chapter 14

goal as environmental variable in the development of intelligence

PATRICIA M. GREENFIELD

I am concerned with the notion of a goal as environmental variable which makes new sense out of a lot of seemingly confusing data on cultural variation in the development of intelligence and which, at the same time, grows out of a new body of empirical data.

Teleological analysis of behavior was out during the reign of behaviorism. The reinforcer does not "cause" behavior; behavior produces the reinforcer. In this way of looking at things, means lead end, not vice versa. Research on young babies at the Center for Cognitive Studies in the 1960s has tended to show that the opposite is true; intention precedes the act, goal dictates the choice of means. A goal may, therefore, have the temporal primacy required of the stimulus in stimulus-response conceptions. Let me cite one example (Bruner, in press). Before babies have the necessary means for capturing an object manually, they reveal the oral goal of capture by vigorous mouthing movements. The reach-and-capture routine is at first indissolubly wed to the goal of bringing the object to the mouth. Only months later does reach-and-capture become an independent routine that can be run off either for itself or as a means to any number of goals. In the beginning the rule seems to be: no goal, no behavior. This very simple example may be useful for illustrating the notion of a goal as an important environmental concept. Reach-grasp-and-mouth an object may be an innate reaction pattern; nonetheless, an object is necessary to set

the pattern off, to arouse the intention reflected in the baby's mouthing movements. Without appropriate objects placed in the environment an essential element of the goal is missing and the reaching skill remains untapped potential.

The reaching example illustrates a general type of relationship between inborn and environmental components of behavior, a relationship long realized by the ethologists: the most genetically specified type of behavior requires a more or less specific environmental trigger, and the trigger very often initiates a period of rapid learning (Thorpe, 1964). The importance of this learning should not be underestimated.

Another finding issuing from the same study of infant reaching, as well as from other studies carried out at the Center for Cognitive Studies, is that a given skill must be *mastered* before it can be inserted as a component in a more complex pattern of skilled behavior. Thus, the ability to deal manually with more than one object at a time depends on the perfection and modularization of the basic reach-and-grasp unit. An awkwardly carried out element evidently demands too much attention in itself and is too unpredictable to be inserted in a complex routine. In consequence, even for a highly preformed behavior like reaching, the lack of environmental opportunity and practice presumably affects future as well as present learning. Thus, the external or environmental component of an internal goal or intention can be conceived as an invitation to carry out a certain type of action—something more than opportunity, something less than compulsion.

Neurological research now supports behavioral evidence that people may be teleological machines. Pribram, Spinelli, and Kamback (1967) have found that intention—the internal counterpart of a goal—can be electrically recorded in the projection areas of the macaque monkey's brain, a phenomenon labeled feed-forward or corollary discharge, and that this mechanism facilitates the intended behavior which follows.

If a goal does have this respectable reality, how does it function in behavior? Internal goals or intentions are important in the formal organization of behavior. Means-end relationships are an important example of the hierarchical structuring that is so prevalent in human functioning. That is, responses or behavioral routines often occur in relation to higher-order goals, which in turn may be subgoals for even more remote ends. These interconnected goal structures are crucial to the temporal integration of behavior, a problem posed by psychologists as divergent as Lashley (1951) and Sartre (1956). The concept of reafference, whereby intention is compared with result and the difference between the two is used as a basis for correction, provides a mechanism by which the goal can control the form of instrumental behavior even after the behavioral sequence is initiated. This process was generalized by Miller, Galanter, and Pribram to many aspects of behavior in their book *Plans and the structure of behavior* (1960).

Goals not only hold behavior together in the formal sense; since

environmental goals precede behavioral means temporally, they function as trigger and energizer as well. The psychological notion of a goal or intention is, therefore, both structural and motivational. Motivation thus becomes intrinsic to the structure of intelligent behavior, not something apart from it. Once motivation is part of the very nature of intelligent behavior, a number of social issues relating to intelligence become illuminated. Before discussing these, let me cite some experiments showing the way in which the psychological organization of behavior in terms of goals determines how much and what kind of learning takes place.

It would seem that if the concept of reafference has general applicability in learning—i.e., if even conceptual behavior is regulated by feedback from its end, then the existence of some goal is critical to learning. Furthermore, the fuller the specification of goals and subgoals, the more precise the comparison of ideal with actual and the more effective the correction procedure. My own experiments on ways to teach 2- and 3-year-olds mathematical concepts indicate that specification of the goal is indeed a critical determinant of success in instruction. Initially I used an inductive or discovery-oriented procedure to teach the quantitative concepts "fat" and "skinny." A child would be told that a raisin was under one of two cans differing in diameter. When he was being taught the concept of fat, he had to discover that the raisin was always under the fatter of the two cans. Although in this procedure the concept fat was embedded in an action sequence as a means to attaining the raisin, a negative outcome did not give much corrective information. When the child erred in this situation, all that he could learn was that the raisin was not under that can. The pedagogical problem is that the raisin is not the true goal of the task; it is actually just a way of letting the child know that he has attained the real goal of lifting the fat can. Since the environment has not specified this goal, no comparison of what happened with what was supposed to happen is possible, and corrective feedback is nil. In fact, 2- and 3-year-olds fail to learn the concept under these conditions. Even if they already know the concept, they cannot apply it in this situation. If, however, the same children are told that the "square" piece in an array of shapes will just fit into a puzzle frame placed in front of them, they will learn the concept "square" rather quickly, even if they did not know it beforehand. Here the true goal is initially represented verbally by the word square and ikonically by the square puzzle frame. An error in this situation yields much more information about the means necessary to succeed. In terms of what the child does, the square puzzle frame gives both enactive and visual feedback from the fitting process, while the adjectival position of the word square indicates that some attribute of the piece is a critical part of the goal. A series of three experiments indicated that simultaneous representation of the concept to be learned in terms of action, image, and word is ideal for teaching the meaning of a given mathematical term to 2- and 3-year-olds. A redundant specification of the goal provides a wealth of

corrective information about what is wrong with the means when the goal is not realized. This redundancy appears to facilitate learning greatly at the early stages. I am not denying that extrinsic reinforcement can give yes-no information about whether a goal has been attained, but in new learning this cannot replace intrinsic feedback from the goal itself.

The difference between the nature of the object goal presented by the environment to trigger infant reaching and the complex verbal and ikonic goal used to trigger the mathematical learning tasks shows how the environmental sources of intention become more varied with age. Nonverbal demonstrations are another type of goal that are very important in certain types of learning.

Let us consider an example from the realm of perceptual learning in order to generalize the central point that what is learned is learned as a means to some end and that feedback from end to means, therefore, regulates learning. The data come from an experiment carried out in the summer of 1969 in Mexico with Carla Childs (1970). Zinacanteco Indian children were asked to reconstruct two different striped patterns using strips of wood in a frame. We found that the girls who knew how to weave the patterns did thread-by-thread representations of these patterns. This analytic type of representation is clearly requisite to the enterprise of weaving. Zinacanteco boys of the same age, by contrast, do not know how to weave, but they are concerned with the culturally defined patterns as male clothing in the case of one pattern, female clothing in the case of the other. Their representations are, typically, grossly inaccurate in terms of woven threads; they emphasize features that relate to general appearance rather than intrinsic structure. If the pattern construction task is a good index of the nature of past learning, then each group has learned what it needs to know to carry out the respective enterprises in which the patterns are embedded; perceptual learning has been regulated by feedback from the goal.

The general point is that people seem to learn what they need to know to accomplish a goal presented by the environment, that is, when the goal provides the necessary information feedback to the instrumental behavior. What is adequate feedback will vary according to age, task, and stage of learning a given activity. As experience is acquired with a particular type of enterprise, some of these complex external goal representations may become internalized and be spontaneously applied in new situations. In fact, when goals are poorly defined, the educated adult in a technical culture may even exhibit search behavior until some goal is found.

The specification of goals by the environment not only determines whether learning takes place, but also what kind of learning. When understanding a given concept is a subgoal in the service of many different ends, that concept takes a more generalized form. Thus, in the experiment on ways to teach the meaning of the term square, children who were asked to carry out three different actions with the square piece were better able to generalize

their learning to new situations than were children who always carried out the same action. Indeed, Werner and Kaplan (1950) have found experimentally that younger children do not differentiate a word from its verbal context and may regard a given word as carrying the meaning of the whole or a part of the context. Variable verbal and action contexts for a given concept then provide a way of generalizing the concept by differentiating it from its context. Equally interesting, this effect of a variety of concrete goals is much larger when *no* verbal labels yet exist within the geometric domain. Thus, if the child already knows the meaning of the word "round," increasing the number of verbal and action contexts no longer is much help in establishing the meaning of the word square. The initially learned label round tends to be overgeneralized to square stimuli, and explicit correction of this overgeneralization becomes the crucial pedagogical problem. At this point in learning exposure to the contrasting labels round and square becomes more effective than using the word square as a means to carrying out a variety of activities. What this may mean educationally is that providing a wide variety of action goals is more important in the initial than in the later stages of mastering concepts in a particular domain; just as for the infant the goal was most critical to the first reaching attempts. The task or goal structure provided by the environment may play its most important role early in life and gradually decline in importance.

The general point about this study, as well as others that could be cited, is that what are learned best, that is, in the most generalized form, are those verbal concepts that function as means to many desired ends. These are concepts that have "relevance" to larger enterprises; the child thus has a "reason" (or motive) to learn about them. Surely in everyday life those concepts most important to action are the ones placed in the greatest variety of contexts and therefore learned the most thoroughly. It then follows that motivation to learn and the hierarchical structuring of a task in terms of means-end relationships are one and the same thing. The role of familiarity becomes that of providing a higher-order structure into which the unfamiliar can be fitted as a necessary component.

Generalization of this line of thought leads to the idea that the goal structure of an environment is extremely important to the development of intelligence. I should like to suggest that when the goal structure of the environment—its means-end relationships—is out of kilter, many of the intellectual phenomena labeled cultural deprivation result. This disorganization of means and ends can be of two types. The first, commonly recognized, occurs when goal attainment is constantly frustrated. In this case the natural process of mastering instrumental behavior or knowledge grinds to a halt. Failure leads to a feeling of powerlessness, to a shifting of responsibility outward, as Rotter, Seaman, and Liverant (1962) demonstrated. Decrease in a sense of self-determination, in turn, reduces means-end analysis and augments a gambling approach to problem solving. This point has been made experimentally by

Rotter and Battle (1963) who showed that people lacking a sense of self-determination failed to relate instrumental behavior to outcomes in predicting the course of future events. Instead, they treated outcomes as randomly determined. But if people generally learn the means to desired goals, then cessation of means-end analysis also means cessation of learning. Thus, a repeated negative outcome of one's projects for whatever social or personal reason would not only annihilate motivation to learn, but also annihilate the structural conditions that make learning possible.

The findings of the Coleman report (1966) on equal educational opportunity confirm this idea with respect to the learning that takes place in school. School achievement for both black and white children was found not to be a function of any objective conditions like curriculum, teacher quality, and so forth, but rather a function of whether the child felt that what he did would affect what happened to him later on—in other words, the perceived ability to determine one's own fate by the use of controllable means. The implication is that children who were continually frustrated in their attempts to achieve anything stopped treating school as a situation in which learning the material is a means to gain one's ends. Instead they started taking the passive role appropriate to a fate- or chance-controlled situation.

If a mother believes that her fate is controlled by external forces, that she does not control the means necessary to achieve her goals, what does this mean for her children? The follow-up data from the Hess group's study of the relation between maternal variables and the development of intelligence shows that the more a mother feels externally controlled when her child is 4 years old, the more likely the child is to have a low IQ and a poor academic record at age 6 or 7 (Hess, Shipman, Brophy, & Bear, 1969).

This high degree of perceived external control that exists among lower-class mothers is also one of the most difficult characteristics to modify. Such was Ira Gordon's (1969) experience from training poor black mothers to play with their babies in an educationally effective way during the first year of life; the high degree of external control felt by the mothers was not modified at all during the course of the program. This feeling of external control may thus be one of the reasons why compensatory educational changes are so difficult to effect.

Not only can people fail to realize goals, the environment can fail to provide a growth-promoting sequence of them. I suggest that the goals set for the child by his caretakers and the relation of these to the child's available means is a critical factor in determining the rate of cognitive growth in the early formative years. By goals, I mean essentially the host of possible enterprises with which a child fills up his day. The means available to him to carry out these enterprises consist of an interplay between what his mother or someone else teaches him through modeling, direct instruction, etc., and what he already knows.

Generalizing the experiment on methods of teaching the concept square, one could say that an ideal strategy for teaching the semantics of a geometric term to someone who was starting from scratch would be to set tasks where understanding the term was a means to accomplishing the enterprise. For example, a mother says to her child when he has a plate of round and square cookies in front of him, "You may eat one round cookie." Clearly, the child will learn which are the round ones. If this remains the only context, however, he will probably think that round is a name for chocolate Oreos. At some later time the mother may say to him, "Your dump truck is in the round box." The more activities in which the concept is embedded, the more generalized the definition will become.

Within this framework, let us examine some more facts about subcultural variation in cognitive development and the environments that produce these differences. Research by Bee, Van Egeren, Streissguth, Nyman, and Leckie (1969) on how mothers—lower-class and middle-class, black and white—teach their 4-year-old children to copy a house made of building blocks indicates that it is precisely the technique of setting a goal and structuring a problem to be solved that differentiates the lower- and middle-class mothers. When the mothers' verbal suggestions are classified according to three levels of specificity, it is found that middle-class mothers use the most general level significantly more than do lower-class mothers. What the middle-class mothers have in common is some mention of the model, that is, the goal. Examples are, "Look at the lady's house," and "Let's start at the front." The more specific levels of suggestion focus on the blocks, that is, they refer to the *means*, not the end. An example of the most concrete level of suggestion is "Put that one over here." The middle-class mothers certainly do not ignore the means—in fact, class differences in the rate of giving the more specific block-oriented suggestions are not statistically significant. The main difference is that middle-class mothers relate means to end, whereas lower-class mothers, on the average, deal with means alone and fail to relate it to any goal. At the same time, the middle-class mothers give their children significantly more positive and significantly less negative feedback. In view of my earlier argument about the effects of success and failure, this emphasis on positive feedback ought to augment the whole process of means-end analysis and realistic goal striving. The relatively high rate of negative feedback from the lower-class mothers, on the other hand, should be leading to feelings of failure and thence to a gambling or luck approach to the situation.

Thus, social reinforcement, as a type of extrinsic feedback vis-à-vis intellectual facts, not only can give information about success, but as a generalized pattern it will also (1) reinforce or fail to reinforce a feeling of competence and (2) select certain types of goals as being more worthwhile than others. Since the latter function is precisely that of cultural values, this view of cognitive activity in terms of a means-end relation makes values part of the very structure of intelligence, not something apart from it.

It may well be that a feeling of external control, a belief that goals cannot be attained, discourages lower-class mothers from structuring their childrens' environment in terms of problems to be solved. (Ironically, this is also a characteristic of the type of education promulgated by the so-called progressive movement. In both cases the child loses the opportunity for the rational goal striving that leads to learning. Although it may help to relax the middle-class child, it ruins the lower-class one.)

A puzzling aspect of the phenomena of cognitive development attributed to cultural deprivation is why these phenomena were not identified before the 1960s. One reason, of course, is that the level of skills demanded by our economy has risen leaving "no room at the bottom." Another reason may be the intensified pace of urbanization. A fascinating study by Graves (1969) comparing rural with urban Spanish-Americans in the Denver area and rural with urban Bagandans in Uganda seems to indicate that in poor families urbanization per se profoundly affects the pattern of enterprises to which a preschool child is exposed. In both Uganda and the United States household tasks for the preschool child are missing in the city. Furthermore, many exploratory activities of which the child is capable become too dangerous in an urban environment. Interviews with mothers revealed also that urban mothers were far less likely than rural mothers to believe that their preschool children were capable of understanding or being taught various principles or skills. The city mothers also rated their children lower in potentialities for independence, self-reliance, and ability to help within the family. When poor mothers move to the city, moreover, they have much more constant contact with small children in the context of relative isolation from adults. This situation engenders frustration and irritation, leading to an increase in the use of power-assertive techniques with children. Urban mothers also use less future-oriented teaching techniques than do their rural counterparts. Thus, it is clear that the urban environment fails to present small children from poor families with the pattern of goal-directed tasks found in a rural environment. At the same time the urban mothers stop believing in their children's efficacy. Interestingly, this belief is correlated with a lowered belief in their *own* efficacy as mothers, a lowered confidence in their own ability to produce the kind of child they desire. Thus, the absence of a sense of self-determination is present in many areas critical to giving the young child himself a sense of competence and self-determination. The lack of confidence in himself appears to be closely linked to the absence of suitable goal-oriented activities for the child to use as vehicles for learning. With more money and education mothers can both escape from the isolation of city life and use imaginative play tasks as substitutes for useful chores; but this approach demands resources unavailable to the poor, relatively uneducated urban dweller.

The findings of Zigler and Butterfield (1968) that motivational factors alone can raise the IQ scores of lower-class children 10 points on the average fits in nicely with these findings about poor urban environments. The type

of motivating procedure used in this study related mainly to making sure that the child had a high degree of success before he was faced with difficult test items. A possible explanation is that a child who was prone to interpret outcomes as a matter of chance over which he had no control was made to see that he did and *does* have control in this situation. Such an attitude leads to the means-end analysis necessary for problem solving and learning; hence, the improvement in intellectual functioning manifest in the test score.

The problem of maintaining compensatory educational gains can now be seen in a new framework. Initially, it was thought that once poor children "caught up" they would respond to school like middle-class children and would continue to develop in the same way. But if it is true that people learn that which functions as a means to some end, and if it is also true that the lower-class environment fails to present such ends to its children, then it will also be true that these children will stop learning in this environment. In nursery school most learning and teaching occurs in the context of concrete tasks. In a regular school, by contrast, learning is often dissociated from any ends. In fact, ends are there; they just become more and more remote from the task at hand. In many cases, the home environment may supply the middle-class child, but not the lower-class child, with an image of the goals toward which school instruction is aimed. For example, this is often the case when it comes to learning to read; the goal is clear for the child who has been read hundreds of books by the time he reaches first grade. If specification of the goal is initially a structural as well as motivational condition for learning, the process of learning to read will be greatly impeded for the lower-class child. Where the requisite goal structure is absent, no amount of past "catching up" is going to affect the course of present and future learning.

School learning is characteristically out of the context of any concrete task. The middle-class environment provides the needed supportive goal structure through its social values and practical activities; the lower-class environment does not. In an industrial, technical society means-end chains become so long and means become so generalized in the sense of being detached from specific goals that it is easy to lose sight of an ultimate purpose. In fact, when final goals become too remote, it is easy even to stop caring what they are. This is possibly one reason why the best educated young people are complaining of lack of relevance in their intellectual training. Perhaps the way is open for educational innovations that will connect learning to the relevant goals so needed by the poor and desired by the rich.

References

Battle, E. S., & Rotter, J. B. Children's feelings of personal control as related to social class and ethnic group. *Journal of Personality*, 1963, *31*, 482–490.

Bee, H. L., Van Egeren, L. F., Streissguth, A., Nyman, B. A., & Leckie, M. S. Social class differences in maternal teaching strategies and speech patterns. *Developmental Psychology*, 1969, *1*, 726–734.

Bruner, J. S. The growth and structure of skill. In K. J. Connolly (Ed.), *The Development of Motor Behavior*. New York: Wiley, in press.

Childs, C. A developmental study of pattern representation in Zinacantan. Unpublished honors thesis, Harvard University, 1970.

Coleman, J. S. *Equality of educational opportunity*. Washington, D.C.: U.S. Government Printing Office, 1966.

Gordon, I. J. Stimulation via parent education. *Children*, 1969, *16*, 57–61.

Graves, N. B. City, country and child rearing in three cultures. Unpublished manuscript, University of Colorado, 1968.

Hess, R. D., Shipman, V. C., Brophy, J. E., & Bear, R. M. The cognitive environment of preschool children: Follow-up phase. Unpublished manuscript, University of Chicago, 1969.

Lashley, K. S. The problem of serial order in behavior. In L. A. Jeffries (Ed.), *Cerebral mechanisms in behavior: The Hixon Symposium*. New York: Wiley, 1951.

Miller, G. A., Galanter, E., & Pribram, K. H. *Plans and the structure of behavior*. New York: Holt, Rinehart and Winston, 1960.

Pribram, K. H., Spinelli, D. N., & Kamback, M. C. Electrocortical correlates of stimulus response and reinforcement. *Science*, 1967, *157*, 94–95.

Rotter, J. B., Seaman, M., & Liverant, S. Internal versus external control of reinforcement: A major variable in behavior theory. In N. F. Washburn (Ed.), *Decision, values, and groups*, Vol. 2. New York: Pergamon, 1962.

Sartre, J.-P. *Being and nothingness*. New York: Philosophical Library, 1956.

Thorpe, W. H. Some concepts of ethology. In J. Cohen (Ed.), *Readings in psychology*. London: Allen & Unwin, 1964.

Werner, H., & Kaplan, E. Development of word meaning through verbal context: An experimental study. *Journal of Psychology*, 1950, *29*, 251–257.

Zigler, E., & Butterfield, E. C. Motivational aspects of changes in IQ test performance of culturally deprived nursery school children. *Child Development*, 1968, *39*, 1–14.