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ABSTRACT

This review of the literature on the development of young children's curiosity is directed specifically toward teachers and other practitioners and emphasizes what socialization agents can do to influence children's curiosity. Gaps in current knowledge about children's curiosity and implications of research findings are discussed. Theoretical perspectives on children's curiosity, including trait, perceptual, mastery motivational, learning, cognitive and ethological theories, are briefly delineated. Developmental and situational factors related to curiosity are pointed out and individual differences among children's expressions of curiosity are probed. Correlates of curiosity, including intelligence, play, creativity, authoritarianism, anxiety and self-concept, are examined. The influence of situation and setting variations on curiosity, such as maternal absence, environmental deprivation, the presence of strangers, educational programs, group size, the opportunity to manipulate objects and object novelty, are reported. Findings show that adults can be instrumental in fostering and maintaining children's curiosity by being attentive, sensitive, and supportive of children's needs to explore, by answering children's questions informatively, and by displaying the positive characteristics of curious people. Areas for further research are indicated. (Author/BH)

DEVELOPING YOUNG CHILDREN'S CURIOSITY: A REVIEW OF RESEARCH WITH IMPLICATIONS FOR TEACHERS

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Young children spend many of their waking hours investigating, manipulating, inspecting, and asking questions about objects and events--behaviors commonly referred to as curiosity. Theorists have speculated that these displays of curiosity are the foundations of more complex behaviors (e.g., reasoning, problem-solving, social competence) that begin in infancy and continue to develop in later years (Berlyne, 1970; Miller & Dyer, 1975; White, 1959). As a result, an increasing amount of empirical work has been conducted and reviewed on children's curiosity since the early 60's (Berlyne, 1960, 1963, 1966; Cantor, 1963; Hutt, 1970; Nunnally & Lemond, 1973). These reviews have focused primarily on the cognitive and motivational processes that are presumed to underlie children's expressions of curiosity. However, none of these reviews has concentrated on individual differences associated with curiosity development and none has presented the growing evidence for how curiosity might be fostered or inhibited by social agents.

Finally, with few exceptions (Berlyne, 1965; Day & Berlyne, 1971), these reviews have not attempted to integrate theory and research information on children's curiosity for a non-research audience. In general, the importance of bridging the information gap between developmental researchers and teachers of young children has been emphasized by Hartup (1967). More specific to the area of children's curiosity, McCandless (1967) believes that familiarity with current research on curiosity could make teachers more aware of children's needs to explore, inquire, and seek novelty and could result in more innovative classroom practices.

Thus, the first purpose of the present paper is to develop a comprehensive review of the curiosity research specifically for teachers and other practitioners that emphasizes what socialization agents can do to influence children's curiosity. Second, and perhaps more important, gaps in the present curiosity

and implications based on what we know (as well as what we don't know about children's curiosity will be considered.

WHAT IS CURIOSITY?

Both teachers and researchers would generally agree that young children spend a great deal of time and effort engaging in activities to which the term "curiosity" seems applicable. However, if we were to ask them what, specifically, curiosity means, we would probably get many diverse answers that range from the teacher's experiential insights to the researcher's theoretical explanations. Therefore, to help us arrive at some common base for discussion, it first seems appropriate to look at one description of the curious child with which most people would agree. Then, we will briefly overview some theories that seek to explain both why children are curious and the significance of curiosity for other aspects of development.

It is not our intent to overload the reader with a group of complex, seemingly unrelated explanations of curiosity. However, we think that teachers who work with children on a day-to-day basis will want to borrow from several theoretical orientations as they attempt to explain the curiosity behavior of their children.

What Is A Curious Child?

Regardless of their theoretical orientations, most people would agree that a curious child is one who (Berlyne, 1960; Day, 1971; Maw & Maw, 1961):

> Reacts positively to new, strange, incongruous, or mysterious elements in the environment by focusing attention on them, moving toward them, manipulating them, and/or seeking information about them. For example, a child who spots a frog hopping across the playground might react by first following the frog, then picking it up and examining it, and finally asking the teacher questions about it.

Persists in examining and exploring stimuli in order to know more about them. For example, the young child above might continue to question his teacher about frogs and perhaps other animals until he understands them more fully. Further, if he has the skills, he might read about frogs until he has obtained enough information to satisfy his curiosity.

Why Are Children Curious? Theoretical Perspectives on Children's Curiosity

In general, theories attempt to describe, explain, and predict observable phenomena. More specifically, theories of curiosity attempt to describe, explain, and predict why children are curious. In this section we will present several theoretical perspectives on curiosity. These theories are not necessarily competing explanations of why children are curious; however, they do differ somewhat in their primary emphases and the ages of children with which they deal.

Trait theories. Perhaps the simplest explanation of why children are curious is to assume that they possess a curiosity trait that is a relatively stable personality disposition to explore, inquire, and generally seek information in all or most situations. No attempt is made to explain the origin or nature of that behavior; rather, trait theorists concentrate on linking the curiosity "trait" to other personality traits or using curiosity to explain and predict other behaviors such as creativity or self-concept (Maw & Maw, 1970a, 1970b).

Perceptual theories. Another group of theorists (e.g., Berlyne, 1960; Piaget, 1950) have hypothesized that curiosity is influenced by the attributes of objects, people, and/or places in the child's immediate environment that s/he perceives as new, surprising, incongruous, or complex. As the child encounters stimuli containing these properties, s/he explores them to relieve the perceptual conflict they arouse. For example, the first author's eight-year-old daughter recently found a model of a Centaur, the mythical

animal with a man's head and a horse's body, in a department store. She obviously found it quite strange: she examined it for several minutes then finally asked her mother several questions about it. The answers to the questions apparently did not satisfy her because when she returned home she attempted to obtain more information about it, first in a book of horses and later in the encyclopedia.

Mastery motivational theories. This approach ascribes to children the need to master their environment, and curiosity is seen as one of several ways in which mastery can be accomplished (White, 1959). From this perspective exploration is viewed as the core of early childhood experience: given a safe environment with many things to explore, children will express their curiosity in many ways because they derive pleasure from the mastery, learning, and feeling of competence that results from their explorations (Piaget, 1950; White, 1959).

Learning theories. This theoretical orientation stresses the role of learning on curiosity development. While this orientation is in itself quite diverse (e.g., Berlyne, 1960; Bijou, 1976; Szxe & Stollack, 1971), there is general recognition of the role that socialization agents play in shaping children's curiosity behavior through modeling and the provision of external incentives such as praise, providing answers to questions, or school grades.

Cognitive theories. This orientation stresses how children come to reason and transform information in order to solve problems in new and efficient ways as they mature cognitively (e.g., Berlyne, 1970; Mosher & Hornsby, 1966; Suchman, 1961). Implied here is an emphasis on the more sophisticated problem-solving strategies acquired by older children. For example, when children play the "Twenty-Questions" game they generally follow one of two strategies (Mosher & Hornsby, 1966). The first involves a series of

guesses at the right answer, while the second involves asking questions that progressively and systematically narrow down the range of possibilities. Generally, as children get older they begin to ask this second type of question more often and engage in less guessing.

Ethological theories. Generally, ethologists study animals' biological adaptiveness to the natural ecology (Ainsworth & Bell, 1970). However, increasingly the study of ethology is being applied to children. More specific to the area of children's curiosity, ethologists view exploration as biologically adaptive behavior that must be learned for survival. That is, the genetic bias of a species is said to lead the infant to venture away from his/her mother, thereby promoting the acquisition of knowledge needed for survival (Ainsworth & Bell, 1970; Rheingold & Eckerman, 1970).

Implications. The underlying assumption of each of these theoretical orientations is that curiosity is important for the overall development of the young child. More specifically, curiosity is viewed as a prerequisite to learning, reasoning, problem-solving, and/or functioning as a competent, self-sufficient human being. Thus, to the extent that curiosity is important in development, teachers should facilitate curiosity by making nursery and elementary school classrooms interesting places to spend the day and by providing many opportunities for children to explore and inquire about the aspects of their world that interest them. (The evidence for how teachers can best facilitate curiosity will be presented in subsequent sections.) This may be a difficult task for teachers who are usually charged with the care and learning of more children than they can comfortably handle. However, the authors believe that in the long run this will be a worthwhile and rewarding task for both teachers and their children.

Is Curiosity Developmental?

With few exceptions (Nunnally & Lemond, 1973; Piaget, 1950) the aforementioned theories have not been particularly concerned with the development of curiosity. However, while there is little empirical evidence to support the following claim, curiosity can be viewed as proceeding developmentally on at least two dimensions: Over the life span and within a given situation (Werner, 1957). Before discussing how curiosity proceeds on each of these time perspectives, it should be noted that theories tend to focus on only one of these perspectives at the expense of the other. However, we think that teachers can profit by keeping both developmental perspectives in mind.

Life span development of curiosity. As teachers and researchers we are all aware that children become increasingly more sophisticated in the ways that they are able to express their curiosity as they mature. For example, in the first few months of life, infants can explore only by attending to objects or persons that are in their direct visual field. Later, they begin to use their eyes more systematically in scanning their environments (Spitzer, 1977). As they gain control over their body movements, they start to explore by moving toward persons and objects that interest them. Language and the ability to ask questions also begin to develop rapidly at this time (Spitzer, 1977).

Finally, as children apprpach the preschool, and later the elementary school years, they become even more skillful in the ways that they are able to gain access to information. They can scan their surroundings, move toward stimuli that interest them, touch, and consult with adults and other "experts," ask rather complicated questions and/or obtain information from books and other resources. Thus, children develop the potential of expressing their curiosity in more ways or combinations of ways as they get older. Further,

the ways in which they can express their curiosity appear to become more internalized and less dependent on immediate environmental stimulation (Nunnally & Lemond, 1973; Spitzer, 1977).

Situational development of curiosity. Curiosity can also be thought of as proceeding developmentally within a given situation. More specifically, it has been hypothesized that whenever a child encounters a new or interesting object, person, or situation, a fairly invariant sequence of curiosity behavior will occur as follows (Hutt, 1970; Nunnally & Lemond, 1973; Weisler & McCall, 1976):

The child

1. looks at or attends to a new stimulus;
2. moves toward the new stimulus;
3. manipulates the new stimulus;
4. seeks to integrate information cognitively by asking questions about the stimulus and/or consulting other sources about it;
5. plays with the stimulus as it becomes more familiar (see subsequent section on the relationship between curiosity and play); and finally
6. becomes bored with the stimulus.

Further, any portion of this sequence can be shortened or lengthened as a function of the child's age and/or interest in the stimulus (Nunnally & Lemond, 1973). For example, a toddler might spend more time manipulating an interesting object than asking questions about it. On the other hand, an elementary school child might spend less time manipulating an interesting object and more time asking questions or obtaining information about it from books.

Implications. Translating the preceding into actual classroom practice, good teachers know that optimal learning depends on a proper "match" between children's developmental or readiness levels and the objects they encounter (Hunt, 1961; Piaget, 1950). Therefore, as teachers organize the classroom

environment to induce curiosity behaviors in their children, they must first be aware of age related limits on children's curiosity behavior. More specifically, a child may not learn through his/her expressions of curiosity because s/he is not old enough or has not developed the prerequisite skills to extract the necessary information from the situation. For example, a child who cannot read will not have his/her curiosity satisfied by being provided with a book. Second, teachers must be aware of individual children's abilities that allow them to express their curiosity in rather diverse ways in specific situations. That is, a child who has the ability to express his/her curiosity in certain ways may not do so because s/he is bored with the objects that the teacher has provided.

ARE THERE INDIVIDUAL DIFFERENCES AMONG CHILDREN'S EXPRESSIONS OF CURIOSITY?

Evidence

Evidence can be obtained from almost any study to show that just as children vary physically and intellectually, they also vary in the amount of curiosity they display (Day & Berlyne, 1971). For example, a number of studies show that there is considerable variability among 10-month-old infants both in their exploratory behavior and in their reactions to novel stimuli (e.g., Corter, 1976; Corter, Rheingold & Eckerman, 1972; Eckerman & Rheingold, 1974). In addition, studies of preschool children's question-asking behavior indicate that some children ask very few questions while others ask questions almost continuously during a short experimental session (e.g., Endsley & Clarey, 1975; Gumusgerdan, Note 1). This information will probably come as no surprise to teachers who have observed this type of variability among children in their classrooms from year to year.

Some theorists have hypothesized that same-aged children often differ considerably in the ways that they express their curiosity in any given situation, particularly as they approach the preschool and elementary school years and develop more sophisticated information-seeking and problem-solving strategies (Nunnally & Lemond, 1973). Children that seemingly touch and ask questions about every new thing they encounter can be described as having more overt information seeking styles (Day & Berlyne, 1971). In the same situation other children have a more internalized or covert style of obtaining information; they sit and cogitate, try to work out solutions to games and problems on their own, or quietly seek information from books (Day & Berlyne, 1971).[1]

Teachers often have difficulty determining whether children are curious because, on the one hand, the first type of child may be bombarding the teacher with questions to satisfy his/her curiosity or simply because s/he wants to maintain a dependency-like contact with the teacher. On the other hand, the second type of child is often so quiet and unobtrusive that it is difficult to tell whether s/he is involved in obtaining information or engaging in other processes (e.g., daydreaming).

Further, although the results are far from consistent, investigators have suggested that there may be sex differences in the ways that same-aged children express their curiosity. For example, a few infant studies have shown that boys are generally less reluctant to leave their mothers and explore objects and toys than are girls (Fagot, 1974; Goldberg & Lewis, 1969). However,

[1]It would be interesting to know whether these individual differences among children's expressions of curiosity are related to hypothesized individual differences in conceptual tempo or problem-solving style (i.e., impulsivity-reflectivity) discussed by Kagan (1965) and Wright and Vlietstra (1975). However, with only one exception (Logan, Note 2) that provided rather inconclusive findings, the area of children's curiosity has not been empirically linked to conceptual tempo.

it has been suggested that the nature of the objects which boys and girls prefer to explore might account for this difference. That is, perhaps girls prefer to explore toys with faces or objects that are more social in nature while boys prefer to explore fixtures and non-social toys and objects (Goldberg & Lewis, 1969; Lewis, Kagan & Kalafat, 1966).

Sex differences among same-aged elementary school children's exploratory behavior might also result from restrictions that adults impose on exploration. It has been suggested that boys explore more than girls when permission to explore is not explicitly given by adults, whereas boys and girls explore equally when permission to explore has been given by adults (Coie, 1974).

Implications

Among children of the same age, some are like "Curious George" the rascal storybook monkey who always gets "into trouble" in the process of satisfying his curiosity. These children are always touching, asking questions, and exploring places and things--sometimes to the teacher's dismay. Other children satisfy their curiosity in more quiet ways by independently examining objects or obtaining information from resources that are available to them. Still other children appear not to exhibit any curiosity, perhaps because they have been punished for past exploratory behavior.

This variability among same-aged children may be linked to genetic differences and/or the ways in which children have learned to relate to other people or situations. In any case, teachers who are aware of these suspected individual differences can more skillfully provide experiences that will enhance the curiosity development of each child. For example, teachers might make a wider variety of activities and materials available for children to explore. In this way, boys and girls whose curiosity is best

satisfied by manipulating concrete objects can be provided with an interesting variety of these objects, perhaps followed by a question and answer session concerning these objects. On the other hand, children whose curiosity is best satisfied by obtaining information independently through books and other resources can be provided with these resources and allowed to work alone (thus freeing the teacher to work with other children). Further, teachers might make it clear to their children that curiosity behaviors are, within limits, valued and sanctioned in the classroom.

WHAT ARE THE CORRELATES OF CURIOSITY?

In this section we will attempt to establish how curiosity is related to other constructs that teachers also consider important for the development of the young child.

What Is The Relationship Between Curiosity and Intelligence?

Teachers (and other people) often assume that children who are more curious are also more intelligent. Perhaps this assumption is made because curious children are often more motivated to achieve, alert, attentive, and interested in the things that are going on around them (Day & Berlyne, 1971). However, with the exception of only one study that compared the curiosity behavior of normal and mentally retarded preschool children (Richman, Kahle & Rutland, 1972), the findings using normal children ranging from first through fifth grade consistently show that there is little or no relationship between curiosity and intelligence test scores (Coie, 1974; Day, 1968; Maw & Maw, 1961; Penney & McCann, 1964).

The one discrepant finding by Richman et al. (1972) may have been due to the wide intelligence range sampled, or to the younger age of the sample

as compared to the sample in the remaining studies. It is generally known that intelligence tests measure different cognitive attributes at different ages (McCandless, 1967; McCandless & Evans, 1973). For example, infant intelligence tests typically measure sensorimotor alertness to the environment or social responsiveness toward an adult (e.g., Bayley, 1965; Cattell, 1940; Gesell & Amatruda, 1941) and preschool intelligence tests typically measure task persistence (McCandless, 1967). Each of these two classes of behaviors is often considered to be more related to curiosity (see previous section, What Is a Curious Child?) than is convergent problem-solving ability which is generally measured in elementary school intelligence tests (McCandless, 1967; McCandless & Evans, 1973).

In any case, teachers should not be too quick to assume that their more curious children are also their most intelligent (and visa-versa). Perhaps the more curious children are simply more motivated to obtain information. Further, this motivation to obtain information may be a more important and powerful factor in learning among normal children than is intelligence Day & Berlyne, 1971).

What Is The Relationship Between Curiosity and Play?

Theorists and researchers have found it extremely troublesome to determine whether curiosity (exploration) and play are related or if they are two separate classes of behaviors (Berlyne, 1960, 1966; Hutt, 1970; Weisler & McCall, 1976). Almost every existing review article on the topics of curiosity and/or play begins with an apology for not being able to define and distinguish these two concepts objectively (Weisler & McCall, 1976). Further, the distinction is complicated by the existence of several types of play--imaginative play, games, dramatic play--some of which may be more related to exploratory behaviors

than are others. In any case, some theorists have hypothesized that curiosity is distinct from play in four ways:

1. The function of curiosity is seen as seeking specific information in a stimulus-rich environment, whereas the function of play is seen as seeking diversion or stimulation in a stimulus-poor (boring) environment (Berlyne, 1960; Hutt, 1966, 1970).

2. Curiosity is viewed as following a predictable sequence (looking, approaching, touching, inquiring), whereas play is viewed as following an unpredictable sequence (Hutt, 1970).

3. Children are said to be curious about novel or unfamiliar stimuli, whereas they are said to play with familiar stimuli (Hutt, 1970).

4. Some theorists have suggested that play follows curiosity in temporal order (Nunnally & Lemond, 1973). That is, when children encounter something new and interesting they explore (look, approach, touch, and inquire); then, as the stimulus becomes familiar, they play with it.

These distinctions between curiosity and play are basically theoretical and, with few exceptions (e.g., Hutt, 1966), have not been empirically tested by researchers. Thus, it may be premature to speculate about implications for teachers. Perhaps the most that can be said is that teachers should be aware that when children "play" with objects they may not necessarily be "exploring" those objects (visa-versa). The next time you observe a child examining objects or materials, you might ask yourself, "Is s/he playing or behaving curiously?"

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What Is The Relationship Between Curiosity and Creativity?

Creativity, the ability to find new solutions to a problem or new modes of artistic expression, is valued highly by most teachers. In order for children to be creative, they must first have the ability to recognize a good problem and tackle it in appropriate but novel ways. Further, they must have the motivation and persistence to tackle and complete problems having

novel, complex, and ambiguous elements (Day & Berlyne, 1971; Torrance, 1971). There are a few studies to show that highly curious elementary school children also score high on tests of creativity (Maw & Maw, Note 3, 1970a). Further, curiosity is often thought of as being a prerequisite condition for creativity (Day & Berlyne, 1971); however, there is no empirical evidence to support this claim.

Perhaps the most we can say is that if we, as people who work with young children, attempt to nurture either curiosity or creativity in any given situation, we will probably contribute to the development of both "attributes." Further, proponents of the "discovery method" of teaching have suggested that both curiosity and creative problem-solving can be aroused in nursery school as well as elementary school children by showing them a sequence of events that they have never seen before and that are inexplicable to them. For example, in informal contexts young children can discover by combining elements in novel ways how soapy water turns to bubbles or how cream turns to butter. In more formal contexts, science experiments can be introduced to spur curiosity and creativity. One example is a brass ball that is just small enough to slip through a ring, but after being heated expands and will not pass through the ring (Berlyne, 1965). In this and other experiments, the children are invited by the teacher to obtain an explanation of the problem by asking questions that relate to the outcome of the experiment.

What Is The Relationship Between Curiosity and Authoritarianism?

Recall that curious children are those that are aroused by and open to new, complex, ambiguous, and incongruent objects, people, and places (Berlyne, 1960; Maw & Maw, 1970a). In contrast to curious children, authoritarian children are said to be prejudiced toward people that are different from

themselves, intolerant of ambiguity, inflexible in their thinking, and resistant to new information (Adorno, Frenkel-Brunswik, Levinson & Sanford, 1950). Although there is only indirect empirical evidence that authoritarian children exhibit low levels of curiosity (Maw & Maw, 1970a), conceptually it would appear that these two attributes are negatively related.

Teachers who are aware of this relationship will be sensitized to the possibility that some children will be more resistant to novel and discrepant objects, information, situations or people than will others. Further, teachers will be better equipped to plan programs and activities that help these children gradually become more open to novelty, more flexible in their thinking, and more creative in their approaches to obtaining information and problem solving (see preceding section on the relationship between curiosity and creativity).

What Is The Relationship Between Curiosity and Anxiety?

The findings consistently show that highly anxious or nervous children exhibit the least exploratory behavior and interest in their environment. This relationship has been found among both preschool and elementary school children regardless of the means by which curiosity or anxiety was assessed (McReynolds, Acker & Pietila, 1961; Mendel, 1965; Penney, 1965). This relationship should be fairly obvious to teachers who intuitively know that children who are fearful, unhappy, or insecure will not venture out and explore their environment until they are made to feel more comfortable with their surroundings.

Perhaps teachers can help to make highly anxious children feel more secure and correspondingly more curious by making classroom environments as non-threatening as possible. For example, teachers might find that highly anxious children prefer to engage in simple tasks in which they can easily succeed (Sarason, 1960). Thus, teachers may need to increase the complexity

of tasks gradually as children begin to feel more successful. Further, teachers might also discover that highly anxious children feel less threatened in situations in which they work alone rather than in pairs (Sutter, Note 4). Teachers might need to work with these children on an individual basis and work up to small group instruction.

What Is The Relationship Between Curiosity and Self-Concept?

Mastery motivational theorists (e.g., White, 1959) have hypothesized that as children explore they learn that they have some control over their environment and correspondingly begin to develop more positive self-concepts. Consistent with this prediction, investigators working with both preschool and elementary school children (Maw & Maw, 1970b; Minuchin, 1971) have shown that children who exhibit the most curiosity also have the most positive self-concepts.

Perhaps children with low self-concepts do not exhibit much curiosity because they expect failure and avoid situations where failure might occur. Or, perhaps lacking curiosity and information-seeking skills, children fail to explore their environment and gain those experiences that will help them to develop better self-concepts (Maw & Maw, 1970b; Minuchin, 1971). Still a third explanation might be that those outside conditions that create low-curiosity also create low self-concepts (although we are not quite sure what these conditions are). In any case, teachers should be thinking of ways to increase the overall curiosity and self-concepts of their children since it is likely that children who are low on either of these behaviors will have problems in meeting the demands of school. For example, praise and other modes of reinforcement can often be used effectively by teachers to enhance each of these classes of behaviors (see upcoming section on how curiosity is influenced by reinforcement).

Implications

The findings presented in this section should make it increasingly clear to the reader that one reason that curiosity is an important construct is that it is related to so many other important aspects of development. Generally, we know from the research that a highly curious child is not necessarily more intelligent (at least as measured by conventional tests), but s/he is more creative, flexible, more secure about and interested in his/her environment, and has a better self-image. These attributes are also generally associated with a broader concept of social and intellectual competence in children (White, 1959). Thus, to the extent that a teacher has the time, energy, and inclination to guide her children's curiosity behaviors, she also may be contributing to many of the correlates of curiosity and vice-versa.

HOW IS CURIOSITY INFLUENCED BY VARIATIONS IN SITUATIONS AND SETTINGS?

As we mentioned previously, some theorists view curiosity as an enduring personality trait that remains relatively stable in a child in all or most situations (e.g., Maw & Maw, 1961). There is, however, considerable evidence to suggest that curiosity is a state that varies from situation to situation (e.g., Cox & Campbell, 1968; Endsley & Gupta, Note 5; Torrance, 1970a, 1970b). In the present portion of this paper we will review how some situations and settings influence children's curiosity.

How Do Long-Term Maternal Absence and Environmental Deprivation Effect Curiosity?

The animal literature provides us with many examples of the devastating effects on curiosity (not to mention other developmental aspects) that result

when infant monkeys are separated from their mothers and raised in isolation (Harlow & Harlow, 1966; Harlow & Zimmerman, 1959). When these monkeys are subsequently removed from isolation they show highly abnormal behaviors: they become irrationally fearful of other monkeys, people, and objects, and cling to their own bodies almost continuously. Depending upon the extent of the isolation period, and the care that they receive subsequent to their isolation, interest in exploring their environment and developing normal social relationships can sometimes be restored.

Although most children are not raised in the extreme isolation associated with laboratory animal studies, there is evidence to suggest that depriving humans of appropriate early maternal and sensory experiences also has a deleterious effect on development in general and curiosity behavior in particular. More specifically, observational studies of children who spend their first years in orphanages show that these children do not develop socially and (sometimes) physically (Bowlby, 1969; Spitz & Wolff, 1946; Provence & Lipton, 1962). That is, these children, like the young monkeys, begin to develop unusual behavior patterns beginning with continual crying and followed by apathy and detachment. This "social retardation" is generally attributed to the almost complete sensory deprivation of the institutional environment in which infants are placed in cribs where they stay all day except for feeding and toileting and where few opportunities to explore, or play with toys or people are provided.

A few studies have specifically examined the curiosity behavior of infants reared in institutions and compared it to the curiosity of children reared at home. In one of these studies (Rheingold, 1963) it was found that both institutional and home-reared babies engaged in visual and manual exploration equally often. However, while home-reared babies explored toys, institutional babies explored their hands, crib bars, bottle holders,

and clothing. However, in another study, somewhat contrary results were obtained (Collard, 1971). That is, it was found that institutional babies looked at, touched, mouthed, and showed less variety in the ways that they used a set of test toys than did both lower- and middle-class home-reared babies.

It is likely that the discrepant results from these two studies are partly a function of the ages of children involved. For example, in the first study (Rheingold, 1963) the children were only three to four months old. At this age, all children are interested in exploring their own hands and their immediate crib environment. The effect of institutionalization may not become obvious until children have developed the motor skills to explore the surroundings outside their crib and are restricted from doing so.

On the other hand, in the second study (Collard, 1971), the children were between 8 and 13 months old and could probably crawl and, in some cases, walk. Any of us who have worked with children at this age know that their own hands or crib bars would not hold their attention very long before they would need to venture out and find something more interesting to explore. Perhaps this is the age when the restrictiveness of an institutional environment begins to blunt exploratory behavior.

Further, the discrepant results obtained in these two studies could also be a function of the type of institution in which the children were reared. Unfortunately, too few details were provided about the literature to compare them. For example, we don't know whether the institutions provided comparable degrees of sensory stimulation for the infants, how much individual attention each child received each day, or the ratio of children to adults.

How Does Short-Term Maternal Absence Effect Curiosity?

Any nursery school teacher who has been through the experience of the

"first week of school" will know, without a doubt, how short-term maternal absence affects young children. Recall how some children leave their mothers with no problems while others cling to their security blankets, refuse to take part in activities, and/or sit in their lockers or "cubbyholes" and cry.

There is also considerable evidence from well controlled laboratory studies to show that the absence of the mother is associated with response decrements in exploratory behavior among 1- to 5-year-old children and that these responses abate when the mother returns (Ainsworth & Bell, 1970; Arsenian, 1943; Cox & Campbell, 1968; Gershaw & Schwartz, 1971; Gumusgerdan, Note 1). Further, it has been found that as children get older, similar but less intense effects are found (Cox & Campbell, 1968; Gershaw & Schwartz, 1971). Thus teachers who are more skillful at helping children make the transition from home to school will soon have children who will express their curiosity more freely.

How Is Curiosity Influenced By The Presence of Mother Versus Stranger?

Again, teachers are generally aware that not only the school situation in which the child is separated from his/her mother, but the "strange" adults in that situation affect children's willingness to explore. Several laboratory studies of children ranging from 1 to 5 years old also suggest that children manipulate toys more when their mothers as compared to strangers are present (e.g., Ainsworth & Bell, 1970; Gumusgerdan, Note 1). Thus, it seems likely that as "strangers" become more familiar, children will begin to feel more comfortable exploring their environment.

How Is Curiosity Influenced by Different Educational Programs?

Montessori preschool programs view the young child as naturally curious and eager to learn (Miller & Dyer, 1975). Other programs, however (e.g.,

DARCEE, Bereiter-Engelmann, and Traditional), assume that some young children have various motivational deficits such as lack of curiosity or persistence that must be remedied by the preschool situation before learning can proceed smoothly (Miller & Dyer, 1975).

Recently one group of investigators (Miller & Dyer, 1975) examined the exploratory and question-asking behavior of children enrolled in Montessori, DARCEE, Bereiter-Engelmann, and Traditional preschool programs, using a novel puzzle-like object called the "Curiosity Box." It was found that from pre-kindergarten through second grade, the greatest gains in curiosity development were made among children in Montessori and DARCEE programs which both stress carefully sequenced tasks, manipulation of objects, and highly academic content, but differ in more ways than they are alike. However, overall gains in curiosity were also found among children in Bereiter-Engelmann and Traditional programs. Thus, while there might be something special about Montessori and DARCEE preschool programs that facilitate children's curiosity behavior, it appears more likely that a stimulating and well-planned preschool experience coupled with sensitive interactions with teachers and peers, rather than the specific program philosophy, contributes to curiosity development in young children.

How Is Curiosity Influenced By Group Size?

Teachers often express an interest in knowing more about what the optimal group size is for inducing children to explore and ask questions about instructional materials. In one interesting study (Rabinowitz, Moely, Finkel & McClinton, 1975), it was found that preschool children explored a novel object more with a peer present than when they were alone. The children were exposed to a colorful structure of a clown driving a train engine. The clown contained several hidden switches and buttons that when activated would make a novel

sound or cause the clown's nose to light up. It was demonstrated that pairs of children more frequently explored and found the hidden switches that could activate the novel aspects of the clown than did children who were exposed to the clown alone.

On the other hand, there is now some research to show that as nursery school and kindergarten group size increases from two to 24, the number of questions generated by the group decreases (Endsley & Gupta, Note 5; Torrance, 1970b). Further, it has been found that among nursery school and first grade children, the most questions are asked when a child is in a one-to-one relationship with an adult (Endsley & Gupta, Note 5; Stallings, 1975). Thus, it seems safe to say that to elicit the most questions about a set of materials, at least among 3- to 7-year-old children, the smaller the group the better.

How Is Curiosity Influenced By the Opportunity To Manipulate Objects?

Teachers (particularly those trained to teach Montessori and DARCEE curricula--Miller & Dyer, 1975) have long been convinced that providing children with three-dimensional objects to manipulate will enhance their interest and curiosity about those objects. There is now some evidence to show that, in fact, children do ask more questions about three-dimensional objects that they are allowed to touch as compared to those that they are not allowed to touch (Endsley, Note 6; Torrance, 1970a). Further, there is evidence to show that providing children with three-dimensional objects that they can touch elicits more questioning than providing them with two-dimensional photographs of those objects (Endsley, Note 6). Thus, it seems that question-asking among preschool and kindergarten children can be maximized by providing them with manipulatable objects.

How Does Object Novelty Effect Curiosity?

Studies that have considered the effect of toy or object novelty on children's curiosity consistently show that children explore more when provided with novel objects. For example, in one infant study (Corter, 1973) it was found that infants placed in an empty unfamiliar room followed their mothers with little delay. However, infants placed in a room with one or more toys explored those toys for several minutes without following their mothers. Further, infants who were exposed to toys for the first time followed their mothers later, played more, and cried less than did infants who had previously been exposed to the same toy. Similarly, in a study using preschool children (Mendel, 1965), children were familiarized with certain toys and then offered a selection from sets containing different proportions of novel and familiar toys. It was found that the children clearly preferred the set containing 100 percent novelty. Further, findings from a third study (Harris, 1965) showed that when nursery school children were familiarized with one or two toys, they would subsequently show a preference for one novel toy, even if it was damaged, over the two familiar toys.

Throughout this paper we have implied that children are more willing to explore objects when they are novel and the findings clearly indicate that this is, in fact, the case. Thus, teachers should be looking for ways to add novel elements to their classrooms whenever they can be used to keep children optimally alert and attentive. Alternation of toys and routines, changes in bulletin boards and the arrangement of furniture and equipment, and introducing new activities are all relatively simple ways that teachers can bring novelty to the classroom. However, teachers must remember that too much novelty may have the effect of making children overly active.

For example, think what might happen if, during the middle of a school year, you completely rearranged your classroom and added all new toys and materials. Too much novelty could also conceivably frighten children, particularly very young children. For example, the first author had this experience when a visitor came to her toddler classroom with a monkey (which, incidently, was taller than most of the children). Although a few of the children were eager to see and touch the monkey, most of them attempted to hide in the supply closet.

Implications

It appears that children's curiosity can be optimized by providing a proper balance between novelty and familiarity. More specifically, the research findings show that children prefer familiar people and situations (e.g., mother versus stranger presence) and express their wariness when they are placed in unfamiliar settings with "strangers." However, children also seem to prefer novel objects and opportunities to seek sensory stimulation from their environment. In fact, studies of institutionalization have shown quite clearly that when sensory stimulation is not provided, children's overall development as well as their curiosity development is stunted. Thus, teachers must take the preceding setting and situational influences on children's curiosity development as a whole (rather than dwelling on specific findings) in deciding how to develop programs that balance novelty with familiarity and correspondingly facilitate the curiosity behavior of young children.

HOW CAN ADULTS INFLUENCE CHILDREN'S CURIOSITY?

How Are Adult Attentiveness, Sensitivity, And Supportiveness Related To Curiosity?

The findings consistently show that adult attentiveness, sensitivity, and supportiveness are positively related to the exploratory behavior of infants, preschool, and elementary school children (Ainsworth, Note 7; Ainsworth, Bell, Blehar, & Main, Note 8; Beckwith, 1972; Moore & Bulbulian, 1976; Rubenstein, 1967; Saxe & Stollack, 1971; Stayton, Hogan & Ainsworth, 1971). One group of studies shows that high maternal attentiveness is related to increased exploratory behavior among both infants and elementary school children (Rubenstein, 1967; Saxe & Stollack, 1971). For example, in one study (Rubenstein, 1967) mothers were placed in high-, medium-, or low attentiveness groups based on previous interview and observational data. Subsequently, two tests of exploratory behavior were administered to their children. It was found that the group of children with the high-attentive mothers exceeded both the other two groups in visual and tactual exploration of novel objects.

In a second group of studies (Ainsworth, Note 6; Ainsworth, et al., Note 8), mother-infant pairs were observed interacting to determine how sensitive mothers were to their infants'needs (e.g., how promptly did a mother respond to her infant's crying). It was found that the most sensitive mothers had the most secure babies who were also the most independent explorers. Further, it was found that relatively long periods of holding the infant produced infants who explored more. It was emphasized that rather than "spoiling" their babies, these mothers actually fostered exploration. Implicit in these findings is that sensitive mothers are

"tuned in" to the appropriate times to hold their infants and the appropriate times to allow them to be independent explorers.

Finally, in a laboratory experimental study using nursery school children (Moore & Bulbulian, 1976) it was found that children exposed to a friendly, approving adult were more likely to display curiosity behaviors and began to explore more quickly than were children who were exposed to an aloof, critical adult. This study, and the others we have presented, indicate quite clearly that adults can be instrumental in fostering curiosity in young children by being attentive, responsive, and supportive of their needs to explore.

How Does Providing Reinforcement Influence Curiosity?

Teachers frequently offer incentives to children when they engage in and/or succeed in activities that the teacher values. Sometimes these incentives take the form of grades, stars, "good worker" badges, or praise. With few exceptions (e.g., Zimmerman & Pike, 1972) the research literature provides little evidence that these extrinsic rewards can, by themselves, increase children's curiosity behavior which is often thought of as being intrinsically rewarding (rewarding in itself).

However, a few studies do provide support for the (instrinsic?) reinforcing effect of providing informative answers to children's questions (Endsley & Clarey, 1975; Ross & Balzer, 1975). For example, in one study it was found that the frequency of questioning increased signficantly in sessions in which children received informative answers to their questions as compared to sessions where no information was given (Endsley & Clarey, 1975). Further, it was found that elementary school children remember more information from answers provided to their own questions than from

overhearing the answers provided to a classmate's questions (Ross & Killey, 1977). It was concluded that children are more attentive and receptive to information that stems from their own curiosity and that this information is easily stored and later retrieved from their own cognitive structure because they generated it in the first place (Ross & Killey, 1977).

The implications from these studies are extremely important for teachers. First, to the extent that we value questioning behavior in young children, we can encourage it and maintain it by providing children with informative answers whenever possible. Second, teachers who generally evaluate their children's learning by asking all the question themselves, might need to provide more opportunities for children to do the questioning. Third, and perhaps more important, it appears that children need to be provided with more individual (rather than group) opportunities to ask their own questions and receive their own answers.

How Does Modeling Influence Children's Curiosity?

One way that children learn is by modeling or imitating the behaviors of respected peers and adults (Bandura, 1969). More specific to the area of children's curiosity, there is research evidence showing that preschool children will display more tactual manipulation of objects (Johns & Endsley, 1977) and that elementary school children will ask more questions (Zimmerman & Pike, 1972) when the children first observe a model displaying these behaviors. Further, modeling has been used as a method to teach children to ask more efficient questions and to engage in more efficient problem-solving strategies (Laughlin, Moss, & Miller, 1969; Zimmerman & Rosenthal, 1974). The implications are clear: if we value curiosity, we should also show children how to be curious by being curious ourselves.

Implications

Again, the findings show quite clearly that adults can be instrumental in fostering and maintaining children's curiosity by being attentive, sensitive, and supportive of children's needs to explore, by answering children's questions informatively, and by displaying the positive characteristics of curious people. Further, most people would agree that if a child explores objects and asks questions for the intrinsic value s/he obtains from these activities, other external modes of reinforcement are unnecessary. However, there are some cases when expressions of curiosity will not occur unless the teacher can initially gain the child's interest and attention. For example, studies of severely mentally retarded children who exhibit little interest in their surroundings have shown that these children can be trained to attend to a teacher and ask questions about objects through the use of token rewards (e.g., Twardosz & Baer, 1973). Certainly, there are other special cases of children (e.g., hyperactive children) whose curiosity behavior could be facilitated by positively reinforcing desirable behaviors, ignoring unwanted behaviors, or punishing undesirable behaviors while also stressing alternatives.

CONCLUSIONS

Clearly, this review of research has revealed both how much we know and how little we know about children's curiosity. An increasing amount of research, particularly in the area of how socialization agents can influence children's curiosity, has been conducted in the last decade. However, this research consistently points to the gaps in our knowledge

and the need for more extensive programs of research. For example, on the one hand, we know from the research that a highly curious child is not necessarily more intelligent (as measured by conventional intelligence tests), but s/he is more motivated to obtain information, creative, flexible, is more secure about and interested in his/her environment, and has a better self-concept than a less curious child. On the other hand, due to a paucity of research, we can only speculate about how curiosity develops (either over the life span or in a given situation), what the prerequisite conditions for curiosity development are, and what ultimately makes some children more efficient at obtaining information and more competent at mastering their environment than others.

Further, we know very little about the generalizability of the existing curiosity research. First, most of the research that exists on children's curiosity has been conducted in the laboratory rather than in the child's home or his/her school. Therefore, until more research is undertaken, we cannot say with confidence that a child who is curious in the laboratory will also be curious in his/her natural environment (Parry, 1972).

There is also a second type of generalizability issue to consider. As mentioned previously, some theorists view curiosity as a stable personality trait. However, given the research, there is more reason to believe that curiosity is subtly influenced by variations in situations and settings. Thus, it may be overly simplistic for teachers and researchers to label children as high- or low-curious, since it is more likely that a typical child will ask questions in some situations, touch and manipulate objects

in other situations, and express no curiosity in still other situations, rather than remaining uniformly curious at all times. Thus, in future research it may be more profitable to go beyond the elementary trait approach to the more complex approaches of examining different modes, patterns, and/or styles of information-seeking that individual children develop in specific situations.

Similarly, most researchers have examined only one specific class of curiosity behavior (e.g., visual scanning, tactual manipulation, question-asking) rather than comparing several curiosity behaviors in a given situation. Again, as a result of this rather simplistic approach, we have little information on whether some children (e.g., overt versus covert information seekers) prefer to exhibit and/or more efficiently exhibit one type of curiosity behavior than another in a given situation.

Finally, as the research in this relatively new area of children's curiosity becomes more sophisticated, perhaps researchers will begin to develop procedures for examining more complex and usually neglected internalized processes such as thinking. A colleague recently asked the question, "How often do we model thinking for children--how often do we say, 'let me think about that,' or 'I'm thinking'?"[2] Perhaps we, as adults, should consider carefully what we do when we think. This might provide us with some important clues to how we can study the processes that go on inside a child's head. Recently, some researchers (see Zimmerman

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2 Lynda Walters (Department of Child and Family Development, University of Georgia) recently posed this question in her reaction to the present paper at the NAEYC meeting, Chicago, 1977.

& Rosenthal, 1974) have taken important steps in this direction by examining how adults can model abstract types of questions and how children will subsequently engage in more abstract types of questioning behaviors which appear to generalize across situations.

In any case, the studies reported in the present review should pave the way for further research on the development of curiosity in young children. Fortunately, many researchers cited in the present paper are well aware of the importance of formulating research questions that have relevance for classroom practice. Further, many of these researchers have had extensive experience working directly with young children and are aware that sharing ideas with teachers can be an invaluable way of developing meaningful research questions.

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Postscript

The Educational Resources Information Center/Early Childhood Education Clearinghouse (ERIC/ECE) is one of a system of 16 clearinghouses sponsored by the National Institute of Education to provide information about current research and developments in the field of education. The clearinghouses, each focusing on a specific area of education (such as early childhood, teacher education, languages and linguistics), are located at universities and institutions throughout the United States.

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READING AND COMMUNICATION SKILLS
1111 Kenyon Road
Urbana, Illinois 61801
(217) 328-3870

RURAL EDUCATION AND SMALL SCHOOLS
New Mexico State University, Box 3AP
Las Cruces, New Mexico 88003
(505) 646-2623

SCIENCE, MATHEMATICS, AND ENVIRONMENTAL EDUCATION
Ohio State University
1200 Chambers Road, Third Floor
Columbus, Ohio 43212
(614) 422-6717

SOCIAL STUDIES/SOCIAL SCIENCE EDUCATION
855 Broadway
Boulder, Colorado 80302
(303) 492-8434

TEACHER EDUCATION
1 Dupont Circle N.W., Suite 616
Washington, D.C. 20036
(202) 293-7280

TESTS, MEASUREMENT AND EVALUATION
Educational Testing Service
Princeton, New Jersey 08540
(609) 921-9000, Ext. 2176

URBAN EDUCATION
Teachers College, Box 40
Columbia University
New York, New York 10027
(212) 678-3438

*ERIC/ECE is responsible for research documents on the social, psychological, physical, educational, and cultural development of children from the prenatal period through pre-adolescence (age 12). Theoretical and practical issues related to staff development, administration, curriculum, and parent/community factors affecting programs for children of this age group are also within the scope of the clearinghouse.