Piaget's Theory of Intellectual Development

Infancy

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From *Piaget's Theory of Intellectual Development* by Herbert P. Ginsburg and Sylvia Opper

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Piaget's theory pides intellectual development into four major periods: sensorimotor (birth to 2 years), preoperational (2 years to 7 years), concrete operational (7 years to 11 years), and formal operational (11 years and above). (As we shall see shortly, these ages are only rough estimates; they vary from inpidual to inpidual, and from culture to culture.) This chapter treats the first of these periods, the sensorimotor, which occurs during infancy.

The account of infancy is novel and sometimes surprising. The surprises usually take one of two forms: cases where, according to Piaget, the infant is capable of much more sophisticated and elaborate forms of behavior than we would have expected and, conversely, cases where the infant shows unexpected deficiencies. Consider an example of the first case.

The untrained observer of an infant in the first few months of life usually reports several impressions. The baby, who is much smaller than anticipated, appears weak and fragile, and extraordinarily passive. He does not seem to *do* much of anything. The newborn spends most of the time in sleep, and usually wakes only to be fed. Even during the feeding, he does not seem very alert, and sometimes, in fact, falls asleep during the meal. Since the infant seems to show little reaction to people or things, our observer may even suspect that the newborn does not *see* the world clearly, if at all. Apparently such an infant is capable of learning almost nothing.

Piaget's view offers a strong contrast to this conception of the newborn as a predominantly helpless and inactive creature, for he characterizes the newborn as active and as an initiator of behavior. The infant quickly learns to distinguish among various features of the immediate environment and to modify his behavior in accordance with their demands. In fact, his activity reveals the *origins of intelligence.*

One of the first questions we should ask about these surprising findings (or indeed about *any* findings) is, how does he know? What are the methods which allow Piaget to penetrate beyond the commonly held assumptions and to propose a new and startling view of infancy? The question is particularly germane in the case of Piaget since he is methodologically unorthodox, at least by some

standards.

METHOD

In the course of his psychological investigations, Piaget has employed a variety of methods. The assumption has been that methods must be tailored to meet the requirements of different problems and age groups. In the case of infancy, the methodology employed is partly naturalistic and partly informal-experimental.

For much of the time, Piaget carefully observed the behavior of his own three infants—Lucienne, Laurent, and Jacqueline—as it occurred naturally. For instance, he would sit by the crib and make careful notes of the infant's play, or he would direct his attention to the infant's eye movements and try to determine the direction of the infant's gaze. In these instances Piaget did not make use of special scientific instruments or experimental apparatus. He did not use another observer to check the reliability of the observations. In general, the intention was to employ careful observation, unaided by instrumentation, to learn as much as possible about the behavior of the infant in the natural habitat. The procedure is obviously different from the usual experimental approach in which the child's behavior or physiological reactions are observed, often with special instruments, under carefully controlled conditions in the laboratory. But Piaget's approach is hardly unique or scientifically taboo. Naturalistic methods are used in zoology, for example, by ethologists interested in the behavior of animals in their natural surroundings. It has been used, too, in child psychology, by the "baby biographers" who observed their own children and who included such notable figures as Charles Darwin.

Piaget's procedure has its unique advantages and disadvantages. The latter have often been stressed at the expense of the former. For example, Piaget based his conclusions on a sample of only three children, hardly a sufficient number to ensure the generality of the results. Piaget and his wife made all the observations themselves. Although both Piaget and his wife were trained psychologists, it is the general feeling that parents are notoriously poor evaluators of their own children's performance. Also, when naturalistic observation is used, it is impossible to identify cause-and-effect relations with certainty. While some event may have seemed to be the cause, other uncontrolled events may in fact have been involved too. Further, the standard statistical tests were not used, although today they are usually

seen as indispensable tools of research.

Despite these apparent deficiencies, Piaget's methods offer a number of advantages. First and foremost, Piaget is an exceedingly sensitive observer of children. Some people, probably regardless of formal training, have this ability and some people do not; Piaget does. The acuity of Piaget's observations is confirmed by their generally successful replication by independent investigators.[1] Second, Piaget's intimate contact with his subjects allowed him to *discover* phenomena which might have gone unobserved or unnoticed in the laboratory. The controlled experiment tends to focus the investigator's attention on the limited class of behavior of interest, and indeed, often makes it impossible for other kinds of behavior to occur or be noticed. These other events, of course, may be of greater interest than those which the experimenter is studying. Third, Piaget's great familiarity with his children often gave him the insight to resolve certain delicate issues of interpretation. If, for example, one of his children was unable to wind up a toy, Piaget's extensive knowledge of the child was likely to give good grounds for deciding whether the failure was due to lack of interest, or fatigue, or real inability. An experimenter, on the other hand, not knowing the subjects well, often is unable to make such reasonable decisions.

Fourth, Piaget was able to observe his subjects over a long period of time. Such longitudinal studies are rare in psychology and provide a perspective which is notably absent from most experimental designs. Fifth, Piaget feels that at the initial stages of research the use of statistics may be premature. One's aim at the outset is to explore and describe. The intention is to discover and identify the significant processes and problems which at a later stage of investigation may be subject to rigorous statistical test. Sixth, Piaget attempted to compensate for the obvious deficiencies of the naturalistic procedure by performing informal experiments. If, for example, observation suggests that the child cannot deed with certain kinds of obstacles, Piaget may intervene in the natural course of events by imposing these obstacles on the child and then observe the results. These experiments are, of course, informal, since a very small number of subjects—three at most—is involved, and since the controls are often incomplete. Nevertheless, Piaget is sensitive to the limitations of naturalistic observation and whenever possible tries to supplement it with experimental techniques. We see then that Piaget's unorthodox procedure for studying infants has a good deal to recommend it and cannot be summarily dismissed.[2]

The result of these investigations is an account of infancy in terms of six "sensorimotor" stages. It

should be emphasized that the age limits of each stage are only approximate, and subject to wide inpidual variations. Piaget stresses the flexibility of the age norms which are probably influenced by inpidual differences in physical and social environment, physiological factors, and so on. What is important is the regular order of succession of the stages, regardless of the particular ages at which they appear.

STAGE 1: BIRTH TO 1 MONTH

The newborn is not a completely helpless creature, but arrives in the world with certain abilities which are provided by heredity. (In fact, over the past several years research has shown that the newborn is far more skilled, visually, for example, than was ever supposed.[3]) One innate skill that the newborn possesses is the sucking reflex. When the lips are touched, the newborn in all cultures responds automatically with unlearned sucking movements. In describing the newborn's behavior, Piaget's central themes are, first, that the sucking reflex, and others too, are not simply activated by external stimuli; instead, the newborn often initiates activity himself. Second, although the physical structure of the infant provides ready-made mechanisms, like the sucking reflex which functions from birth and which is of obvious utility, these furnish only a basis for future development. Even in the first month of life experience plays an important role in modifying and supplementing the inherited mechanisms.

Consider the following observation.

> During the second day also Laurent again begins to make sucking-movements between meals. . . . His lips open and close as if to receive a real nippleful but without having an object. This behavior subsequently became more frequent. . . . (*Origins of Intelligence, OI*, pp. 25-26)[4]

The observation may at first seem quite pedestrian. But let us review it. Why did Laurent suck between meals? There are several possible interpretations. Sometimes reflex activity may be said to be involved. That is, an "external excitant" or "unconditioned stimulus," like a finger, may automatically set off the reflex of sucking by touching the lips. But in the case of Laurent, a reflex interpretation seems untenable, since no external excitant appears to have been involved. Another explanation might attribute Laurent's sucking to hunger, but this interpretation too seems implausible, since Laurent's sucking sometimes occurred soon after his last feeding (when, presumably, he was not hungry) and not

just immediately preceding the next feeding (when he probably was hungry). A third possibility, also rejected by Piaget, involves two steps: (1) We assume that in the past the child's nutritive sucking had been associated with pleasure; that is, when he sucks he gets milk, which reduces his hunger pangs and is therefore pleasurable. (2) Because of this previous association between sucking and pleasure, it gradually occurs that sucking alone in the absence of milk acquires the power to elicit feelings of pleasure in the infant. Consequently, it may be that in the observation cited, Laurent sucked because sucking itself had become rewarding through its past association with pleasure. But this explanation also seems implausible since the extent of the association between pleasure and sucking was limited to such a short period of time.

Since these various explanations—external excitant, hunger, and association with pleasure—do not seem able to account for nonnutritive sucking, Piaget invokes one form of assimilation to explain the results. Recall that in Chapter 1 we defined assimilation as a *functional invariant,* a tendency common to all forms of life. In its most general form assimilation involves the organism's tendency to deal with environmental events in terms of current structures. Piaget has further proposed that assimilation takes three particular forms. In the present instance, the principle of *functional assimilation* applies. (The other two types are *recognitory assimilation* and *generalizing assimilation,* which we will discuss later.) The principle of functional assimilation asserts that when an organism has a structure available, there is a basic tendency to exercise the structure, to make it function. This is particularly true when the structure is not well formed or is incomplete in some way. Also, the principle applies whether the structure is innate, as in the case of the sucking reflex, or learned, as in other instances we will review shortly. When applied to the present observation, the principle of functioned assimilation asserts that Laurent's nonnutritive sucking simply represents the tendency of the sucking reflex to exercise itself or to function. This simple behavioral scheme is not yet well formed and requires exercise to consolidate itself. In other words, Laurent did not suck because he was hungry, or because an external excitant set off the reflex, or because he had associated the sucking with pleasure. He sucked because there is a tendency for available schemes like sucking to function.

A closely related tendency is *generalizing assimilation.* Since schemes need exercise and repetition, they also require objects to be used in satisfying this need. The sucking scheme, therefore, tends to extend itself, to *generalize,* to a variety of objects. While the newborn at first sucks only the nipple, or perhaps a

finger that accidentally comes into contact with the lips, the infant later exercises sucking on new objects like a blanket or various toys. Thus, Piaget stresses activity on the part of the infant. The sucking reflex is not simply activated by a series of excitants; rather, the infant, in seeking to exercise this scheme (functional assimilation), actively searches out objects which will allow it to function. The objects serve as nourishment, or "aliments," for the need to suck.

The first two principles—functional and generalizing assimilation—are energetic: they get the newborn's behavior started. In the course of his activities, the newborn has the occasion to learn about the environment. The reflex of sucking becomes "differentiated." Consider this observation concerning Laurent:

> At 0;0(20) [zero years, zero months, and 20 days] he bites the breast which is given him 5 cm. from the nipple. For a moment he sucks the skin which he then lets go in order to move his mouth about 2 cm. As soon as he begins sucking again he stops. . . . When his search subsequently leads him accidently to touch the nipple with the mucosa of the upper lip (his mouth being wide open), he at once adjusts his lips and begins to suck. (*OI*, p. 26)

From this and other similar observations, Piaget concludes that the infant in the first month of life shows a primitive recognition called *recognitory assimilation.* When the infant is not too hungry, he may suck anything—the fingers, the blanket, whatever—to exercise his scheme. But when hunger is strong, the infant shows selectivity or discrimination in choosing objects to suck. While rejecting the skin surrounding the nipple, the infant seizes immediately upon the nipple itself and does this so rapidly that we may reasonably call the behavior a crude form of recognition. One caution here: Piaget does not propose that the infant "recognizes" the nipple in the same sense that an adult does. (We will see later that the infant's concept of objects is immature.) In the present case the infant merely shows that when it is necessary he can perceive the difference between the nipple and other things.

How does the infant learn to recognize the nipple? Learning must be involved since the newborn does not immediately display this kind of recognition; experience is certainly required for it to develop. Piaget's position is that in the course of exercising and generalizing the sucking scheme, the infant comes into contact with a variety of stimulation. Some of the stimulation is visual (the sight of the breast, etc.). Some is tactual-kinesthetic (touches on the lips, the feeling of swallowing milk, etc.). And some stimulation is postural (the infant is generally lying down in a certain position). While accumulating this

experience, the infant comes to differentiate among many aspects. He finds that some areas of the breast look different from others; some feel different from others; and that one area yields milk while others do not. The infant comes to make these discriminations through repetitious experience which is the result of functional and generalizing assimilation. Then, when hungry the infant shows evidence of previous perceptual learning[5] by choosing that area which has produced milk in the past and by rejecting other areas. To put the matter in another way, the infant learns about the world in the course of many explorations; when properly motivated, he manifests this learning by the performance of certain distinctive reactions.

Finally, an even more complicated kind of learning occurs during the first stage. The principle of accommodation—of modification of the scheme to suit the demands of the environment—is also operative, and one result is that the infant learns to search for the nipple in an increasingly effective manner. Consider these observations:

At first, when put to the breast, Laurent does not show a particularly systematic search for the nipple. He obviously has not had sufficient experience either to recognize the nipple or locate it. But on

> the third day Laurent makes new progress in his adjustment to the breast. All he needs in order to grope with open mouth toward fined success is to have touched the breast or the surrounding teguments with his lips. But he hunts on the wrong side as well as on the right side. . . . As soon as his cheek comes into contact with the breast, Laurent at 0;0(12) applies himself to seeking until he finds drink. His search takes its bearings: immediately from the correct side, that is to say, the side where he experienced contact. . . . At 0;0(26) Laurent . . . feels the nipple in the middle of his right cheek. But as he tries to grasp it, it is withdrawn 10 cm. He then turns his head in the right direction and searches. . . . This time he goes on to touch the nipple, first with his nose and then with the region between his nostrils and lips. . . . He raises his head in order to grasp the nipple. (OI, pp. 26, 29)

We quote these observations in some detail to document the extent of the infant's learning during the first month. The infant learns not only to recognize the nipple, but also where to look for it. Thus, in response to the requirements of the situation, he accommodates—he develops new patterns of action, which result in fairly systematic search. How are these patterns of behavior learned? At the outset the child's head movements are "desultory," that is, essentially without order in relation to the nipple. By chance, some of the movements lead to grasping the nipple and some are unsuccessful. As time goes on, the infant learns through this process of trial and error that a turn of the head in the direction of the touch on the cheek provided by the nipple leads to the reward of swallowing milk. With increased

experience the infant becomes relatively proficient and flexible in this search and now can proceed not only in a sideways direction toward the cheek, but in an upward or downward direction as well. This last observation is important since some head movements at birth are reflexive. When the infant is touched on the cheek near the mouth, he automatically turns the head in that direction. The sideways movement is the "rooting reflex." Consequently, a learning explanation may not be required for the sideways movement, but does seem necessary for the upward and downward motions.

Such, then, is the first stage. The apparently primitive behavior of the infant in the first month of life in fact involves considerable complexity, and the extent of the learning achieved is not immediately obvious. The result is that the hereditary sucking scheme becomes progressively modified and elaborated as a function of experience. At the end of stage 1, sucking is no longer an automatic pattern of behavior provided by heredity. In accordance with the principle of *organization,* the sucking scheme has become elaborated and has developed into a fairly complex psychological structure which now incorporates the results of the infant's experiences.

While stage 1 involves significant learning, there are also limitations on the infant's accomplishments. Learning is confined to the sphere of the reflexes and does not go far beyond them; the effects of experience are centered on the mechanisms provided by heredity. We shall see how the infant in stage 2 begins to overcome these limitations.

At the time it was proposed, Piaget's view of infancy was novel in several respects. The two most influential theories of the day—Freud's personality psychology and Hull's experimental psychology—both emphasized that the organism seeks *escape* from stimulation and excitation. All motives were seen as analogous to the sexual or hunger drives; when these drives intensify, the organism takes actions to reduce them and to return to a quiescent state. Piaget's emphasis, on the other hand, is that even in the first few days of life the infant often *seeks stimulation.* When capable of activity, he tends to perform it (functional assimilation); when a structure is available, he tends to generalize it to new objects (generalizing assimilation). In Piaget's view, all behavior cannot be explained by the infant's reacting to a noxious state of affairs; instead, the infant sometimes actively *seeks* the stimulation which his behavior provides. It seems fair to say that recent psychological research has shown that the Hullian and Freudian concepts are not fully adequate and that alternative views designed to explain the inpidual's preference

for activity and stimulation must be developed (Hunt, 1961).

STAGE 2: 1 TO 4 MONTHS

In the second stage of sensorimotor development the infant acquires certain habits, which, although fairly simple and centered about his own body, nevertheless surpass the acquisitions of the first stage. Now the historical development of sucking, for example, extends beyond the feeding situation.

Primary Circular Reaction

Piaget's theory involves the notion of *primary circular reaction*. The infant's behavior by chance leads to an advantageous or interesting result; he immediately attempts to reinstate or rediscover the effective behavior and, after a process of trial and error, is successful in doing so. Thereafter, the behavior and the result may be repeated; the sequence has become a "habit." Consider these examples:

> At 0; 1(1) Laurent is held by his nurse in an almost vertical position. . . . He is very hungry. . . . Twice, when his hand was laid on his right cheek, Laurent turned his head and tried to grasp his fingers with his mouth. The first time he failed and succeeded the second. But the movements of his arms are not coordinated with those of his head: the hand escapes while the mouth tries to maintain contact. . . .
>
> At 0; 1(3) . . . after a meal ... his arms, instead of gesticulating aimlessly, constantly move toward his mouth ... it has occurred to me several times that the chance contact of hand and mouth set in motion the directing of the latter toward the former and that then (but only then), the hand tries to return to the mouth. . . . [Later, though] it is no longer the mouth that seeks the hand, but the hand which reaches for the mouth. Thirteen times in succession I have been able to observe the hand go back into the mouth. There is no longer any doubt that coordination exists. ...
>
> At 0;1(4) . . . his right hand may be seen approaching his mouth. . . . But as only the index finger was grasped, the hand fell out again. Shortly after it returned. This time the thumb was in the mouth ... I then remove the hand and place it near his waist. . . . After a few minutes the lips move and the hand approaches them again. This time there is a series of setbacks. . . . [But finally] the hand enters the mouth, the thumb alone is retained and sucking continues. I again remove the hand. Again lip movements cease, new attempts ensue, success results for the ninth and tenth time, after which the experiment is interrupted. (*OI*, pp. 51-53)

These observations nicely illustrate Piaget's dual role of observer and experimenter. Note how Piaget as patient observer records that the infant spontaneously places the hand in the mouth thirteen times in succession. Then, Piaget as experimenter intervenes in the natural course of events by placing the infant's hand near his waist to determine whether, under these modified conditions, the infant is able to direct the hand to the mouth.

The observations also display the gradual and steady development of thumb-sucking. First, the infant cannot consistently get the hand into the mouth and then slowly learns to do so; next he learns to suck the thumb alone, not the whole hand; and, finally, after a long and continuous process of learning, the infant is able to perform with rapidity the entire sequence of actions.

Piaget's explanation of thumb-sucking again involves principles of assimilation and of accommodation. However, the sequence begins with an unplanned or unintentional occurrence. Recall that another person initially placed Laurent's hand on his cheek; he did not do so himself. After the hand was put there, Laurent took the initiative by attempting to grasp the hand with the mouth. This action was, of course, a previously learned scheme: Laurent had earlier acquired behavior patterns enabling him to search for the nipple. Other observations not described here reveal that in some cases the initial behavior is a chance occurrence, and not caused by the intervention of another person. In either event, the unplanned behavior leads to a result which has value for the infant. In the case of Laurent the hand in the mouth enables the sucking scheme to function. This is rewarding since, according to the principle of functional assimilation, the sucking scheme needs to function. In other words, a fortuitous occurrence has given the infant a chance to exercise one of his previously established schemes, and this activity, in itself, is a satisfying event. But Laurent's movements are not yet fully coordinated; it occurs that the hand falls from the mouth and interrupts the functioning of the sucking scheme. The child then desires to reinstate the pleasurable activity and resume sucking the thumb. This desire, stemming from the interruption, then *directs* the child's behavior. Laurent actively tries to insert the hand in the mouth. In two senses, then, the infant's learning is active: his desire sets in motion the sequence of events, and he initiates behavior to fulfill this desire.

The principle of accommodation is now operative. The infant modifies the previously aimless movements of the hand to make them effective in bringing it to the mouth. Initially, Laurent is on the wrong track; he tries to bring the mouth to the hand. It is only after some failure that he reverses the procedure. The learning is slow and seems to involve two factors—muscular adjustments and direction by the proper cues. The infant must learn to make certain new and precise muscular movements and must learn to bring these movements under the direction of the proper cues. When touching the blanket, the hand must be moved in certain ways; when touching the cheek, it must be moved in other ways. The infant learns that particular cues and movements are useful while others are not. The useful ones, of

course, are those which lead to placing the hand in the mouth. Thus, success "confirms" some of the movements and cues, while failure eliminates other attempts at accommodation. Yet the observations show that the infant's learning is not complete. He apparently finds it more satisfying to suck the thumb than the other fingers, and through a process of learning similar to that just described becomes able to place the thumb alone in the mouth. Further, the infant's behavior shows the ability to distinguish (recognitory assimilation) the thumb from the rest of the hand. The result of all this learning is finally a smoothly organized and directed series of movements, a new scheme or structure, which can be exercised repeatedly.

In summary, the primary circular reaction involves an action on the part of the infant which fortuitously leads to an event which has value for him and which is centered about his own body. The infant then learns to repeat the behavior to reinstate the event. The culmination of the process is an organized scheme.

Primitive Anticipations

While the newborn in the feeding situation sucks only when his lips are in contact with the breast, the older infant shows a different pattern of behavior. This observation concerns Laurent at the beginning of the second month.

> as soon as he is in a position to eat (in his mother's arms or on the bed, etc.) his hands lose interest, leave his mouth, and it becomes obvious that the child no longer seeks anything but the breast, that is to say, contact with food ... at the end of the month, Laurent only tries to nurse when he is in his mother's arms and no longer when on the dressing table. (*OI*, p. 58)

> . . . between 0;3(15) and 0;4 . . . [when Laurent] is put in my arms in position for nursing, he looks at me and then searches all around . . . but he does not attempt to nurse. When I place him in his mother's arms without his touching the breast, he looks at her and immediately opens his mouth wide. (*OI*, p. 60)

The infant initially sucks, then, only when the nipple is inserted in his mouth. The nipple is an external excitant which automatically elicits sucking. After a period of experience with feeding, he makes sucking-like movements *before* the external excitant can operate. During the second month, Laurent shows sucking as soon as he is placed in his mother's arms or on the bed. Later, Laurent's sucking-like movements are aroused only by being in the mother's arms. One way of looking at these facts is to say that, while at first only the nipple served as a cue or signal for sucking, later the infant's being in the mother's

arms replaced the nipple as a signal for sucking. Another way of phrasing the matter is to maintain that the infant seems to show a primitive *anticipation* of feeding and that this expectancy, as time goes on, is evoked by fewer and more appropriate events than formerly. In either event, the phenomenon is similar to what has been called "classical conditioning," although Piaget's explanation of the facts differs from the traditional one.

Piaget emphasizes that the association between sucking and the various signals (e.g., position in the mother's arms) that precede it is not acquired in a mechanical way. What happens is this: the sucking scheme comes to consist of more than sucking alone. It also involves a set of postural kinesthetic cues. That is, when the infant nurses in the first few months he is almost invariably held in the same position, and the internal body sensations associated with this position become a part of the act of sucking. The body sensations and the movements of the lips form a whole. Then, when the infant is placed in the position for nursing and the postural and kinesthetic sensations are activated, the whole cycle of the sucking act is released. Because the two aspects of the cycle—bodily sensations and lip movements—form a whole, the occurrence of one aspect usually evokes the other. Piaget feels that this process does not involve mere "passive recording" on the part of the child, since the infant himself *enlarges* the initially limited scheme of sucking to include other components such as bodily cues. Furthermore, the association cannot be maintained if it is not consistently "confirmed" by the environment. That is, for postural cues to provoke the child's anticipatory sucking, the sucking must ordinarily be followed by drinking milk. Thus, the association between postural cues and sucking derives its meaning only from a larger set of relationships existing between the scheme of sucking and its satisfaction. The reflex must have a chance to function effectively (to drink milk) before any associations can be formed. Thus, the sequence *bodily cues* —► *sucking* —► *satisfaction of need* forms a whole, and to isolate the first two terms in this sequence and call them a conditioned reflex omits much that is relevant.

Curiosity

In the discussion of the second stage Piaget introduces a motivational principle of great importance. The following is a preliminary observation in connection with the problem of vision:

> Laurent at 0;0(24) watches the back of my hand, which is motionless, with such attention and so marked protrusion of the lips that I expect him to suck it. But it is only visual interest. … At 0;0(25) he spends nearly an

hour in his cradle without crying, his eyes wide open. . . . He stares at a piece of fringe on his cradle. (*OI*, p. 64)

Why does the infant attend to these mundane features of the environment? He is not rewarded for doing so and is not in any other way encouraged to direct attention to an object like the fringe of the cradle. Again, Piaget invokes the principle of functional assimilation to account for these facts. The eyes are structures, given by specific heredity, and require exercise. In the present instance exercise means looking at thing, and the things looked at are necessary for the functioning of the eyes.

Thus far, the principle of functional assimilation has been applied to the case of vision in much the same way as it was used to explain some features of sucking: both schemes need to function. One result of repetitious looking at things is that they become familiar to the infant. Through a process of perceptual learning, the infant becomes acquainted with the environment and comes to recognize things. These observations are made next:

> At 0; 1(15) he systematically explores the hood of his bassinet which I shook slightly. He begins by the edge, then little by little looks backward at the lowest part of the roof. . . . Four days later he resumes this exploration in the opposite direction. . . . Subsequently, he constantly resumes examining the cradle, but, during the third month, he only looks at the toys hanging from the hood or at the hood itself when an unwonted movement excites his curiosity or when he discovers a particular new point (a pleat in the material, etc.). (*OI*, p. 68)

Notice how at first the infant thoroughly examines the cradle until he is apparently familiar with it. Then, during the third month his attention becomes more selective than was previously the case. He no longer seems to explore the cradle and instead directs his attention to novel objects or movements connected with the cradle. For example, he stares at toys hanging from the hood or at a previously unnoticed pleat in the material.

Piaget's explanation of the infant's curiosity involves an extension—really a further specification—of the principle of generalizing assimilation. The infant's looking scheme, according to Piaget, tends to extend the range of objects it "uses." But the infant does not simply look at more and more things. His visual preferences become selective. The infant's attention is directed at events which are *moderately novel:* "one observes that the subject looks neither at what is too familiar, because he is in a way surfeited with it, nor at what is too new because this does not correspond to anything in his [schemes]" *(OI,* p. 68). This motivational principle may appear deceptively simple and trite. In reality, however, it represents a

point of view which is radically different from previous (and some current) theories and is only now receiving the attention it deserves. First, like the principle of assimilation, the moderate novelty principle is strongly at odds with theories which stress avoidance of stimulation as the only kind of motivation. On the contrary, according to Piaget's view, the child actively seeks out new stimulation—he is not forced to look at novel objects. Second, the moderate novelty principle is different from other motivational theories in that it is a relativistic concept. That which catches an inpidual's curiosity is not entirely the physical nature of the event. It is not the object per se that attracts attention; instead, curiosity is a function of the *relation* between the new object and the inpidual's previous experience. A given toy may elicit interest in one child and boredom in another. Presumably the first child has had experience with toys moderately different from the one in question; the second child may either have had experience with toys *highly* similar to the new one or else may have had no experience with toys, in which case the new object presumably "does not correspond to anything in his [schemes]." In sum, the novelty principle asserts that what determines curiosity is not the physical nature of the object, but rather the degree to which the object is discrepant from what the inpidual is familiar with, which, of course, depends entirely on the inpidual's experience.

Imitation

An important aspect of the infant's behavior is imitation. Piaget considers imitation, like all other behaviors, as yet another expression of the infant's endeavors to comprehend reality and interact effectively with the world. Consequently, the development of imitation is seen to progress concurrently with other aspects of the infant's behavior.

During stage 2, as we have seen, the reflexes are modified to become habits or primary circular reactions. This extension of the child's hereditary schemes leads to a rudimentary and sporadic form of imitation. At this stage the child imitates only actions which he has himself previously performed. Since the child's repertory of actions is still restricted, imitation is confined to elementary vocal and visual movements, and to grasping (prehension). Here is an example of the imitation of this stage:

> At 0; 1(21), Lucienne spontaneously uttered the sound rra, but did not react at once when I reproduced it. At 0;1(24); however, when I made a prolonged aa, she twice uttered a similar sound, although she had previously been silent for a quarter of an hour.

> At 0; 1(25) she was watching me while I said "a ha, ha, rra," etc. I noticed certain movements of her mouth, movements not of suction but of vocalization. She succeeded once or twice in producing some rather vague sounds, and although there was no imitation in the strict sense, there was obvious vocal contagion.
>
> At 0;3(5) I noted a differentation in the sounds of her laughter. I imitated them. She reacted by reproducing them quite clearly, but only when she had already uttered them immediately before.
>
> At 0;3(24) she imitated aa, and vaguely arr in similar conditions, i.e., when there was mutual imitation. (*Play, Dreams, and Imitation in Childhood*, PDI, p. 10)

The early forms of vocal imitation are characterized by two major features. First, there is the phenomenon of "vocal contagion." A person called a "model" makes a sound, and the infant tries to reproduce it. Limited abilities, however, prevent the infant from perfect reproduction of the sounds. Nevertheless, stimulated by the model's sounds, the infant continues to produce vocalizations of many kinds having little relation to the model's sounds. "Vocal contagion" refers, then, to the model's stimulation of diffuse vocal activity in the infant.

Second, there is "mutual imitation." If the model reproduces a sound which the infant is currently engaged in producing, the child is stimulated to repeat the same sound. If the model again imitates the child, there is set in motion a pattern of alternating imitation by infant and model which continues until one or the other tires or loses interest. This pattern of behavior does *not* occur if the model makes a sound which is new for the infant.

Piaget explains both the contagion and mutual imitation phenomena by reference to the principle of functional assimilation. You may recall that the child has a tendency to repeat schemes which have already been established. In the case of vocal contagion the principle of functional assimilation is applied in the following way. When the model makes a sound the infant does not distinguish it from his own; it is as if the infant had made the sound. Because of the process of functioned assimilation, the infant tends to repeat the activity (not distinguished from his own) which has already been set in motion; that is, the infant carries on the activity of making sounds in general.

In the case of mutual imitation a similar explanation is advanced. When the infant produces a sound, the model's imitation merely stimulates the process of functional assimilation. The infant's imitation is in a way illusory; the infant does not so much *reproduce* the model's behavior as merely continue his own. Note that in both cases—contagion and mutual imitation—the infant repeats behavior

of which he is already capable. The infant cannot yet reproduce novel activities of a model.

Categories of Reality

Thus far, we have described the inception of several aspects of the infant's behavior. In particular, we have noted the contribution of experience toward the elaboration of the infant's activity, and the ways in which he extends his behavior beyond the feeding situation. As the infant begins to manipulate surrounding objects, he gradually develops a practical "understanding" of external reality. In playing with toys, blankets, his own body, and adults, he learns something about the properties of these things and about the relations among them. And as skills increase in number and scope, the infant acquires an increasingly complex practical knowledge of certain features of the environment.

During the sensorimotor period, the infant elaborates severed basic dimensions of reality, especially the primitive notions of the *permanent object*, *space*, *time*, and *causality*. At first, these basic dimensions of reality are closely related to the infant's bodily actions, to the movements of his arms, fingers, legs, and eyes. The infant's initial "understanding" of the world is based entirely on what Piaget calls the "plane of action." Only later, after a gradual process of development, does the infant become able to elaborate the categories of reality on the "plane of thought." One of Piaget's central themes is that concrete action precedes and makes possible the use of intellect. Thus, the acquisitions of the sensorimotor period form the foundations of the inpidual's mental development. We will discuss only one of these categories, the concept of the permanent object. The other notions follow a similar development.

Object Concept (Stages 1 and 2)

To understand the development of what Piaget calls the *object concept*, it is important to keep in mind one essential point. An "object," according to Piaget, is something which the inpidual conceives of as having a reality of its own, and as extending beyond his immediate perception. For example, a man who has hung his coat in a closet knows several hours later that, in all likelihood, the coat is still there. Although he cannot see or touch the coat, he knows that it remains behind the closet door. The object, therefore, involves more than the direct perception of external reality; the object is conceived to exist

independently of a person's perception of it. Strange as it may sound, the infant is at first incapable of this apparently simple notion, and it is only after a long process of development that he elaborates the cognitive skills necessary for a mature object concept.

During stage 1 the infant's reactions are evoked only by immediately present sensory events which may be internal or external. Feeling the pangs of hunger, the infant cries; experiencing a touch on the lips, he sucks. The same holds in the case of visual perception. If the mother's face suddenly appears in the visual field, the infant stares at it. But when the face is just as suddenly withdrawn, the infant immediately stops looking and resumes other activities. It is clear that the infant has no conception that the face continues to exist when he loses visual contact with it. Instead, the infant merely perceives an unrelated series of images or *pictures,* as Piaget calls them, which appear and then disappear.

Certain behavioral patterns which appear in stage 2 are a first step toward the acquisition of the object concept. The infant coordinates various perceptual schemes which, until then, had been used in unrelated ways. Consider the coordination of vision and hearing. In stage 1, if a sound had occurred near a newborn, he would have shown evidence (for example, a startle) of having heard it, but he would have made no effort to bring the source of the sound into sight. In stage 2, however, the infant tries to turn toward the sound he hears to see what produced it. At first these efforts are clumsy, but with practice, they gradually improve and become more successful. Because of this coordination of vision and hearing, external reality is usually experienced through two or more senses simultaneously. The result is that after a time the infant establishes relations between what is heard and seen. He finds that certain sounds, like the voice, usually emanate from certain sources, like the mouth. The infant begins to discover a coherence in the world. Instead of merely perceiving isolated and unrelated aspects of reality, the infant learns that sights and sounds (and other kinds of percepts too) often go together in regular ways. This coordination of basic schemes, since it introduces a measure of coherence to the infant's world, is a vital first step toward acquisition of the object concept.

Another accomplishment of stage 2 concerns *passive expectation.* The clearest example involves vision. At this stage the infant can follow a moving object with his eyes. Or, as Piaget says, the infant accommodates his looking scheme to the moving thing. The interesting observation here is that once the object leaves the visual field, the infant continues to stare at the spot where the thing disappeared. One

might almost be tempted to state that he already has the object concept and is hoping for the thing to return. But this interpretation, Piaget feels, is fallacious, since the infant does not actively *search* for the vanished object as he will do in later stages. Instead, the stage 2 infant merely pursues an action (looking) which has been interrupted. If after a short while the thing does not reappear, the infant discontinues passive watching and turns to other elements of his surroundings. But this passive expectation, which does not go beyond the simple repetition of the already-activated looking scheme, is the first step toward the later active search for the missing object and hence toward acquisition of the object concept.

In summary, the first two stages are characterized by a passive attitude toward objects which disappear from the infant's immediate perception. In stage 1, the infant immediately turns attention to those things he can see; in stage 2, he merely repeats earlier actions (looking) which occurred when the object was present. While the second reaction represents an advance over the first, both indicate the lack of the mature object concept.

STAGE 3: 4 TO 10 MONTHS

Secondary Circular Reactions

In stage 2, the primary circular reaction is always centered on the infant's own body. The infant learned, for example, to bring the thumb to his mouth. In stage 3, the infant's horizons expand. He begins to crawl and manipulate things extensively. The circular reactions of this stage are called "secondary," since they now involve events or objects in the external environment. The secondary circular reactions describe the infant's new-found ability to develop schemes to reproduce interesting events which were initially discovered by chance in the external environment. The following excerpt is a lengthy record of such a reaction and illustrates Piaget's skill and caution as an observer:

> Laurent, from the middle of the third month, revealed global reactions of pleasure, while looking at the toys hanging from the hood of his bassinet. . . . He babbles, arches himself, beats the air with his arms, moves his legs, etc. ... At 0;2(17) I observe that when his movements induce those of the toys, he stops to contemplate them, far from grasping that it is he who produces them. . . . On the other hand at 0;2(24) I made the following experiment. ... As Laurent was striking his chest and shaking his hands which were bandaged and held by strings attached to the handle of the bassinet (to prevent him from sucking), I had the idea of using the thing, and I attached the strings to the celluloid balls hanging from the hood. Laurent naturally shook the balls by chance

> and looked at them at once (the rattle made a noise inside them). As the shaking was repeated more and more frequently Laurent arched himself, waved his arms and legs—in short, he revealed increasing pleasure and through this maintained the interesting result. But nothing yet authorizes us to speak of circular reaction. . . .
>
> The next day, at 0;2(25) I connect his right hand to the celluloid balls. . . . The left hand is free. At first the arm movements are inadequate and the rattle does not move. Then the movements become more extensive . . . and the rattle moves. . . . There seems to be conscious coordination but both arms move equally and it is not yet possible to be sure that this is not a mere pleasure reaction. The next day, same reactions.
>
> At 0;2(27), on the other hand, conscious coordination seems definite, for the following four reasons: (1) Laurent was surprised and frightened by the first shake of the rattle which was unexpected. On the other hand, since the second or third shake, he swung his right arm (connected to the rattle) with regularity, whereas the left remained almost motionless. . . . (2) Laurent's eye blinks beforehand as soon as his hand moves and before the rattle moves, as though the child knew he was going to shake it. (3) When Laurent temporarily gives up the game and joins his hands for a moment, the right hand (connected to the rattle) alone resumes the movement while the left stays motionless. (4) The regular shakes . . . reveal a certain skill; the movement is regular.
>
> At 0;3(10) I attached a string to the left arm after six days of experiments with the right. The first shake is given by chance: fright, curiosity, etc. Then, at once, there is coordinated circular reaction: this time the right arm is outstretched and barely mobile while the left swings. . . . This time it is therefore possible to speak definitely of secondary circular reaction. (*OI*, pp. 160-62)

One interpretation of the infant's behavior is that a secondary circular reaction is involved. The infant, lying in his crib, by chance makes an arm movement which causes the string attached to his hand to move and rattle the toys. Laurent does not, of course, have this goad in mind from the outset. The movement and rattling are interesting to the infant, and he desires to continue them. Over a period of time, he learns the arm movements necessary to reproduce the interesting result. At this point, his behavior is intentional.

But another interpretation is possible, and it is particularly fascinating to observe how Piaget attempts to rule it out. The alternative explanation asserts that the infant's arm movements are not intended to produce the interesting result. Instead, just the reverse is true: the interesting event causes arm movements in the infant. In other words, the infant initially moves his arm by accident. The balls move and make the infant happy. As part of his joy the infant shows physical excitement which again, by accident, produces the shaking of the balls; this in turn starts the cycle over again and is the *cause* of the infant's hand movements.

The observations show that Piaget was quite cautious in his interpretations. He did not accept the first explanation (secondary circular reaction) until the facts made it abundantly clear that the

alternative explanation was not plausible. For example, Piaget observed that Laurent seemed to anticipate the result before it occurred; consequently, the result could not be an accident. In fact, the sequence of observations shows why Piaget's observational procedure is not necessarily inferior to the formal experimental method; the advantages of detailed knowledge of the child's history are obvious, and many of the observations perform the same function as control groups in ordinary experiments.

The explanation of the infant's learning of secondary circular reactions involves many of the principles that were invoked earlier. First, the infant's accidental movement produces an external result which is moderately novel and which therefore interests him. Second, the infant perceives that his actions are related to the external result. Piaget asserts that if the infant does not perceive the connection, no further learning is possible. Third, once the interest and the connection between act and result are established, the infant desires to repeat the interesting event. In other words, after the infant looks at and listens to the toys rattling (or, in more technical language, assimilates the interesting event into the visual and auditory schemes), he wants to reinstate the interesting events and assimilate them once again into the schemes of looking and listening. This, of course, is the familiar principle of functional assimilation: once a scheme (in this case viewing and hearing the toys) is able to function, it tends to repeat itself. After this point, the infant's goal of restoring the interesting events motivates and directs actions.

Thus far, the infant has perceived an interesting result, has recognized that it is connected to his actions, and desires to repeat the result. The fourth step involves accommodation; the infant needs to learn the hand movements necessary for consistent reproduction of the result. Part of the process involves rediscovering the movements which were previously effective. While Piaget does not make the matter entirely explicit, it is clear from his observations that a directed trial-and-error process is involved. The infant's behavior is directed in the sense that the desire to reproduce the interesting result guides his actions and in the sense that he attempts only behaviors which are clearly relevant: the infant does not kick his feet, but limits his efforts to arm movements. Within these constraints the process involves trial and error since the infant does not know at first precisely which arm movements are effective. He has to try them out to see which meet with success and which with failure. It is also clear from the observations, and again not explicit in Piaget's explanation, that the infant does not simply rediscover old movements. This may be the original objective and accomplishment, but with practice the infant develops movements which are more precise, skilled, and effective than those which originally and accidentally

obtained the goal.

The result of this activity is a secondary circular reaction which is a far more complex structure than anything the infant had developed earlier. Now the infant is interested in the external environment and is able to develop behaviors which serve as a primitive means for obtaining various ends. However, the secondary circular reaction has two deficiencies. First, it is not fully intentional as the infant does not have a goal in mind from the outset; rather, the goal has been discovered by accident, and it is only after this chance event has occurred that the goal guides behavior and gives it thereby a purposive character. A second deficiency is that the behavior is essentially conservative. The infant's aim is to reproduce, to duplicate some behavior which produced interesting results in the past. He does not attempt to invent new behaviors. These two deficiencies lead Piaget to maintain that the secondary circular reaction does not yet constitute *intelligent* behavior.

Primitive Classes

One of the most interesting aspects of Piaget's theory has to do with the infant's formation of classes or meaning. Their development, according to Piaget, begins very early in life. The following observations illustrate the matter:

> At 0;6(12) Lucienne perceives from a distance two celluloid parrots attached to a chandelier and which she had sometimes had in her bassinet. As soon as she sees them, she definitely but briefly shakes her legs without trying to act upon them from a distance. ... So too, at 0;6(19) it suffices that she catches sight of her dolls from a distance for her to outline the movements of swinging them with her hand.
>
> From 0;7(27) certain too familiar situations no longer set in motion secondary circular reactions, but simply outlines of schemes. Thus when seeing a doll which she has actually swung many times, Lucienne limits herself to opening and closing her hands or shaking her legs, but very briefly and without real effort. (*OI*, pp. 186-87)

In essence, Piaget has observed that when the infant comes into contact with some familiar object he does not apply to it the secondary circular reaction which normally would be employed. Instead, Lucienne exhibits an *abbreviated* form of the behavior and does not seem to intend to produce the usual result. The abbreviated action does not seem mechanical, like a conditioned response. Further, the infant is "perfectly serious" and repeats the action on a number of different occasions.

Piaget's interpretation is that the abbreviated acts are special cases of recognitory assimilation. If

you will recall, in earlier stages the infant's overt behavior showed the ability to distinguish between various objects; for example, when hungry he sucked the nipple but rejected a pacifier. Thus, the infant's behavior is said to involve recognitory assimilation when he is selective in applying specific schemes to various aspects of the environment.

The case of abbreviated movements involves a similar selectivity. Lucienne, for example, kicks in response to toys which she has swung, but not in response to other toys. However, the present instance involves more than selectivity. The infant's behavior is abbreviated; she does not choose to display the entire scheme when it would be quite feasible to do so. Piaget interprets the abbreviation as a behavioral precursor of *classification* or *meaning*. Lucienne, of course, does not have an abstract conception of the parrot. She cannot verbalize its properties or identify it as an instance of the class of animal toys. But the abbreviated behavior shows that Lucienne makes a beginning attempt at classification of the object. The brief kicking, for instance, is the first step toward thinking the thought, "That's the parrot; that's something to be swung." Her "understanding" is of course quite primitive and does not yet operate on a mental level. Nevertheless, she has made progress over stages 1 and 2, since she displays behavior which indicates that the initial steps toward internalization of action are occurring. The abbreviated scheme is the first approximation to thought.

Piaget proposes a technical terminology for describing these events. He designates as a *signifier* an object or event that stands for something else; the child's reaction to the object or event is the *signified.* In the present case the signifier is the parrot, and the signified is the child's brief kicking. The signifier is the "thing," and the signified is what it means to the infant. With development, the signifier may be no longer a thing but a word, and the signified may be not a behavior but an act of intellectual understanding.

Primitive Relations

As we shall see later, in Chapter 4, classification is considered a vital aspect of the child's thought and is investigated in great detail. Similarly, we shall see in the same chapter that the notion of *relation* occupies a prominent place in Piaget's theories. And relations, too, have primitive behavioral origins which arise in the course of the first several stages. Here is an example:

In the evening of 0;3(13) Laurent by chance strikes the chain while sucking his fingers ... he grasps it and slowly

> displaces it while looking at the rattles. He then begins to swing it very gently which first produces a slight movement of the hanging rattles and an as yet faint sound inside them. Laurent then definitely increases by degrees his own movements: he shakes the chain more and more vigorously and laughs uproariously at the result obtained.—On seeing the child's expression it is impossible not to deem this gradation intentional. (*OI*, p. 185)

In other words, the infant seems to see the difference between a slight movement on his part and a strong one; similarly, he can discriminate between a loud and a soft rattle. The infant can put two sounds or two movements into relationship with each other. Furthermore, the infant seems to see that the intensity of his movements is directly related to the intensity of sounds made by the rattle. These perceptions of differences in intensity are the origins of quantitative thought. We shall see later how these relationships are developed in stage 4.

Imitation

In stage 3 the infant's attempts at imitation become increasingly systematic. Through the secondary circular reactions the infant acquires increasingly extensive experience of the environment. The infant's schemes increase in number and range, with the result that he is more capable than formerly of behavior which matches that of a model. Since he can now assimilate more models, there is greater opportunity for imitation. It is still the case, however, that the infant continues to imitate only what is familiar—only actions which he already can do—and cannot yet reproduce novel actions. This conservative feature of imitation is analogous to that displayed by the secondary circular reactions.

Object Concept

In stage 2 we saw that the infant made no attempt to search for a vanished object. Stage 3, on the other hand, is characterized by the acquisition of four new behavior patterns which represent considerable progress in the formation of the object concept.

First, there is visual anticipation of the future positions of objects. If, for example, an object drops very quickly and the infant cannot see all the movement, he can nevertheless anticipate the final resting place of the object. At first the infant does this best if he himself has dropped the object. Later, he can anticipate the position of an object dropped by someone else. Consider the following illustration:

> At 0;6(3) Laurent, lying down, holds in his hand a box five centimeters in diameter. When it escapes him he looks for it in the right direction (beside him). I then grasp the box and drop it myself, vertically, and too fast for him to be able to follow the trajectory. His eyes search for it at once on the sofa on which he is lying. I manage to eliminate any sound or shock and I perform the experiment at his right and at his left; the result is always positive. (*The Construction of Reality in the Child*, CR, pp. 14-15)

Here we see that the infant no longer continues passive viewing of the place where he saw the object vanish, as he did in the previous stage, but he now visually searches for it in a new location. This behavior shows that the infant anticipates that the object's movement will continue even though he himself is unable to see it. In this sense the infant confers on the object a preliminary sort of intrinsic permanence which, however, remains subjective since it is closely related to his own actions. He searches for the object chiefly if he himself has caused its disappearance.

A second achievement of this stage is what Piaget calls *interrupted prehension.* This is the tactual equivalent to the above-mentioned behavior of visual accommodation to rapid movements. In other words, if the infant has already set in motion certain movements of the hand or fingers for the purpose of grasping an object and then loses it or does not succeed in grasping it, he will search for the object by continuing the movements.

As in the case of visual accommodation, the infant attributes only a subjective permanence to the object. The object exists only in relation to the action he was performing when it vanished or slipped from his grasp.

The infant originates no new movements to retrieve the lost object, but merely repeats past gestures of holding or attempting to hold the object. Also, if no movements toward the object had been initiated in the first place, the infant makes no active attempt to search for a disappearing object.

Third, we can observe during this stage a behavior which is called *deferred, circular reaction.* In this case a circular reaction involving an object is interrupted and resumed spontaneously by the infant at a later time. The resumption of the actions on an object implies that the infant expects it to continue to be available. For example,

> At 0;8(30) Lucienne is busy scratching a powder box placed next to her on her left, but abandons that game when she sees me appear on her right. She drops the box and plays with me for a moment, babbles, etc. Then she suddenly stops looking at me and turns at once in the correct position to grasp the box; obviously she does not doubt that this will be at her disposal in the very place where she used it before. (*CR*, p. 25)

This is an important step forward, since such behavior is not merely a continuation of previous movements when an object is lost from sight or touch. Here the action has been completely interrupted and replaced by another quite different pattern of behavior. Yet at a later point, not too far removed in time, the infant of his own accord returns to the place where he had been playing and expects what he had been playing with to be there still. This shows that the infant attributes at least some permanence to the object. Despite this accomplishment, the infant's object concept is not yet fully developed. By contrast with advances to be made in the future, the infant's behavior in the present stage is still too closely associated with a practical situation and previous activities, and does not yet involve an entirely mature object concept.

In a fourth reaction typical of the present stage, the infant can now recognize an invisible object even when able to see only certain parts of it. If the infant is shown a toy which (while he watches) is completely covered by a cloth, he makes no attempt to search for the toy. If, however, certain parts are left visible the infant tries to lift the cloth to discover the rest of the toy. But even this ability is curiously limited; he is able to recognize the whole only when some portions are visible. For example, one of Piaget's children was able to recognize his bottle only if either end was visible and the middle hidden. If only the middle portion were shown, he was not able to recognize the bottle and made no attempt to suck on it.

The recognition of partly hidden objects occurs only after the child has acquired sufficient skill in manipulating things. While handling a variety of toys and other objects, the infant explores them visually. By varying the distances and angles of these things, bringing them closer to the eyes, turning them around, and moving them from side to side, the infant will gradually gain a better knowledge of their shape and their other properties. This sort of knowledge, of course, is necessary for such activity as the recognition of partly hidden objects and thus contributes toward the development of a genuine object concept.

In brief, we see that the four behaviors of the present stage—(1) visual anticipation of rapid movements, (2) interrupted prehension, (3) deferred circular reactions, and (4) reconstruction of an invisible whole from a visible fraction—all present similar limitations and shortcomings with respect to the object concept. These behaviors all indicate that at this stage the object does not have a fully

independent or inpidual existence but is closely related to the infant's own action. When the object disappears, the infant is content to repeat actions that were being performed at the time of its disappearance. The infant's attempts to rediscover the lost object consist only of a repetition of the past actions associated with the object. No novel behavior is introduced.

STAGE 4: 10 TO 12 MONTHS

Coordination of Secondary Schemes

The following observations show how after initial failure the child develops the behavior patterns characteristic of stage 4:

> at 0;6(0) I present Laurent with a matchbox, extending my hand laterally to make an obstacle to his prehension. Laurent tries to pass over my hand, or to the side, but he does not attempt to displace it. As each time I prevent his passage, he ends by storming at the box while waving his hand. . . . Same reactions at 0;6(8), 0;6(10), 0;6(21), etc.
>
> Finally, at 0;7(13) Laurent reacts quite differently almost from the beginning of the experiment. I present a box of matches above my hand, but behind it, so that he cannot reach it without setting the obstacle aside. But Laurent, after trying to take no notice of it, suddenly tries to hit my hand as though to remove or lower it; I let him do it to me and he grasps the box. I recommence to bar his passage, but using as a screen a sufficiently supple cushion to keep the impress of the child's gestures. Laurent tries to reach the box, and bothered by the obstacles, he at once strikes it, definitely lowering it until the way is clear. . . .
>
> Moreover, one notes that the intermediate act serving as means (removing the obstacle) is borrowed from a familiar scheme: the scheme of striking. We recall that Laurent from 0;4(7) and above all from 0;4(19) has the habit of hitting hanging objects in order to swing them and finally from 0;5(2) of striking the objects. . . . Now, this is the usual scheme of which Laurent makes use at the present time, no longer in the capacity of an end in itself (of
>
> a final scheme) but as a means (a transitional or mobile scheme). (*OI*, pp. 217-18)

The interpretation of Laurent's behavior utilizes many of the principles discussed in connection with stage 3. There are, however, some important differences. One difference is that Laurent has the goal in mind from the outset. If you will recall, in stage 3 the infant *accidentally* discovers a goal and only then pursues it. In stage 4, on the other hand, Laurent initially perceives the presented object as a familiar goal. The infant has already developed schemes for dealing with the goal and immediately tries to assimilate it into them. Or in simpler language, the infant already knows what to do with the object and wants to do it. The directional force affecting the infant's behavior—his desire to achieve the goal—is, of

course, once again a matter of functional assimilation. Once the scheme of the goal—grabbing the matchbox—is activated, it needs to function.

But an obstacle arises (the father's hand or the cushion) which prevents the child from attaining the goal. Now we can see the second feature which distinguishes behavior in stage 4 from that in stage 3. The infant is now required to develop new means for removing the obstacle to achieve his ends. Unlike stage 3, it is not now simply a matter of *rediscovering* some behavior which earlier led (accidentally) to the goal. The infant must show some degree of originality to remove the obstacle. But this originality is of a very limited sort. Instead of *inventing* new means for dealing with the obstacle, Laurent attempts to utilize as means schemes which have been developed in connection with other situations. That is, he generalizes patterns of previously learned behavior to the new problem (generalizing assimilation). In the course of this generalization, the older schemes may be somewhat, but not fundamentally, modified. Also, he may try out several schemes, but in the end retains only the one which works by removing the obstacle. Accommodation is once again dependent on practical success. The result is a coordination of two secondary schemes, each of which had been learned earlier, and each of which is only slightly modified for the present occasion. One scheme serves as the means and the other as the ends. The child's originality rests not in inventing two separate schemes but in combining in a novel way two previously learned patterns of behavior.

Several features of this coordination are emphasized by Piaget. First, it is still essentially conservative. The infant's aim is to treat the goal object in the same way as previously. Once the obstacle is removed, the infant applies a *familiar* scheme. Second, the infant's behavior at this stage is for the first time truly intentional and therefore "intelligent." Piaget's criteria for the existence of intention are three in number: (1) the infant has the goal in mind from the beginning and does not discover it accidentally as was the case in stage 3, (2) an obstacle arises which prevents direct attainment of the goal and necessitates some kind of indirect approach, and (3) to overcome the obstacle, the infant employs a scheme (means) which is different from that employed in the case of the goal (ends).

A third feature of this coordination emphasized by Piaget is that the behavior under discussion is mobile. The novel coordination between two schemes not previously associated is made possible by the infant's relatively new ability to detach his schemes from their usual contents. In other words, the scheme

used as means is generalized or transferred from the situation in which it was originally learned. This flexibility in the application of schemes is what constitutes mobility.

Relations

In stage 3 we discussed the very first manifestations of relations in the infant. With the coordination of schemes in stage 4, the infant becomes capable of establishing more complex relationships.

Let us recall, for example, Laurent's coordination of secondary schemes: removing an obstacle to attain a goal. When Laurent does this, it is as if he "understands" that the obstacle stands in a certain relationship to the goal. The obstacle is *in front of* the goal, and it must be removed *before* the goal can be attained. In other words, just as an abbreviated performance of one scheme is a primitive indication of a class, so the *coordination* of two schemes implies a behavioral analogue of the understanding of relations.

Let us take another example:

> at 0;9(17), Laurent lifts a cushion in order to look for a cigar case. When the object is entirely hidden the child lifts the screen with hesitation, but when one end of the case appears Laurent removes the cushion with one hand and with the other tries to extricate the objective. The act of lifting the screen is therefore entirely separate from that of grasping the desired object and constitutes an autonomous "means," no doubt derived from earlier and analogous acts. (*OI*, p. 222)

Thus the sequence is a clear case of secondary circular reaction. Laurent has learned how to get the goal. But has he not also learned something of the relation between obstacle and goal? Laurent's behavior may be interpreted as showing a concrete understanding of certain relations: the cushion is *on top of* the cigar box which in turn is *under* the pillow. We emphasize once again that the child's "understanding" of relations is not abstract like the adult's; instead, it is entirely contained in his means-end behavior.

Perhaps the most remarkable feature of relations is that even in the first few stages, they involve an element of quantity. For example,

> At 0;9(4) Laurent imitates the sounds which he knows how to make spontaneously. I say "papa" to him, he replies *papa* or *baba*. When I say "papa-papa" he replies *apapa* or *bababa*. When I say "papapapapapapa" he replies *papapapa*, etc. There exists a global evaluation of the number of syllables: the quantity corresponding to 2 is in any case distinguished from 3, 4, or 5. . . .
>
> At 0;10(4) Laurent repeats *pa* when I say "pa," papa for "*papa*" and papapa for a number of 4 or more than 4.

(*OI*, p. 241)

Thus the infant shows a primitive appreciation of number in the ability to discriminate among different numbers of syllables.

Anticipation

If you will, recall that in connection with the abbreviated schemes of stage 3, we discussed the development of the operations of classification and the relation between the signifier and the signified. For example, when Lucienne briefly shakes her legs at the hanging parrots, the sight of the toys is the signifier and the abbreviated motion is the signified—the primitive meaning of the parrots for the child. In the present stage, the system of meanings is used in the service of anticipation. (This occurs also in stage 3, but in rudimentary form.) Here is an example concerning Jacqueline:

> At 0;9(16) . . . she likes the grape juice in a glass, but not the soup in a bowl. She watches her mother's activity. When the spoon comes out of the glass she opens her mouth wide, whereas when it comes from the bowl, her mouth remains closed. ... At 0;9(18) Jacqueline no longer needs to look at the spoon. She notes by the sound whether the spoonful comes from the glass or from the bowl and obstinately closes her mouth in the latter case. . . .
>
> Lucienne has revealed most of the same reactions. Thus at 0;8(23) she also closes her mouth to the spoonful coming from the bowl (of soup) and opens it to those coming from the glass (of fruit juice). (*OI*, p. 249)

How can we interpret these reactions? First, note that they are *anticipatory.* The infant does not avoid the soup when it is in her mouth, but before it gets there. Apparently the sight of the soup or even its distinctive sound is a signifier, and the signified is the unpleasant taste of the soup. In other words, the infant sees or hears the soup, and its meaning for her is an unpleasant experience. She then closes her mouth, not in response to the actual taste of the soup, but to the meaning that soup has for her before it enters her mouth. Furthermore, the infant in this stage does not form only anticipations which are connected with her own actions. For example, Jacqueline once cried when she saw someone who was sitting next to her get up. Apparently for Jacqueline the sight of the person getting up was a signifier of his expected imminent departure (the signified), and it was to this signified (the expectation of departure) that she reacted.

How do these anticipations develop? Formerly, Jacqueline had observed that the signifier—in this

case the person getting up—was followed by another event, his departure. She had consequently perceived a connection between the two events, so that now the signifier gives rise to an anticipation concerning the event to follow.

Imitation

Considerable progress in imitation occurs during stage 4. The infant can now establish relationships between the movements of a model and the corresponding movements of invisible parts of his own body. Also, he begins to imitate new actions of models.

Consider this example of the first case:

> at 0;8(4) Jacqueline began by making a slight noise with her saliva as a result of the friction of her lips against her teeth, and I had imitated this sound at the outset. [On the same day] Jacqueline was moving her lips as she bit her jaws. I did the same thing and she stopped and watched me attentively. When I stopped she began again. I imitated her. She again stopped and so it went on. (*PDI*, pp. 30-31)

Here we see that Jacqueline establishes a connection between what she sees in the model (the movement of his lips) and what she cannot see in herself, but can only feel, namely, her own lip movements. How does she manage to do this? At first with her saliva she makes a sound which is imitated by Piaget. Jacqueline repeats this sound and at the same time carefully watches the movements of the model's mouth. Now while she is reproducing the sound of the saliva and watching Piaget's mouth, she becomes aware of certain tactile-kinesthetic feelings. The sound becomes associated on the one hand with these feelings, and on the other with the sight of the model's lip movements. Thus, the sound is a common denominator linking the visual and kinesthetic cues. Later the sound is no longer necessary, and she becomes able to imitate mouth movements without either the model or herself having to produce the sound first.

The following is an example of the imitation of new actions of a model:

> At 0;9(12) I alternately bent and straightened my finger, and she [Jacqueline] opened and closed her hand. At 0;9(16) she reacted to the same model several times in succession by waving her hand, but as soon as she stopped trying to imitate me she raised her finger correctly. When I resumed she again began to wave goodbye.
>
> At 0;9(19) I tried the same experiment. She imitated me, but used her whole hand which she straightened and

bent without taking her eyes off my finger.

. . . Finally at 0;9(22) she succeeded in isolating and imitating correctly the movement of the forefinger. (*PDI*, pp. 46-47)

Here Piaget initiates a new movement in front of the child. Jacqueline, contrary to her reactions of the preceding stage, no longer ignores the new movement, but tries to imitate it. Two restrictions on the initial imitation of novel behavior are apparent in the foregoing example. In the first place, the infant imitates only movements which are similar to those she is already able to perform. For instance, bending and straightening the finger is not too different from bending and straightening the hand. The infant is consequently interested in imitating such behavior since she can assimilate it to some known scheme. Furthermore, imitation is only very approximate at this point. The infant rarely succeeds in reproducing the correct movement on the first trial. She gradually improves her technique with practice and, by a succession of adjustments, accommodates her schemes to the novel movement.

Object Concept

The behavior of the stage 4 infant toward objects shows a marked progress in comparison with that of the previous stage and is a result of the infant's improved manipulatory skills. Since the infant is now better able to coordinate hand and eye movements, he can explore objects more adequately than before. By holding an object while he brings it closer to or further from the eyes, or by turning it around in the hand, he becomes aware that the object remains the same even though many visual changes have taken place. This discovery leads to the attribution of qualities of permanence and substance to objects. As a result, when an object vanishes the infant tries to find it again by active search. He no longer attempts to rediscover the object by merely prolonging or repeating the actions already underway when the object disappeared. Instead, the infant now initiates new movements and actions which indicate that the object has become detached from its previous subjective relationship with the infant's own activity.

In certain conditions, however, the object concept continues to retain some of its subjective qualities. This phenomenon may be seen clearly from the following observation:

At 0; 10(18) Jacqueline is seated on a mattress without anything to disturb or distract her (no coverlets, etc.). I take her parrot from her hands and hide it twice in succession under the mattress, on her left, in A. Both times Jacqueline looks for the object immediately and grabs it. Then I take it from her hands and move it very slowly before her eyes to the corresponding place on her right, under the mattress, in B. Jacqueline watches this

> movement but at the moment when the parrot disappears in B she turns to her left and looks where it was before, in A. (*CR*, p. 51)

Jacqueline presents the reaction typical of this stage. In certain situations the infant is unable to take into account the number or complexity of the movements of an object, and attempts to look for the object in the place where she had previously succeeded in discovering it. In other words, if the situation is too complex, she tends to attribute to the object a sort of absolute or privileged position which is that associated with previously successful discoveries. If, on the other hand, the object simply disappears in one spot, the infant searches for it in the right place.

In stage 4, then, the infant sometimes attributes to the object qualities of substance and permanence. In straightforward situations the object is detached from the infant's actions and is an objective entity. Should its movements become too complicated for the infant to follow, however, the object once again takes on certain subjective properties and becomes related to the infant's past actions, especially those which had previously proven successful in discovering the object.

STAGE 5: 12 TO 18 MONTHS

Tertiary Circular Reaction

In stage 5 behavior loses its conservative emphasis, and the child, who has now begun to walk, begins to search for novelty. Here is an observation on Laurent:

> at 0; 10(2) Laurent discovered in "exploring" a case of soap, the possibility of throwing this object and letting it fall. Now, what interested him at first was not the objective phenomenon of the fall—that is to say the object's trajectory—but the very act of letting go. He therefore limited himself, at the beginning, merely to reproducing the result observed fortuitously.
>
> ... at 0; 10(10) . . . Laurent manipulates a small piece of bread. . . . Now, in contradistinction to what has happened on the preceding days, he pays no attention to the act of letting go whereas he watches with great interest the body in motion . . . [the falling bread].
>
> At 0; 10(11) Laurent is lying on his back. . . . He grasps in succession a celluloid swan, a box, etc., stretches out his arm and lets them fall. He distinctly varies the positions of the fall. Sometimes he stretches out his arm vertically, sometimes he holds it obliquely, in front or behind his eyes, etc. When the object falls in a new position (for example, on his pillow), he lets it fall two or three more times on the same place, as though to study the spatial relation; then he modifies the situation. At a certain moment the swan falls near his mouth; now he does not suck it (even though this object habitually serves this purpose), but drops it three times more while merely making the gesture of opening his mouth. (*OI*, pp. 268-69)

The striking thing about these observations is Laurent's curiosity about the objects in his world. Laurent does not focus interest on himself or on those properties of an object which aid in attaining some goal; instead, he seems curious about the object as an object, and he seems desirous of learning all he can about its nature. This interest in novelty for its own sake is called a *tertiary circular reaction.*

Piaget's explanation begins with noting that the infant often discovers the initial result by chance. For example, in the process of playing with his soap dish Laurent accidentally dropped it and observed the fall. Moreover, the initial chance event interests the infant, and this interest can be explained in terms of the moderate novelty principle described earlier. The infant, of course, desires to *reproduce* the interesting event, and this behavior involves the principle of functional assimilation. Consequently, Laurent repeats the original act and drops the case of soap several times in succession.

Thus far the infant's behavior is no different from that of stage 3: an interesting result accidentally occurs, and the infant attempts to find a means by which to conserve it. However, at this point two distinctive features of the tertiary reaction manifest themselves. First, instead of continuing simple and rigid repetition of the interesting event, Laurent initiates behavioral changes which produce variations in the event itself. Laurent drops the bread and then the toys from different heights or from different positions. Second, he acts as if he now has interest in the new actions of the objects themselves and searches for novelties—for the unexpected. He seems to treat the unanticipated trajectories of the toys as something to be understood.

The explanation of the tertiary circular reaction involves several steps:

1. At first the infant tries to assimilate the new objects into his usual scheme of dropping. He finds, however, that the habitual scheme does not work very well as he meets with resistance. That is, the infant tries to drop the piece of bread in the same way he dropped the soap case; then he tries to drop the swan in the same way he dropped the bread. Since all these objects do not fall in the same way, he meets with a resistance which is imposed by the reality of the objects themselves. Laurent finds that his available scheme of dropping does not apply in the same way to all of the objects. Each object has properties of its own which must be taken into account.

2. The infant becomes interested in these resistances. Piaget points out that at this stage of development the infant is more capable than before of appreciating novelty. If you will

recall, the "interesting" was defined as that which is moderately different from what the infant recognizes as familiar. Consequently, the more things the infant is familiar with and the more schemes he has, the more objects and events he is able to recognize as novel and interesting. The newborn's world is largely restricted to sucking; events outside the oral sphere (as most events are) cannot be interesting because of the lack of schemes relevant to them. But the infant at stage 5 has developed skills which permit contact with increasingly larger segments of the world; consequently, there is much that he will find interesting. In summary, the more complex the system of schemes, the more the infant will be attracted to novelty. He will then be interested in the resistances encountered by applying old schemes to new events.

3. The infant is interested in the properties of objects from another point of view, too. At this stage the infant has begun to attribute permanence to objects and recognizes that they have an existence independent of his own. In fact, objects are even "centers of forces," with powers and properties of their own. This new objectification of the world also contributes to the infant's desire to explore.

Once the infant recognizes and has interest in the potential novelties of a situation, he begins to accommodate, by "groping" or using a kind of trial-and-error procedure to discover the properties of the objects. The infant's groping does not involve completely random responses; rather each of his explorations guides the next. The results of one "experiment" lead to new experiments. For instance, Laurent may release the swan from points which are increasingly high above his head and observe the extent to which the swan bounces when it hits the bed. The infant, of course, does not know beforehand what will happen; he modifies his behavior to find out. By exploring the object and accommodating his own behavior to it, the infant may eventually become able to master the object—to assimilate it without difficulty into his (modified) schemes. In this way he begins to explore and understand novel aspects of the world.

Discovery of New Means

The infant's tendency toward experimentation permits the discovery of new means for attaining a goal. Consider the following observation on Lucienne at 1 ;0(5). Piaget presents her with this problem. On a table is a large box turned upside down. The box is so arranged that it moves only by pivoting around its center point. On the box, away from the infant's reach, is an attractive toy, a bottle.

Lucienne at first tries to grasp the box, but she goes about it as though the handkerchief were still involved.

> [Pulling a handkerchief was a scheme which Piaget had previously observed in the child.] She tries to pinch it between two fingers, in the center, and tries this for a moment without being able to grasp it. Then, with a rapid and unhesitating movement she pushes it at a point on its right edge. . . . She then notes the sliding of the box and makes it pivot without trying to lift it; as the box revolves, she succeeds in grasping the bottle. (*OI*, p. 287)

To get the object, Lucienne at first attempted to apply an already available scheme; pinching the box like a handkerchief. Then, however, she "groped" and accommodated her behavior in a trial-and-error sort of way. The result was discovery of a new means. Lucienne struck the box, and this action was successful in bringing the toy close. But while her behavior was to some extent characterized by groping, or trial and error, her actions were nevertheless *directed* in two senses. First, her accommodations were directed by the goal: Lucienne wanted to get the bottle and was trying out various means for this purpose. The means were hardly selected in a random fashion; she did not, for instance, try to obtain the toy by taking off her socks. Second, Lucienne interpreted the groping by means of her already available schemes. That is, after Lucienne by chance hit the box and saw it move, she was able, through her past experience, to "understand" the meaning of her action. She interpreted the hitting as another method for displacing objects. Thus the child's groping is directed both by the goal and by earlier schemes which enable her to understand what is happening. Therefore, learning is not explained solely by contact with the environment, that is, by experience with a world that simply forces the infant's behavior to take certain forms. The infant herself also makes an important contribution as she interprets and gives meaning to the data of experience.

Imitation

At stage 5 the child becomes capable of the systematic imitation of new models. In the previous stage, the infant had begun to imitate new models which were not too different from his own spontaneous actions, but he was rarely correct on the first trial. In the present stage the infant becomes more systematic in his techniques of imitation. Here is an example:

> At 0; 11(20) she [Jacqueline] watched me with interest when I touched my forehead with my forefinger. She then put her right forefinger on her left eye, moved it over her eyebrow, then rubbed the left side of her forehead with the back of her hand, but as if she were looking for something else. She reached her ear, but came back toward her eye. . . .
>
> At 0; 11(28) J., confronted with the same model, continued merely to rub her eye and eyebrows. But afterwards, when I seized a lock of my hair and moved it about on my temple, she succeeded for the first time

> in imitating me. She suddenly took her hand from her eyebrow, which she was touching, felt above it, found her hair and took hold of it, quite deliberately.
>
> At 0; 11(30) she at once pulled her hair when I pulled mine. She also touched her head when I did so, but when I rubbed my forehead she gave up. ... It is noteworthy that when she pulled her hair she sometimes turned her head suddenly in an attempt to see it. This movement is a clear indication of an effort to discover the connection between tactual and visual perception. . . .
>
> At 1 ;0(16), J. discovered her forehead. When I touched the middle of mine, she first rubbed her eye, then felt above it and touched her hair, after which she brought her hand down a little and finally put her finger on her forehead. On the following day she at once succeeded in imitating this gesture, and even found approximately the right spots indicated by the model. (*PDI*, pp. 55-56)

Two points are of interest concerning these examples. First, they clearly show that the infant is more adept than she formerly was at the immediate imitation of new actions of models. The infant tries to control her movements in a systematic way. For example, Jacqueline tries to look at her hair when she pulls it. Second, the examples illustrate some general processes of imitation. The chief aim of imitation is to reproduce the act of a model. When the model's actions are new, as in the present case, accommodation is required. That is, the infant must modify her movements to make them like the model's. Thus, accommodation has priority over assimilation. In the case of intelligent behavior, on the other hand, the processes of assimilation and accommodation are in balance. The infant attempts both to modify her behavior in response to the demands of the environment (accommodation) and to understand this environment in terms of her own schemes (assimilation).

Object Concept

In stage 5 the infant is finally able to follow correctly a visible sequence of an object's movements. He now understands positional relationships between the object and other elements of the environment. Therefore, even if the object disappears successively in a number of places the infant will search for it in the place where it was last seen. The infant does not, as in stage 4, look for the object in the place where it had previously been discovered. Thus, the object is no longer connected with a practical situation (the infant's past successes), but has acquired a permanence of its own. At this stage, though, the infant can understand only visible movements of the object. If he is unable to see all the displacements and must therefore infer that some are invisible, the infant reverts to an earlier reaction—looking for the object where he had been successful in finding it in the past. The reason for the failure is that when invisible

movements of the object are involved, the infant must *infer* relationships of position but is not yet capable of inference. Consider the following illustration:

> At 1; 1(18) Lucienne is seated on a bed, between shawl A and cloth B. I hide a safety pin in my hand and my hand under the shawl. I remove my hand closed and empty. Lucienne opens it at once and looks for the pin. Not finding it, she searches under the shawl and finds it. . . .
>
> But with a beret, things become complicated. I put my watch in the beret and the beret under pillow A (on the right); Lucienne lifts the pillow, takes the beret, and removes the watch from it. Then I place the beret, again containing the watch, under cushion B on the left; Lucienne looks for it in B but, as it is hidden too far down for her to find it at once, she returns to A.
>
> Then, twice, I raise cushion B so that Lucienne sees the beret obviously containing the object; both times she resumes looking in B but, not finding the watch right away, returns to A! She searches even longer in A than in B after having seen the object in B! (*CR*, pp. 76-77)

Here we see that the object seems to be endowed with a dual nature. On the one hand, if the infant is able to follow the object's movements perceptually, she believes in its permanence and continued existence. If, however, she cannot follow the movements visually but must imagine them, the infant no longer endows the object with the property of permanence. The object reverts to its earlier status of being associated with a previously successful scheme.

STAGE 6: 18 MONTHS TO 2 YEARS

Beginning of Thought

In the course of his five stages of development, the infant has most certainly made great progress. The newborn displays simple patterns of learning which are limited to the sphere of hereditary mechanisms; the infant in stage 5 has a genuine interest in the things of the environment, explores them, and even has the ability to *invent* new ways of dealing with the world. But the infant's achievement to this point is as nothing compared with the next development. Before stage 6 the infant was not capable of thought or language and so was largely limited to the immediate data of experience. Stage 6, however, forms the transition to the next period of development in which the infant is able to use mental symbols and words to refer to absent objects. This period of symbolic thought begins to free the infant from the concrete here and now and introduces him to the world of possibilities. In Chapter 3 we shall discuss symbolic thought in detail; at present we will limit ourselves to a brief description of its beginnings, as

illustrated by these observations:

Piaget is playing with Lucienne, at 1;4(0) and hides an attractive watch chain inside an empty match box.

> I put the chain back into the box and reduce the opening to 3 mm. It is understood that Lucienne is not aware of the functioning of the opening and closing of the match box and has not seen me prepare the experiment. She only possesses two preceding schemes: turning the box over in order to empty it of its contents, and sliding her fingers into the slit to make the chain come out. It is of course this last procedure that she tries first: she puts her finger inside and gropes to reach the chain, but fails completely. A pause follows during which Lucienne manifests a very curious reaction. . . .
>
> She looks at the slit with great attention; then, several times in succession, she opens and shuts her mouth, at first slightly, then wider and wider!
>
> [Then] . . . Lucienne unhesitatingly puts her finger in the slit, and instead of trying as before to reach the chain, she pulls so as to enlarge the opening. She succeeds and grasps the chain. (*OI*, pp. 337-38)

This observation reveals an important advance in the child's capabilities. Lucienne was confronted with a situation for which a new solution was required. To get the chain out of the box she tried methods which had in the past been successful in similar situations. But these schemes were not adequate for the new problem. What would the stage 5 infant do in these circumstances? He would experiment with various new means until one of the inventions was successful. His behavior would show groping.

But Lucienne does not do this. Instead, she pauses and looks at the box intensely. Her chief overt behavior at this time is only an opening and closing of the mouth. After this delay, she immediately solves the problem. What does the opening and closing of the mouth signify? Piaget interprets it as showing that she tries to think about ways of solving the problem. Lucienne is not yet proficient at thought; she is not yet capable of representing the situation to herself fully in mental terms. Consequently, she "thinks out" the problem partly by way of movements of the mouth. Even though her thought is not yet fully internalized, it involves a considerable short cut over the groping of stage 5. Now Lucienne need not act out her attempted solution, for she is at least partially able to employ a more economical procedure: to *think.* Thus, Lucienne is on the threshold of a new period of intellectual development in which the acquisition of the symbolic function permits the growth of true mental activity.

Imitation

The notable achievement of stage 6 is the appearance of the capacity to represent mentally an object or action which is not perceptually present. The capacity for such *representation* has repercussions for the progress of imitation and contributes to the appearance of two new reactions during stage 6. In the first place, when faced with new models, the infant no longer needs to perform overtly trial attempts at imitation; instead, he now tries out the various movements mentally. Having made the necessary mental adjustments, the infant can then perform the correct action. Since the process is largely mental, the stage 6 infant can imitate more quickly than the one who must first try out all the movements. The internalization of the trial-and-error process consequently leads to what appears to be an immediate imitation of models.

Another feature of the present stage is that the infant becomes capable of imitating for the first time a model which is no longer present. This *deferred imitation* is due to the fact that the infant can imagine the model even though it is absent. That is, the infant is capable of evoking (representing) the absent model in some internal symbolic form, for example, by means of a visual image. Consider the following example of deferred imitation:

> At 1;4(3) Jacqueline had a visit from a little boy of 1;6 whom she used to see from time to time, and who, in the course of the afternoon, got into a terrible temper. He screamed as he tried to get out of a playpen and pushed it backward, stamping his feet. Jacqueline stood watching him in amazement, never having witnessed such a scene before. The next day, she herself screamed in her playpen and tried to move it, stamping her foot lightly several times in succession. (*PDI*, p. 63)

The internalization of the action is quite clear. The infant does not reproduce the scene at the time of its occurrence, but at some later period. Therefore, representation was required for the child to preserve the original scene for it to be evoked at a later time.

Object Concept

Finally, at stage 6 the concept of the permanent object is fully elaborated. The infant not only takes into account visible displacements of the object, but can also reconstruct correctly a series of invisible displacements. For example,

> At 1;7(23) Jacqueline is seated opposite three object-screens, A, B and C (a beret, a handkerchief, and her

> jacket) aligned equidistant from each other. I hide a small pencil in my hand saying, "Coucou, the pencil." [The child had previously found it under A.] I hold out my closed hand to her, put it under A, then under B, then under C (leaving the pencil under C); at each step I again extend my closed hand, repeating, ''Coucou, the pencil." Jacqueline then searches for the pencil directly in C, finds it and laughs. (*CR*, pp. 79-80)

Jacqueline has seen the pencil disappear only once and into Piaget's hand. She does not, however, look into his hand to find the pencil, but under the last object where he had placed his hand. This reaction indicates that she believes that the pencil continued to exist within the hand during the whole sequence of displacements, and that she has inferred that the invisible object was displaced from A to B to C. In other words, Jacqueline has formed a mental image of the pencil and can follow the image through a series of complex displacements.

SUMMARY AND CONCLUSIONS

The infant's development in the sensorimotor period is a truly remarkable achievement. In stage 1, the newborn depends heavily on reflexes for interaction with the environment. The environment, however, does not simply turn on and off these tools provided by heredity. The infant, even in the first month of life, profits from experience and actively modifies the reflex schemes. He learns, for example, to recognize the nipple and to search for it.

In stage 2, the infant shows behavior patterns which are removed from the feeding situation. (1) He develops the primary circular reactions, for example, the motor coordinations necessary for bringing the hand to the mouth. (2) The infant learns in a primitive way to anticipate future events. When placed in the appropriate position, the infant anticipates nursing by initiating sucking movements. (2) The first signs of curiosity appear. The infant shows an interest in moderately novel events. (4) The infant sometimes repeats the behavior of models. This is a very primitive kind of imitation, since it occurs only when the model performs an action highly similar to a scheme available to the infant. It is as if the infant did not distinguish the model's acts from his own; therefore, the apparent imitation is merely the infant's repetition of behavior no different from his own. (5) The infant lacks a mature object concept, but develops several patterns of behavior which are preliminary steps in the right direction. He coordinates the previously independent schemes of looking and hearing, among others, and shows passive expectancy by watching for a brief time the spot where an object has disappeared.

In stage 3, the infant's behavior and interest extend beyond his own body and makes more extensive, but still immature, contact with the external environment. (1) The infant develops secondary circular reactions. By chance, he discovers an interesting environmental event and attempts to reproduce the actions which caused it. (2) The infant shows preliminary indications of classification or meaning. Presented with a familiar object, he sometimes reacts by showing mere abbreviations of the actions it usually elicits. This behavior appears to be a precursor of mental recognition and understanding of the object. (3) The infant's imitation is now more systematic and precise. He is fairly successful at imitation of models, but only when familiar patterns of behavior are involved. (4) The infant makes considerable progress toward attainment of the object concept. If he himself has caused an object's disappearance, the infant attempts a visual or tactual search. This search only involves continuation of behavior (like looking or grasping) which is already under way. To this extent the object concept remains subjective—intimately bound to the infant's own behavior.

In stage 4, the infant's behavior is increasingly systematic and well organized. (1) He is able to coordinate secondary schemes. He has a goal in mind from the outset and uses one scheme as a means for attaining the goal and a second scheme for dealing with the goal. This behavior is purposive and therefore intelligent. (2) By interacting with the environment, the infant learns something about relations among objects. In removing an obstacle to a goal, for instance, the child achieves a preliminary and concrete understanding of the fact that the obstacle is *in front of* the goal and must be removed *before* the goal can be attained. (3) The infant's increasing understanding of the environment is apparent in the ability to anticipate events which do not depend on his own actions. At this period the infant expects people to act in certain ways; he begins to recognize that they are "centers of forces" independent of himself. (4) The infant begins to imitate the novel behavior of models, but is not yet strikingly successful. Also he imitates actions—like sticking out the tongue—which he cannot see himself perform. (5) The infant's object concept is almost fully developed. He employs a variety of behavior to search for vanished objects. He clearly attributes to things a degree of substance and permanence and begins to conceive of objects as autonomous and as independent of his own subjective state. Nevertheless, he is not yet successful at following a complex series of displacements of an object.

Stage 5 is the climax of the sensorimotor period. (1) The infant shows an active interest in producing new behavior and novel events. Before this stage, the infant's behavior was essentially

conservative. He tried to rediscover old actions which happened to lead to interesting results. (2) When confronted with an obstacle the infant attempts to develop new means for dealing with it and does not rely solely on schemes which were successful previously. (3) The infant is now increasingly adept at imitating new actions of models. The infant attempts, for instance, to produce sounds he has never uttered before. (4) The infant has reached a further stage in the sensorimotor development of the object concept and can now comprehend a complex series of displacements and search for the object in the proper place.

Stage 6 forms the transition to symbolic thought. (1) In our preliminary overview we saw that the infant attempted to *think* about a problem, to develop solutions on a mental rather than a physical level. (2) Similarly, the infant can now imitate a model even though the latter may not be present. It is apparent that after observing a model, the infant forms a mental representation of it, so that the later imitation is based not on a physically present model, but on its mental surrogate. (3) The infant now can reconstruct a series of invisible displacements of an object because of these new abilities in representation.

In the most general sense, development reveals a process of *decentration.* The infant begins life in an undifferentiated state, not separating self from environment or wish from reality. He is *centered* about the self. For example, we have seen how the infant in the first few stages does not have a mature object concept. A thing ceases to exist when it passes outside his immediate perception. Furthermore, for the infant the world is merely a series of unstable and unconnected "pictures." Neither self nor external environment exist as autonomous entities. In the course of development the infant advances from this "adualistic" or undifferentiated state to one of greater separation of self and environment. He *decenters* from the self. In the case of the object concept, for example, the infant now conceives of things existing independently. Objects now are centers of forces and have properties which do not depend on his will. This greater understanding of the external world is at the same time an increased comprehension of the self. The realization of the separateness of things necessarily involves the simultaneous apprehension of the existence of self. In other words, the person who believes that his wishes influence the movements of things does not understand either self or things; the person who believes that the two are separate has a greater understanding of both.

Piaget stresses severed points concerning development in the sensorimotor period. First, the age

norms are only approximate. As we noted earlier it is impossible to give precise age norms because only three infants provide the data for study. More important, Piaget fully recognizes that the timing of the stages depends on a host of factors which vary among children. Development is a function of complex interaction among many factors, among which may be the nature of the social environment, the infant's rate of physical maturation, and so on. Given these complexities, it is clear that infants' progress through the stages will show many inpidual differences. For instance, Piaget cites the example of Jacqueline who was born in the winter. Because she was bundled up in the carriage to protect her against the cold, she did not have as much opportunity as did the other children, born in warmer weather, to develop coordination between hand and eye. From findings like these, Piaget concluded that the sensorimotor stages do not appear at precisely defined ages in the infant's life.

Second, Piaget insists, however, that the ordering of the stages is invariant. A child must pass through stage 3 before stage 4, and the reverse cannot occur. Also, a child cannot skip a stage entirely. The reasons for Piaget's assertion are both empirical and theoretical. First, Piaget's observations showed that his three children followed the sequence of development in the order described. Second, each stage is both a culmination of the one preceding and a preparation for the one to follow. Since each stage lays the groundwork for the following stage, it is hard to see, on rational grounds alone, how the order of any two stages can be reversed.

Third, Piaget emphasizes that development is a gradual and continuous process. One does not find sudden transformations in an infant's behavior so that one day he is characterized by stage 3 and the next by stage 4 activities. Development takes time, and because of this one seldom sees "pure" examples of the behaviors which Piaget uses to describe a stage. Piaget's stages are, in fact, ideal types which are abstracted from the continuum of the infant's development. While these abstractions are very useful and convenient, Piaget is careful to remind us that in the normal course of events the infant's behavior takes many forms intermediary between those described by the stages. Also, development is not always consistent across all spheres of behavior. The "stage 4 infant" is again only an abstraction. In fact, one sees infants whose object concept may be characterized by stage 4, while at the same time their level of imitation is stage 3, and so on.

Fourth, Piaget stresses that the behaviors characteristic of a given stage do not disappear when the

infant attains the next stage. Instead, even as new abilities are added the infant retains many of the old ones. For example, the stage 5 infant, confronted with an obstacle and trying to remove it, may first apply schemes which have been successful in other situations (stage 4 behavior), and only then may he attempt to invent new means (stage 5 behavior).

In conclusion, we would like to make a few general comments about Piaget's theory of infancy and clarify some aspects that are often misunderstood. First, Piaget's position on the role of the environment is subtle, and consequently often misinterpreted. He feels that it is obvious that the environment exerts effects on the infant, but acceptance of this proposition hardly solves any problems. The task then becomes to discover *how* the environment operates. Piaget feels that the environment does not mold behavior by simply imposing itself on a passive subject, evoking the infant's response and rewarding it. Instead, Piaget's central theme is that the infant is *active;* that is, the infant seeks contact with the environment. His curiosity does not permit waiting for environmental events to happen; rather he searches them out and seeks increased levels of stimulation and excitation. When some environmental event occurs, the infant does not register it passively, but instead interprets it. It is this interpretation, not the event itself, which affects behavior. Suppose we have two infants, one who is capable of anticipations concerning adults and one who is not. Both witness an adult who rises and puts on a coat. One infant cries and the other remains calm. "Experience"—seeing the adult get up and put on the coat—has affected the infants differently. The explanation is that one infant expected him to leave and the other did not. The infants interpreted the events in different ways. We might even say that there existed two different "realities," each one constructed by an infant. The infants assimilated the perceived event into their differing expectations concerning adult behavior. This assimilation or interpretation gave the event meaning and produced the subsequent behaviors. So the infants did not passively register a mere "copy" of reality; instead, they interpreted, constructed, and assimilated, or, in short, gave meaning to the events.

Experience, then, does not exert effects *on* an infant, but instead, exerts effects *with* an infant. The child modifies raw experience as much as it changes him.

Second, Piaget is sometimes misunderstood concerning his views of the roles of maturation and learning. It should be abundantly clear that Piaget is not a simple maturationist. He does not believe that the infant's development unfolds solely as a result of some kind of physical maturation. Piaget's position

is that maturation plays a role in development, but it certainly is not the only factor. As we have seen, he believes that the effects of the environment are quite important, and to this extent Piaget is in agreement with the environmentalists. But, as has been noted, Piaget's account of learning is quite subtle and is in many ways at variance with other theories of learning. For example, he introduces novel motivational principles, such as assimilation and the moderate novelty principle, and emphasizes the infant's interpretation of the raw data of sensory experience. In short, Piaget is neither a maturationist nor an environmentalist, at least not in the dominant behaviorist tradition. His position incorporates elements of both traditions, and, in addition, elaborates on them in highly original ways. He thinks of himself as an "interactionist," for his theory stresses that intellectual development results from an interplay between internal and external factors.

As we shall see in Chapter 6, Piaget has elaborated and supplemented his account of experience and maturation since his writing of the books on infancy. The later theory of "equilibration" expands on the role of experience and, in addition, introduces the concept of interned cognitive conflict.

Third, the nature of Piaget's stages is occasionally misunderstood. Piaget is sometimes compared with Gesell, who offered an account of infancy in terms of stages of development. Gesell's stages were merely listings of specific *behaviors* which occurred at different ages. For example, the infant is found to crawl at such and such an age, to walk at another, to run at another, and so on. While such information may be valuable, it is clear that Gesell's stages merely list the empirical phenomena and have no theoretical content whatsoever. By contrast, Piaget's stages are a theoretical taxonomy. Take, for example, stage 4, which is concerned with the coordination of secondary schemes. Piaget's theory proposes that in this stage the infant can coordinate two previously disparate patterns of behavior to attain a preconceived goal. This statement—the theory of this stage—is an abstraction which transcends the details of any specific behaviors that merely illustrate the stage. The statement is intended to allow us to understand what the infant does *regardless* of the particular behaviors involved. Piaget's stages are therefore theoretical or explanatory, and as such are radically different from Gesell's.

Notes

1 For example, see Ina C. Uzgiris, "Organization of Sensorimotor Intelligence," in M. Lewis, ed., *Origins of Intelligence* (New York: Plenum Press, 1976).

2Indeed, the reader should recognize that unorthodox procedures have led to many of the great discoveries in psychology, including Freud's free association technique, Wertheimer's demonstration experiments, Chomsky's introspective analyses of language, Brown's naturalistic observations of the language of three children, Skinner's studies of inpidual pigeons, and the Gardner's examination of Washoe's sign language.

3 For example, see T. Appleton, R. Clifton, and S. Goldberg, "The Development of Behavioral Competence in Infancy," in F. D. Horowitz, ed., *Review of Child Development Research*, Vol. IV (Chicago: University of Chicago Press, 1975).

4 In this and subsequent chapters, when a book is frequently cited, we give first an abbreviated title (e.g., *Origins of Intelligence*) followed by brief initials (*e.g., OI*). In later references only the initials are used.

5 Piaget's "recognitory assimilation" combines several processes usually treated under different rubrics by the theory of perceptual learning. The infant *discriminates* (as when he sees that one area of the breast looks different from another); he *recognizes* (as when he knows that he has made contact with the breast before); and he *identifies* (as when he learns that the nipple gives milk). For a fuller discussion of perceptual learning, see E. J. Gibson, *Principles of Perceptual Learning and Development* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1969).