), it will be attention demanding. The conceptual standard, or scheme, by which this discrepancy is measured is provided by past experience.

> Once a schema has been formed, events that are discrepant from that schema--alterations in the arrangement or form of the distinctive elements of the schema--will elicit longer fixations from the infant than events perfectly representative of the schema or having no relation to the schema. That is, there is a curvilinear relation between fixation time and degree of discrepancy between schema and external event. (Kagan, 1969, p. 1123).

Kagan (1969) commented on the early age at which experiential factors enter the consideration of what is of interest and attention-demanding to the infant. Studies suggest that there is a measurable acquired determinant by the time the infant is 12 weeks old, and that the degree of discrepancy between the stimulus and an acquired schema becomes an important determinant of fixation time at this age.

Support for this hypothesis was found in the pattern of fixation times of four-month-old infants to schematic representations of human faces and to meaningless designs. Achromatic illustrations of male faces elicited fixation times twice as long as those elicited by random shapes of varying number of turns which are extremely novel and contain greater contour contrast than the faces. (McCall and Kagan, 1967a). Moreover, the four-month-old studies a regular schematic face longer than one which has the same facial components disarranged (Haaf and Bell, 1967). Further support for the discrepancy hypothesis came from a study in which three-month-old infants were exposed to a novel stimulus at home for one month and then shown that stimulus and three transformations of it at four months of age. Infants in a control group were shown all four stimuli for the first time at four months. The experimental infants showed shorter fixation times for all four stimuli than did the control infants; and the experimental girls, but not the boys, showed longer fixation times to the transformation than to the standard stimulus they had viewed at home, thereby lending support to the discrepancy hypothesis. (McCall and Kagan, 1967b). These findings also provide tentative support for the notion that stimuli which are very familiar and stimuli which are very novel elicit shorter fixation times than events which are only moderately discrepant from the established schema. (Kagan, 1969).

The distribution of attention to different degrees of discrepancy was studied by McCall and Melson (1969). Attention in infant boys was found to vary as a function of the magnitude of discrepancy, as predicted by Kagan (1969). The very novel and the very familiar evoked shorter fixation times than moderately discrepant stimuli.

Meaningful Stimuli

The idea of meaningfulness as an added variable of stimuli which elicit attention in infants was suggested by Kagan (1969). In his work, Kagan combined Berlyne's complexity and novelty characteristics into one variable, high rate of change. He used the word discrepancy instead of incongruity to refer to differences between expectation and perception, and added the variable, meaningfulness.

> A third determinant of fixation time--in addition to high rate of change and discrepancy--first appears during the last third of the first year and becomes prominent by two years. It concerns the meaningfulness of the event and is defined by the density of hypothesis associated with a class of events. With age, a child acquires both a more articulated schema for a particular class of events, as well as a set of associations and hypotheses which he activates when he is exposed to an event that is discrepant from his schema. The activation of these hypotheses leads to prolonged fixations. The child's attention is maintained because he is trying to construct the familiar from the discrepant; he is actively trying out cognitive hypotheses that will permit him to assimilate the event. The more knowledge he has about a class of stimuli, the longer he can work at this construction. The child's attention remains riveted on the stimulus in approximate proportion to the density of these hypotheses. In sum, three factors appear to control duration of fixation in the infant; high rate of change in the physical parameters of the stimulus operating during the opening weeks of life, to which is added moderate discrepancy at about 3 months and activation of hypotheses at 9-10 months. It is suggested that these factors supplement each other; an event that has contrast, is discrepant, and engages meaningful hypotheses should elicit longer fixations from an 18-month-old than a stimulus with only one or two of these characteristics. (Kagan, 1969, pp. 1126-1127).

In testing the suggestion that factors which appear to control fixation supplement each other, Kagan (1969) used a set of four different representations of a male face. In a longitudinal study of 150 infants, the faces were presented at four, eight, 13 and 27 months of age. Fixation times were highest at four months, reflecting the fact that the stimuli were discrepant from the infant's acquired

schema for his parent's face. Fixation time was lowest at eight and 13 months, reflecting the fact that the stimuli were much less discrepant but did not elicit any hypotheses. The fixation times began to rise between 13 and 27 months, reflecting the fact that the stimuli did elicit hypotheses. The largest increase in fixation time between 13 and 27 months occurred for a scrambled face (a face that had eyes, nose, and mouth rearranged), suggesting the complementary action of discrepancy and meaningfulness.

Independent data gathered by Finley (1957) corroborated these ideas and extended the age variable to three years. The greatest increase in fixation time from one to three years occurred for the rearranged or scrambled face. The scrambled face was more difficult to assimilate than the other two faces (regular and blank) used in this experiment; and it elicited a richer set of hypotheses in the service of this assimilation. One two-year-old child said, "What happened to his nose? Who hit him in the nose?" Another said, "Who that, mommy? A monster, that a monster, mommy?"

Vocalization and Question Asking

Several experimenters have studied the babbling response of the young infant to sights and sounds that interest and please him. (Cameron, Livson, and Bayley, 1967; Moore, 1967). The most distinctive findings of these studies have been the sex differences in the causes and incidences of babbling. In general, girls vocalized more and showed more discrimination among the stimuli than did boys. This sex difference may be caused by differences in the kinds of maternal attention or perhaps by an actual difference in organization of the

central nervous system. (Kagan, 1969). It is possible that vocalization is a more prepotent reaction for girls than boys when the infant is in the state of arousal created by processing information.

Question asking has long been considered an indication of curiosity. Isaacs (1930) referred to children's "Why" questions as "true causal inquiry which represent puzzlement produced by a sudden clash, gap or disparity between our past experience and any present event." (Isaacs, 1930, p. 295). Questions are indications of Berlyne's epistemic curiosity inasmuch as they are knowledge-seeking.

Very few experiments have used question-asking as a measure of curiosity in the young child. Torrance (1963) found that the opportunity to manipulate objects significantly increased the number and quality of questions asked about them. Gilmore (1965) found that children who showed a preference for the novel were the children who did the most talking during the familiarization phase of her curiosity research. Torrance (1970) used question-asking as the criterion for determining the optimum group size for early learning experiences. He showed Mother Goose prints to five-year-old children and asked them to produce as many questions as they could in a ten-minute period. Group size had a significant effect on the number of different questions asked, the number of discrepant event questions and the number of repeated questions. The performances of children in groups of from four to six were superior to the performances of children in larger groups.

Impersonal-Material Environments that Stimulate and Sustain Curiosity

In her work with self-directive learning, Waring (1964) pointed out that there are two interacting environments in the optimum learning situation--the impersonal-material and the personal-social. At different ages and stages of development, she felt, there was for each individual an optimal balance of these two environments.

> Each environment contributes vitally and uniquely to the child's development. The personal-social environment contributes in terms of the child's personal security, his self-respect, his increasing skill and ability, and the relative values he is building by which he selects and directs his activities. For these contributions the child is dependent on relationships with his adults. The impersonal-material environment contributes to his self-direction and self-approval in terms of choice, planning, judging and evaluating his activities, as he takes over for himself the directions and values internalized from his personal-social environment. (Waring, 1964, p. 8).

Play is the learning behavior of early childhood and play materials are the learning equipment of early childhood education. If curiosity is to serve the purpose of learning, play materials must be selected that will stimulate and sustain it.

Waring (1971) described characteristic usages of play materials. For a period of two years she observed some 200 kindergarten children at free play. She distinguished two broad categories for the use of play materials in self-directive learning: (1) materials for sensibility (sensory) and motor reaction, and (2) materials for constructive, representative and imaginative play. She found that the initial and fundamental appeal of all preprimary materials is for the sensory-motor reactions, the exploratory and manipulative play that informs the child of the distinctive and elemental characteristics of the object. Sensory-motor learning is based on

discrimination and materials are chosen for the diversity of sense experience they offer. Knowledge of the qualities of materials gained through the exploring play is later used for a purpose. The ability to discriminate and qualify stimuli supplies the child with the distinct and definite images which he utilizes in his constructive and representative play. At this stage the play materials are chosen for their adaptability to the expression of the images which the child wishes to represent.

> Only by using now one and now the other can the child develop fully. Now acquiring knowledge and now using that knowledge in his execution according to his present interest and need. In the final test for efficiency all materials must be judged upon the measure with which they stimulate plays which meet present needs for expression and at the same time create a desire for activities which shall continue the process of self-education. (Waring, 1971, p. 34).

It would seem that there are parallels between Waring's two types of uses for play materials and the two types of curiosity suggested by Berlyne (1960). Perceptual curiosity guides the child into the discriminations in sight, sound and feeling suggested by sensory-motor reactions; and epistemic curiosity guides the child into the seeking and storing of knowledge to perfect skills and adapt images suggested by constructive and representative play.

In a great deal of current research, play is identified with exploratory behavior, but Sutton-Smith (1967) noted that play is related to more advanced types of learning.

> The viewpoint is taken that when a child plays with particular objects, varying his responses with them playfully, he increases the range of his associations for those particular objects. In addition, he discovers many more uses for those objects than he would otherwise. . . Presumably, almost anything in the child's repertoire of responses or cognitions can thus be combined with anything else for a novel result. While it is probable that most of this associative and combinatorial activity is of no

> utility except as a self-expressive, self-rewarding exercise, it is also probable that this activity increases the child's repertoire of responses and cognition so that if he is asked a "creativity" question involving similar objects and associations, he is more likely to make a unique (that is, creative) response. This is to say that play increases the child's repertoire of responses, an increase which has potential value. . . for subsequent adaptive responses. (Sutton-Smith, 1967b, pp. 365-366).

Sutton-Smith (1967a) tested the above hypothesis in research with kindergarten children and found that well-explored toys elicited more statements of possible usages and more unique usages than did toys which could be named and described but with which the children had not had play experience.

The initial and fundamental use of all play materials is for sensory-motor response (Waring, 1971), which suggests that this characteristic is of primary importance in the actual selection of materials for research or for early childhood education. For their work with young infants, Dennis and Sayegh (1965) searched for objects which would prompt inspecting and manipulatory activity. The objects which were most often successful were materials that were light in weight, manipulative, and harmless; and many were brightly colored and reflected images. Among these were the following: an aluminum ash tray with an irredescent surface, a red plastic ash tray, plastic medicine bottles, a set of multiple colored discs with perforated centers, aluminum jelly molds, cardboard boxes, paper bags, and fly swatters.

In the Florida Parent Education Project, many materials and activities have been tested for their value in encouraging infant learning. (Gordon, 1970). Some of these materials are listed below and are identified as appropriate for the infant at a particular stage of his development.

For the very young infant: Rattles, mobiles and cradle gyms.

For the sitting and "lap" baby: Nesting cans or jars, blankets for hide-and-seek and for retrieving play, string that can be attached to toys and used to retrieve them, and a simple toy made of a spool and a piece of elastic that will stretch when pulled.

For the creeper-crawler: Balls, boxes or baskets to put things in, spools, rings, paper bags, snap-top jars with a slot in the top through which objects may be inserted and dropped.

For the stander and toddler: Screw-top jars with slotted lids, old magazines, stacking boxes or blocks, and water play.

For the older toddler: Simple picture books, stuffed toys, simple jigsaw puzzles, a Tupperware shape-sorting toy, unit blocks, push-pull toys, and make-believe equipment.

Materials used by Waring (1971) included Froebellian and Montessori equipment as well as the usual play objects of the American kindergarten--picture books, puzzle blocks, sand-table, blackboard, dolls, constructive toys and tools. Waring was interested in the children's natural reactions toward the materials, and conditions of individual choice prevailed for all materials. The Froebellian and Montessori equipment proved particularly useful for sensory-motor responses. With these, the children became interested in color, texture, size, shape and weight discriminations, and in the manipulative exercises of fitting, tying, buttoning, lacing, snapping and stringing. When constructive and representative play developed, then the children used quantities of hollow and unit blocks, planks, construction sets, objects for dramatic representation, and they used clay and paint for pictorial and form representation.

The criteria for use in the selection of materials for self-directive learning, as suggested by Waring (1971), include that the material be attractive and adaptable to individual experimental play.

Beyond this for materials designed to elicit sensory-motor reaction, added criteria are that the material have a self-corrective quality, and that it open the way to other and more definitely intellectual development. For material designed to elicit representative, constructive and dramatic play, the added criteria were that the material have the capacity for stimulating creative expression and that it demand reason, judgment and adaptation, and thereby dovetail the experience of the child into the broader and more complex activities of self-development.

Another impersonal-material environment designed to encourage self-motivated learning was arranged by Moore (1968).

> In teaching nursery-school children to read, he (Moore) has them strike the keys of an electric typewriter so arranged that, as each key is struck, the child sees the letter struck and hears the name of the letter. Nursery-school children are introduced to the apparatus by a child who explains that "we take turns." Each day a child is asked if he wishes his turn. Given this opportunity, each child nearly always does. After a period of free exploration of the keyboard, the speaker in the apparatus can be used to tell the child what letter to strike. By keeping all keys but the named one fixed, the child can gradually be taught the keyboard. By means of further programmed changes in the experience, children can fairly rapidly be led to the point where they are typing from dictation. While this program concerns reading, it minimizes the motor side and is based on visual and auditory responses from the typing on the apparatus. When children with several months of such experience are provided with a blackboard, Moore reports that after noting that some of their marks resemble the letters they have learned on the typewriter, they quickly explore making all those letters with chalk. Moreover, the motor dexterity and the control of these four-and five-year-olds, as it appears in their writing, has been judged by experts to be like that typical of seven-and eight-year-olds. (Hunt, 1968, p. 118).

The "talking typewriter" and the rules for its use were planned to keep the learning environment responsive to the initiative of the children. Moore's definition of a <u>responsive environment</u> follows:

A person P is said to be in a responsive environment R if

(a) R allows for a variety of actions on the part of P.

(b) R responds in some reasonably systematic way to P's action, with the result that P is informed immediately--or at some specified interval--of the consequences of his action relative to R.

(c) The pace of the activity is determined principally by P; P is not rushed or delayed in his action relative to R, although some necessary time lag is allowed for R's response.

(d) R permits P to use his capacity for discovering constant features of R, relations between the behavior of P and the response of R, etc.

(e) R is sufficiently complex so that the interconnected relations discovered under (d) are generalizable; they shed light for P on general properties of physical, social or cultural worlds. (Moore, 1968, pp. 175-176).

An adaptation of Moore's responsive environment was developed by Nimnicht (1969). He constructed a learning environment for deprived children in Denver, using Moore's criteria, but without the advanced electronic machinery of the talking typewriter.

Personal-Social Environments that Stimulate and Sustain Curiosity

The value of the personal-social environment for the young child has been described by Waring (1964).

> In the personal-social (environment), . . . attentive interest, understanding and sometimes sharing the child's activity, general and specific approval for his efforts and achievements, and qualifying approval, all have their unique functions. Some enhance the child's satisfaction; some promote thinking and expand meanings; and others supplement the child's efforts so that success and satisfaction may insure continued activites that are educative. (Waring, 1964, p. 5).

Curiosity and the Self

There are psychosocial threats to the development and retention of curiosity. They operate in the form of personality maladjustments which cause a child to be rigid, anxious, withdrawn or in conflict with his environment. Psychiatrists are agreed that many of these non-productive ways of coping with the world develop very early in the life of the child. Conversely, healthy open personalities, eager to explore and understand the world, develop through basic stages of psychosocial crisis and satisfaction. The development of a basic sense of trust and a sense of autonomy is necessary during the first two years of life. (Erikson, 1950).

> The child's expectation that something outside of himself will satisfy his needs is what powerfully increases his interest in the world and his impulse to learn more about it. . . Normally, the infant's reactions will not differ too radically from his mother's, or she will be able to make the needed adjustments. So from the very beginning he will not only seek and respond to bodily comfort, but will soon interact with his environment. The sooner his actions leave the realm of chance or random behavior, the better. First, he has learned to gear them to the environment, however minutely, and to expect certain responses from it. And second, if things go well, he has learned that some consequences of his actions are predictable. These are the basic preconditions of personality development. (Bettelheim, 1967, pp. 60 and 65).

As the child interacts with more and more complex situations, the importance of the predictability of the environment, and the child's basic confidence that it is knowable, increases. Holt (1964) described the panic reactions of school-aged children when confronted with a problem. They tended to be so anxious to find a solution--any solution--that they barely considered the problem at all. Holt suggested that these children do not trust the world, and he contrasted their reaction to the reactions of seemingly more intelligent children.

> Intelligent children act as if they thought the universe made some sense. They check their answers and their thoughts against common sense, while other children, not expecting answers to make sense, not knowing what is sense, see no point in checking, no way of checking. Yet the difference may go deeper than this. It seems as if what we call intelligent children feel that the universe can be trusted even when it does not seem to make sense, that even when you don't understand it you can be fairly sure that it is not going to play dirty tricks on you. (Holt, 1964, p. 46).

The relationship between children's anxiety and their curiosity, their tendency to choose the novel, interested Mendel (1965). She found that low-anxious children preferred greater novelty more frequently than did high-anxious children.

Curiosity and the Significant "Other"

The relationship of feelings of security to the play responses of young children, 11 to 30 months or age, was explored by Arsenian (1943). Some of the children were accompanied by their mothers or some very familiar person while they played in an experimental room, and other children faced the new situation alone. The children who were accompanied by their mothers explored the room more freely and played with more objects than did the children who were entirely alone.

The function of the mother in this security-providing relationship is suggested by Bronson (1971). In an in-depth study of the second year of life, she organized an "encounter group" of toddlers who met once a week to play as their mothers sat nearby. Like Arsenian, Bronson noted the reinforcement of the child by the mother's presence.

> The child does something, and then, from a distance, turns to the mother and smiles, "Look, I've done something!" It very often doesn't require of the mother that she say (anything) but she must smile back and there is a moment of contact. It is love, it is sharing, it is communication. I think it gives the child a renewed interest in what he is doing because he has been able to share it with someone he loves. (Bronson, 1971).

Waring (1964) found that spoken approval enhanced the responses of kindergarten children. In her study, she used equipment designed to elicit a series of motor tasks. The children were divided into two groups. In one group, each child was allowed to play with the apparatus with no verbal feedback from the adult who was present. In the other group, whenever a child performed the task the equipment was planned to evoke, the child was rewarded by the adult with the single word "Benito" spoken in a pleasant, approving voice. Waring found that the verbal approval significantly extended and improved the quality of the children's play.

Personal-Social Relationships and Question-Asking

Schermann (1966) has suggested that probably the most useful thing that the preschool can do is to teach a child to ask worthwhile questions. She stressed, not only the need for adequate stimuli to encourage curiosity and learning, but also the need for the adult to provide an opportunity for the child to respond to the stimuli in discriminating ways. She felt that the adult could reinforce question-asking by approval and by readiness to answer questions. Torrance (1970) was concerned about the effect that the size of the peer group would have on the question-asking of the children. In research designed to study this problem, he found that smaller groups of children (groups of four and six) asked significantly more and better questions than did larger groups (groups of 12 and 24 children).

Gardner and Moriarity (1967) studied the mental health of a large sample of school-age children and were negatively impressed by the degree to which intellectual and other forms of curiosity are

inhibited. In their study, they pinpointed one of the many sources of this inhibition--the imposition upon the child of highly structured beliefs and other conceptions held by the parents.

> In some families, . . . preformed views are imposed on the child's budding conception of reality in ways that make it inappropriate for him to ask certain kinds of questions or to attempt to answer them for himself. In fact, the child may become unable to experience certain obvious kinds of questions about his world. Here, in extreme cases, is a massive, blanket-like source of curiosity-inhibition that I fear we all, as parents, are susceptible to in some degree. (Gardner, 1967, p. 84).

Another observation has been that the middle class parent seems to find it difficult to leave his child alone. Gardner commented that this constant intervention limited the development of autonomy in the child and deprived him of the freedom necessary to develop self-motivation. In contrast, some children whose families are on the lowest rungs of our socio-economic ladder suffer from harmful excesses of autonomy. That is, they are required to develop all too little self-control, in their early development, and they develop this control without the experiences necessary for cognitive and affective differentiation. (Gardner, 1967).

Activities that Stimulate and Sustain Curiosity

Suchman (1961) did considerable research with Inquiry Training by which he hoped to help children build skills for autonomous discovery. He described the value of his ideas about autonomous discovery in these words:

> Concepts are the most meaningful, are retained the longest, and are most available for future thinking, when the learner actively gathers and processes data from which the concepts emerge. This is true (a) because the experience of data gathering (exploration, manipulation, experimentation, etc.) is intrinsically rewarding; (b) because discovery strengthens the child's faith in the

> regularity of the universe which enables him to pursue causal relationships under highly frustrating conditions; (c) because discovery builds self-confidence which encourages the child to make creative intuitive leaps; and (d) because practice in the use of logical inductive processes involved in discovery strengthens and extends these cognitive skills. (Suchman, 1961, p. 148).

Discovery-oriented activities designed to help infants learn were the concern of Gordon (1968) and his associates. In the Florida Parent Education Project, they explored ways parents in limited socio-economic environments could help their babies begin to learn. As part of this study, well-known infant-parent games were tested and new ones were devised. Their purpose was two-fold: (1) to provide fun, interest and learning experiences for the infants, and (2) to make the experience of playing with their infants satisfying to the parents so that they would continue to seek their own ways of relating to them. Another important aim of the parent education project was to foster a happy attitude toward exploratory activity. One outgrowth of the Florida project was the publication of Baby Learning Through Baby Play (Gordon, 1970), a book in which parent-child activities for various stages of development are described. A sample listing of these activities follows:

> Games for the early months: Dialogue, repeating the sounds the infant makes; Tracking, games in which the infant follows objects visually; Gotcha, games in which the infant is encouraged to grasp.
>
> Games for the Sitting Baby: Two-Way Stretch, in which the child's effort pulls a toy on an elastic band nearer to him; The Rattle Rides Again, the sound of the rattle encourages the sitting baby to twist and turn his body to see it and grasp it; Man in Space, stacking, knock-down and fitting of objects; Rhythm and Finger Plays, all the old favorites, Pat-A-Cake, This Little Pig, Beehive, and Hickory-Dickory-Dock.
>
> Games for the Creeper-Crawler: Fetch, the baby crawls after balls and other household objects; Fill'er Up, a new

> Space game of putting things in and taking them out of containers; Searching Games, single and double barrier hiding; The Supermarket School, talking your way through, letting baby help by taking things and putting them down in the cart.
>
> Activities for the Stander and Toddler: Knock-the-Bunny-Off, a toy is placed on a corner of the play pen a few steps from the stander, he is encouraged to knock it off, Father retrieves, ad infinitum. . .; Who Do You Know?, recognizing family members by name and by voice; Reading Readiness, magazine play.
>
> Activities for the Older Toddler: The Old Shell Game, with different sized cans and a small toy; The Child's First Picture Books; Naming body parts and body actions; push-pull toys; and Make Believe, the beginning of dramatic play.

In her study of kindergarten children, Waring (1971) found that freedom to structure their own play resulted in the children spontaneously evolving a great number of creative game activities. These games began as the exploratory play of individual children and grew into varied and complex social forms of play. They were an excellent example of both self-directive and discovery-oriented learning. One example of this type of activity was the following:

> Touch Game: One of the simplest forms of a group game recorded, and a good representative game, was developed soon after the opening of a term by two small girls of about four and a half and five. Ruth and Ilene each took upon her lap a chest of cloth materials. Ilene called a third child, Ivan, from nearby and told him to stand between them, close his eyes, and feel a piece of cloth from her box. Then Ilene closed her box and told Ivan to find one that felt like it in Ruth's box. Ivan felt in every drawer until he came upon the right one. "Just right!" exclaimed both the girls. "What is it?" asked Ilene. "Velvet," replied Ivan. Another "Just right," was his reward. Thereupon Ivan ran to get Fred and by the close of Fred's turn several others appeared for turns. Sometimes a child was unsuccessful and had to "feel again" and the rule developed that if he remained unsuccessful for three times, either in matching or in naming, he tried with his eyes. (Waring, 1971, pp. 35-36).

In their use of the Froebellian and Montessori materials, the children developed other creative games which involved the use of color, form and dimension, and numbers and letters.

The activities described above are focused on the perceptual curiosity of the young child--the sensory-motor discriminations and exercises that excite the efforts of the young child and motivate the psychosocial growth which facilitates their practice. Beyond this, there need to be ways of channeling curiosity into the more powerful intellectual pursuits. In this regard, Waring (1964) also pointed out the need for all self-educative activities to (1) bring satisfaction now, (2) to continue to bring satisfaction and (3) to lead-on to other satisfying experiences.

> Note that "the leading on" process has two routes. The child finds new materials with which to continue the activity, or he finds new activities for the same materials.
>
> How can an adult facilitate both kinds of exploring and discovering? By enriching the child's environment, both personal-social and impersonal-material. She can respect his activity per se, particularly his exploring activity. She can approve his exploring efforts in the direction of new materials and new activities. She can approve in ways that bring optimum meaning to the discoveries he makes. (Waring, 1964, p. 3).

All self-educative activities imply a quest for knowledge, and this knowledge is procurred by means of information-gathering and information-storing processes. The significance of these processes for the young child has been described by Waring (1971).

> All reflective thinking centers around a problem. The child begins very early to set himself small problems. His eternal "why?" shows that every experience is beginning to denote a problem. When once that little word "because" gets a sane footing in his mind, there is nothing that seems unsurmountable to it. Once the child begins to relate his experiences as cause and effect, his question box is opened up for good and all. All of his sense experiences now come into fuller and richer meaning. He applies his "how" and "why" and What makes it" to each and every one. . .
>
> Many teachers fail to utilize the (child's love of a) problem on its native ground, as thought activity per se, where it is purely a mental romp, a game in which the child may say with delight at the end "Just right" with as much assurance as in any material game.

> It was a revelation to discover the joy which children take in thinking out problems on the level of their solution. Children are pleased to learn facts about their environment--that is why they ask questions so steadily; but they are vastly more pleased if some one just starts them to thinking on the right line so that they DISCOVER facts for themselves. It is a mistake to tell a child what his own thinking effort can discover with the means at hand. . . It is the process of thinking and associating to which his effort is directed, and not to offhand facts which may be given him. Therein is the helpful function in helping him to think attentively, definitely and logically, i.e., from like to like, from cause to effect, etc. . . from the childish puzzle of "Guess what," grow four general types of thought problems which shade into each other so closely that no exact definitions are possible. They may be roughly described as two kinds of "How many" puzzles and two kinds of "And then what" puzzles. The gradation runs, puzzle problems, enumerative problems, summary problems, serial or process problems and source problems. (Waring, 1971, pp. 151-152).

The following are some of the children's questions for each of the five thought problems described above:

(1) Puzzle Problems: I'm thinking of something that grows on a tree; it's red and has black seeds. Or, I'm thinking of something that grows on a tree; outside it's hard and brown, inside it's good to eat.

(2) Enumerative Problems: I'm thinking of all the things we saw flying. What were they? Or, How many things can you think of that have four legs? How many things crawl?

(3) Summary Problems: Let's think of all the things we know about the wind; how many kinds of things can the wind do? How many things can the wind make go? How does the wind help the farmer? What do people do when the cold wind blows?

(4) Serial or Process Problem: How did the sea shells get on the beach? How are sheep sheared? How are cup cakes made?

(5) Source Problems: Where does the bean come from? What becomes of the water when a storm floods the street? If all the rain in the clouds should fall, where would new rain clouds come from?

Later, as the children became curious about "symbols about symbols"--numerals and the alphabet--the spontaneously devised play-games with which they practiced and extended what they learned increased to include such symbols. Waring (1971) described a series of number games invented by the kindergarten children.

> Among our Montessori materials was one set of black sandpaper figures mounted on cards. The children early asked for more in order to play games, and several additional sets were made of sandpaper, or crayola, and of cut-out figures from large calendars. The simple games produced were:
>
> 1. Matching a figure held up by the leader, from the assortment laid out in the center of the ring.
>
> 2. Matching in the right order two figures held by the leader, one in each hand, such as a 2 and a 1, as either 21 or 12.
>
> 3. One day a leader asked me to write a number on the board and see how fast they could match the written number. (This proved great fun.)
>
> 4. When two figures were matched the rule developed, "You must see both figures before you leave your place." This rule made the attention very alert and it avoided confusion.
>
> 5. One day Billy surprised the group by going to the board and writing figures. They were intelligible enough to be matched by the group. The children could scarcely wait for turns, so eager were they when they discovered that they were able to write figures well enough to be matched in the game. . .
>
> All this time the games had been entirely for the game activity, but at this point arose a distinct interest in the names of numbers. . . the directions came verbally. (Waring, 1971, pp. 40-41)

Strategies for the encouraging of curiosity have been suggested by Williams (1970) in his booklet on Classroom Ideas for Encouraging Thinking and Feeling. He described strategies for use with elementary-aged children but which might be adapted for younger children. These strategies included the following: (1) Paradoxes: Jamey left a pail of water in the sand box yesterday, and this morning we found a pail of

ice. (2) Analogies: What do you know that is shaped like a doughnut? How are cats and dogs alike? (3) Discrepancies: Why didn't Polly's seed come up? How are cats and dogs different? (4) Provocative Questions: What is big to you? What is big to an elephant? If you were a dog, what kind of a dog would you want to be? How many uses can you think of for a hole? (5) Discovery Questions: What kinds of things will a magnet pick up? What kind of things float? Does the puzzle piece fit?

In the preface of the booklet, Classroom Ideas for Encouraging Thinking and Feeling, Williams (1970) described the children who continue to develop their creative potential.

> They are the more fortunate pupils who have courage to be bold risk takers by venturing past the edges of the known and the familiar. They are curious and inquisitive about many possibilities and other alternatives rather than dealing with absolutes and permanencies. These are children who learn early to use their imaginations in order to reach beyond artificial or limited boundaries and are willing to delve into the complexities of open-ended problems, situations, or questions. (Williams, 1970, p. 1).

Summary

Research studies included in this chapter were selected to focus upon the curiosity behaviors of the young child and to evaluate the effect of environmental factors in stimulating and sustaining those behaviors. Particular emphasis was given to research designs and to those materials and methods of education which might be used in further research in the curiosity of the young child.

Behaviors that Show Curiosity in the Young Child

Behaviors showing curiosity in the young child were predominantly sensory-motor in nature. Visual fixation and manipulatory activities were commonly studied behaviors. Vocalization in the infant was shown to be related to attention patterns, and, in early childhood, question-asking served as a measure of epistemic curiosity.

The characteristic of stimuli that most frequently elicited curiosity behaviors was novelty. Some modification of the novelty-familiarity variable was a factor in most stimuli which evoked exploratory behaviors. The curiosity of the very young infant was piqued by a degree of physical novelty such as produced by design contour and movement; later in infancy, attention was riveted by a discrepant (or slightly novel) stimuli; and finally, late in the first year, curiosity was concentrated on stimuli that elicited many cognitive hypotheses in explanation of their apparent novelty. In early childhood combinations of the three modifications of novelty affected the incidence and duration of curious behaviors.

Impersonal-Material Environments

In the experimental work on impersonal-material environments, the most pertinent studies seemed to be those concerned with play materials and materials for self-directed learning. Both exploratory play and play that is repetitive and adaptive were considered as self-directed learning activities. Exploratory play elicited sensory-motor usages of play materials, and repetitive and adaptive play elicited representative, constructive and dramatic usages of materials.

Criteria for the selection of play materials and for the planning of self-directed learning environments was followed by the listing of actual materials which have stimulated curiosity and interest in the learning of young children.

Personal-Social Environments

The optimum personal-social environment of the child was shown to provide the personal security and social stimulation needed for openness and interest in learning. The adult can provide security and by his approval encourage curiosity, but his role must be wisely restrained if the child is to be allowed the autonomy and self-direction necessary for continuing self-motivated education. Different learning strategies--parent-infant play, creative games, problem puzzles and various methods of discovery-oriented learning--provide for structure and direction, yet give choices and provide alternatives so that the child can use his curiosity in exploring and understanding his world.

CHAPTER IV

GENERALIZATIONS AND IMPLICATIONS

Generalizations

From the literature, it is possible to isolate several ideas about curiosity--ideas concerning which there is considerable agreement among scientists.

(1) There is a pervasive relationship between curiosity and learning. The human organism needs, seeks and processes information, and curiosity reflects the nature of his functioning in these activities. (Fowler, 1965). Curiosity is defined as knowledge-seeking and knowledge-storing. (Berlyne, 1960). The motives of interest and curiosity are inherent in intelligent activities. (Piaget, 1945).

(2) Curiosity is a fundamental and dynamic motivation for learning. Curiosity is not dependent on other drives or motivations for its appearance in behaviors, but rather springs from the ceaseless neural activity of the brain itself. (Hebb, 1949; Lindsley, 1951; White, 1959). Curiosity is sensitive to internal states of arousal and to external stimulation from the environment. (Harlow, 1953; Lueba, 1955; Berlyne, 1957a, 1957b, 1960; Hunt, 1968).

(3) The rewards of curiosity are intrinsic and non-goal-oriented. They are contained in the behavior itself--pleasure comes to the organism when complexities <u>are being</u> absorbed, when novelty <u>is</u>

being explored, when discrepancies are being noted and when meaning is being selected from the alternatives available in the stored experience. (White, 1959; Fowler, 1965; Bruner, 1966).

(4) The development of curiosity depends upon the nature of the interaction between the child and the environment. Change in circumstances is required for the development of the earliest acquired schemas of the infant. (Piaget, 1936). A rich diet of sensory inputs during early childhood from the environment stimulates language acquisition and conceptual organization. By the end of early childhood the nature of the child's interactions with his world should have helped him resolve some of his early confusions about space, time and number and should have given him confidence in his ability to understand more about himself, others and the universe around him. (Dennis and Dennis, 1936; Wellman, 1940; Goldfarb, 1943; Spitz, 1949; Bruner, 1959; Dennis, 1960; Waring, 1964, 1971; Dennis and Sayegh, 1965; Getzels, 1966; Schermann, 1966; Gardner, 1967; Gordon, 1967; Sutton-Smith, 1967a and 1967b; Hunt, 1968).

(5) For curiosity to continue to serve as a motivation for learning, there must be a progressive "matching" of the internal and the external experience. It is the discrepancy or incongruity, the slight difference, the new in the old which alerts the cognitive search. Because each child is a unique individual with a unique experiential background, it is difficult, if not impossible, to arrange such matches entirely from the outside. Therefore, those educational systems which allow the child the freedom necessary to locate his own growing edge are recommended by many educators. Pestalozzi and Froebel encouraged this freedom for young children. Methods which allow the

child an element of choice in determining the nature and pace of his learning are referred to as self-selective, self-motivated, self-directive or autonomous learning arrangements.

(6) There is a need to keep curiosity alive in early childhood; to allow it to develop into interest in more advanced intellectual pursuits. The will to learn must be joined by the joy of achieving competence. The child must be helped to trust his world, to discover the constancies in his life space, and to extend and refine his conceptual hierarchies. Learning models suggested to encourage curiosity in more advanced forms of cognitive activity include Creative Game Activities, Problem Games, Discovery Learning, Inquiry Learning and Inductive Learning. (Erikson, 1950; White, 1959; Suchman, 1961; Holt, 1964; Bruner, 1966; Bettelheim, 1967; Moore, 1967; Williams, 1970; Waring, 1971).

Implications

Interest in an intensive study of curiosity has been prompted by a belief in the inseparable relationship of curiosity to cognitive functioning and to self-directive learning. These relationships suggest (1) that an intensive study of curiosity should contribute to our understanding of cognitive functioning and self-directive learning, and (2) that it should also contribute to the development of methods of diagnosing or pinpointing the specific problems of children who are exhibiting difficulties in cognitive functioning or self-directive learning, and (3) that it should also contribute to the development of remedial methods for helping these children overcome the problems with which they are faced.

The Need for Understanding

In studies of underprivileged and culturally different children, there has been evidence of a rigidity in cognitive functioning. Some children do not develop a pattern of cognitive functioning which allows them to respond successfully to educational programs. This was apparent in the evaluation of Headstart. Educators were puzzled, and continue to be puzzled, by the fact that these programs had little measureable success in improving the cognitive functioning of severely disadvantaged children. This problem led many researchers to focus on early cognitive development in an effort to gain a better understanding of what happens during the first few years of life, and why, for disadvantaged children, it is so difficult to stimulate this type of development at a later age. An intensive study of curiosity, combined with current research efforts, should contribute to the solution of these problems.

Diagnosing Problems

The diagnosing or pinpointing of special problems is dependent upon the development of carefully designed research instruments, and among these there must be an instrument for the measurement of curiosity. A possible design for such an instrument can be found in the work of Waring (1971). She was able to isolate four basic steps in self-directive learning--Exploration, Discovery, Repetition and Adaptation--and was able to categorize children's spontaneous responses to stimuli under these four headings. Several theses are suggested by these steps: They are basic behaviors denoting curiosity; they are

basic behaviors used by all individuals in all self-motivated learning, and they are ordinal in character.

A fairly clear parallel can be drawn between Waring's four steps in self-directive learning and Piaget's stages of sensorimotor learning in infancy. Exploration, discovery and repetition parallel the first stages in sensorimotor learning in which the infant visually explores his world, discovers or acquires new action patterns (schemas) which happen to produce interesting results, and repeats or prolongs interesting events; and adaptation is seen in the young infant's behavior when he is able to adapt familiar schemas to new situations and is able to invent new behavior patterns. Thus, Piaget's stages in infancy, explicitly described as ordinal scales by Hunt and Uzgiris (1971), provide another dimension for the research framework which may serve to guide the development of an instrument for the measurement of curiosity.

Remedial Methods

From the summary of ideas about curiosity and its nurture, two seemingly paradoxical priorities for educative practice emerge. (1) There is a need for early education to provide responsive open environments in which the child can be the initiator of his learning process, can be free to find his own level of cognitive action and continue to learn with approval. The child needs adults who will listen to his questions and then give him only as much direction as will allow him to discover the answers for himself. (2) There is a need for early education to provide responsible environments, with elements of protective structure that free the child within them

from harmful insecurities and excesses of autonomy. The child needs adults who will provide rich and rewarding environments and guide him in his search for the order and meaning in life that sustain his desire to learn.

The problem of knowing how to balance the responsive and the responsible elements of the educational environment is part of the problem that faces early childhood education. Surely, the balance would not be the same for every program. With an integrated understanding of sequential cognitive development and the instruments to pinpoint the areas of difficulty, remedial efforts could be tailored to meet the needs of specific children.

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