PIAGETS THEORY

Major theorists differ as to how much of developmental change stems from experience with the environment and how much stems from maturation guided by the blueprint of genetic inheritance. Piaget takes the position that both forces profoundly influence development, and this emphasis on the biological as well as the environmental origins of change is harmonious with his lifelong interest in the biological sciences. Piaget's first intellectual inquiries were in zoology, a branch of biology dealing with the animal kingdom, and his current psychological theory reflects sensitivity to the human species' position in that kingdom. A central concept in the field of biology is the notion of adaptation, to maintain a favorable interchange with the environment; all animals must adjust to ecological change. Herds instinctively seek new grazing in a drought, while chameleons change color to conceal themselves from predators. Humans too have unique methods of adaptation. More than any other animal, we rely on the acquisition and use of higher mental processes.

Piaget sees the child's cognitive **adaptation** in terms of two basic processes, **assimilation** and **accommodation**. **Assimilation** is a process whereby the child interprets reality in terms of his or her internal model of the world constructed from previous knowledge. **Accommodation** is the complementary process of improving one's model of the world by adjusting it to external reality. Consider the following illustration of the role of these two processes functioning in service of adaptation:

Suppose an infant of 4 months is presented with a rattle. He has never before had the opportunity to play with rattles or similar toys. The rattle, then, is a feature of the environment to which he needs to adapt. His subsequent behavior reveals the tendencies of assimilation and accommodation. The infant tries to grasp the rattle. In order to do this successfully he must accommodate in more ways than are immediately apparent. First, he must accommodate his visual activities to perceive the rattle correctly; then he must reach out and accommodate his movements to the distance between himself and the rattle; in grasping the rattle he must adjust his fingers to its shape; in lifting the rattle he must accommodate his muscular exertion to its weight. In sum, the grasping of the rattle involves a series of acts of accommodation, or modifications of the infant's behavioral structures to sit the demands of the environment.

Adaptation, the, I a basic tendency of the organism and consists of the two processes of assimilation and accommodation. How do the two relate to one another? First, it is clear that they are complementary processes. Assimilation involves the person's dealing with the environment in terms of his structures in response to the environment. Moreover, the processes are simultaneously present in every act. When the infant grasps the rattle his fingers accommodate to its shape; at the same time he is assimilating the rattle into his framework, the grasping structure.

In Piaget's system there is a unique term for the infant's miniature models of the world implied in the preceding passage by the words « habitual pattern of behavior » and « grasping s structure. « The term is schema. A schema is the structure underlying a sequence of behaviors such as grasping. **Schemata**[1] differ in complexity, but even the simple grasping schema organizes the actions of reaching, fingers-curling, and drawing in.

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[1] Schemata is the plural form of schema

As the infant gains experience, it will learn to grasp in different ways – e.g., « for something far away » « for something nearby », » « for something small », « for something large », and so on. The grasping schema then becomes a kind of category or underlying strategy which subsumes o collection of distinct but similar action sequences. Infants develop many schemata start out isolated from each other; they eventually coalesce into a coherent and coordinated blueprint of how to react to the world of objects (Flavell, 1963).

Schemata formed during early infancy either change or give way to increasingly sophisticated models of the world which emerges in later life. But the child's changing way of viewing the world, his or her level of cognitive development, does not change in an entirely smooth or continuous fashion. Rather, Piaget feels that the emergence of intellectual sophistication and an adult view of the world involves four distinct periods of cognitive development.

1. **Sensorimotor period (0 to 2 years)**
2. **Preoperational period (2 to 7 years)**
3. **Period of concrete operations (7 to 11 years)**
4. **Period of formal operations (11 through adulthood)**

Note, though, that the ages shown are only approximate averages and will vary considerably with the environment and background of the child.

THE SENSORIMOTOR PERIOD (0 TO 2 YEARS)

Though untutored by experience, the newborn infant is not completely helpless because he or she is born with inherited reflexes. During the two years of the sensorimotor period certain reflexes, among them sucking and grasping, which initially are as inflexible as the jerk of the knee to the tap of the doctor's hammer will evolve into flexible and planful movements. By the end of the period the child will be able to maneuver a stick through playpen bars or open the door with hands full – but not at the beginning. Piaget casts the sensorimotor period in terms of six successive sub stages.

Stage 1 This stage is estimated to occupy approximately the first month of life and involves merely the increasingly smooth and systematic use of natural reflexes. This infant is said to engage mostly in « reflexe exercise. » But even at this stage, only one month after birth, evolution toward greater sophistication can be observed.

Piaget sees evidence suggesting that there also are subtle and limited, but nonetheless genuine, accommodator modifications in the reflex almost from the first hours of life. For example, Laurent[2]shows minimal but definite progress in distinguishing and localizing the nipple as opposed to the surrounding skin areas. It is not so much that the sucking pattern itself – the actual form of the response – gets modified, but rather that the environmental conditions which trigger it off or the instrumental activities leading up to it undergo slight variation

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[2] Many of Piagets descriptions of the sensorimotor period stem from observations of his own three children-Laurent.Lucienne, and Jacqueline.

Stage 2 During the second stage, from the first to approximately the fourth month of life, the infant begins to display a class of behavior called **circular reactions**. A circular reaction is a sequence of events consisting, « first, of stumbling upon some experience as a consequence of some act, and second, of trying to recapture the experience by re-enacting the original movements again and again in a kind o rhythmic cycle. The importance of circular reactions lies in the fact that it is the sensory-motor device par excellence for making new adaptations, and of course new adaptations are the heart and soul of intellectual development at any stage » (Flavell, 1963, p 93) Primary circular reactions are typical of stage 2. They are repetitive acts that center on the infant's own body: thumb-sucking, frequently seen in three and four-month old infants, is a good example. 1-4

Stage 3 Between the fourth and eighth months of life **secondary circular reactions** appear. Circular reactions at this stage are aimed at maintaining environmental events originally brought about by chance. For example, suppose the infant accidentally shakes a rattle and hears a noise. The infant will repeatedly try to shakes it in order to hear the noise again- perhaps unsuccessfully at first. Interestingly, this action pattern requires the coordination of two action patterns heretofore used separately, that is, grasping and hearing. Typically, coordination between previously isolated behaviors occurs during this stage. Thus, for example, the first coordinations between vision and movement take place at this time: 4-8

The baby starts grasping and manipulating everything he sees in his immediate vicinity. For example, a subject of this age catches hold of a cord hanging from the top of his cradle, which has the effect of shaking all the rattles suspended above him. He immediately repeats the gesture a number of times. Each time the interesting result motivates the repetition. Later you need only hang a new toy from the top of the cradle for the child to look for the cord, which constitutes the beginning of a differentiation between means and ends. (Piaget and Inhelder, 1969, p 10)

Stage 4 Examples such as the foregoing suggest at least the **threshold** of intelligent behavior. However, it is not until stage 4 (between the eighth and twelfth months of life) that the acquisition of truly instrumental behavior seems to occur. Piaget finds evidence for this process by setting up problems derived from natural situations and observing the reactions of children. Here is an example in which his son Laurent had to move an obstacle in order to reach a toy: 8-12

Until now (he was seven months and thirteen days old) Laurent has never really succeeded in setting aside the obstacle: he has simply attempted to take no notice of it...For instance... (At six months) present Laurent with a matchbox, extending my hand laterally to make an obstacle to his pretension. Laurent tries to pass over my hand, or to the side, but he does not attempt to displace it... (At seven months, ten days, (Laurent tries to grasp a new box in front of which I place my hand...He sets the obstacle aside, but not intentionally ; he simply tries to reach the box sliding next to my hand and when he touches it, tries to take no notice of it ..Finally (at age seven months, thirteen days).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 which out 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.. Laurent tries to reach the box, and bothered by the obstacle, he at once strikes it, definitely lowering it until the way is clear.

Pushing the obstacle aside is now not an « accident »; rather, it is an act recognized as necessary for reaching the object. It seems that secondary circular reactions (which conserve knowledge originally hit upon by accident) combine to launch new behavior which is intentionally **goal-directed**, as the first glimmer of real intelligence appears.

Stage 5 The fifth stage, twelve to eighteen months, gives **rise to tertiary circular reactions.** In the secondary circular reaction the child tries to recapture an external event by activating the behavior that led to it in action the infant seems to be exploring the relationship between action and object. The child experiments with objects in order to see, understand, and pursue the novel. Consider the following example of the tertiary circular reaction. 12 – 18
Jacqueline holds in her hands an object which is next to her: a round, flat box, which she turns all over, shakes, rubs against the bassinet, etc. She lets it go and tries to pick it up. But she only succeeds in touching it with her index finger, without grasping it. She nevertheless makes an attempt and presses on the edge. The box then tilts up and falls again. Jacqueine, very much interested in this fortuitous result, immediately applies herself to studying it. Hitherto it is only a question of an attempt at assimilation... and of the fortuitous discovery of a new result, but this discovery, instead of giving rise to a simple circular reaction, is at once extended to « experiments in order to see ».
In effect, Jacqueline immediately rests the box on the ground and pushes it... Afterward Jacqueline puts her finger on the box and presses it. But as she places her finger on the center of the box she simply displaces it and makes it slide instead of tilting it up. She amuses herself with this game and keeps it up (resumes it after intervals, etc…) for several minutes. Then, changing the point of contact, she finally again places her finger on the edge of the box, which tilts it up. She repeats this many times, varying the conditions, but keeping track of her discovery...

Stage 4 children can only construct means to goals by coordinating actions that by chance exist in their repertoires. In contrast, stage 5 children, **through trial-and-error experimentation**, actively search for new means. Suppose an infant in a playpen wants o long stick lying out-side the playpen bars. The situation is new, and no familiar method of solution is at hand. To find a successful approach the Stage 5 child will use trial and error, performing « experiments in order to see » just as Jacqueline did in Piaget's example. And, eventually, this method will work. Sooner or later the Stage 5 child will tilt the stick parallel to the opening between the bars of the playpen and draw it through.

Stage 6 During the sixth stage, eighteen to twenty-four months of age, the ability to covertly plan without trial-and-error experimentation emerges. This new process is insight. 18 – 24

..Jacqueline (at 1 year, 8 months, 9 days) arrives at a closed door – with a blade of grass in each hand. She stretches out her right hand toward the knob but sees that she cannot turn it without letting go of the grass. She puts the grass on the floor, opens the door, picks up the grass again and enters. But when she wants to leave the room things become complicated. She puts the grass on the floor and grasps the doorknob. But then she perceives that in pulling the door toward her she will simultaneously chase away the grass which she placed between the door and the threshold. She therefore picks it up in order to put it outside the door's zone of movement

The exceedingly important, newly developed process that underlies the emergence of insightful behavior is called representation. The process of representation allows the child to

to search for an appropriate solution through the manipulation of internal symbols instead of physical objects. We shall have more to say about it later.
In his account of the sensorimotor period, Piaget compared fumbling beginnings with subsequent advances in the infant's knowledge of the world. In summary, the six sub stages of the sensorimotor period describe in orderly sequence the different stretches of terrain through which the infant passes on a journey from automatic, reflexive reactions to planful behavior efficiently coordinated with the infant's own goals and desires.

The end of the sensorimotor period coincides with the beginning of the preoperational period. Henceforth the child will begin to deal with increasingly complex problems and will gradually come to rely on merital representations in solving them. During the preoperational period then, the child begins to develop a perspective of the world and displays and increased ability to accommodate to new information and experience. At first, however, the emerging perspective is egocentric, meaning that children have trouble understanding that others will often view the physical and social environment differently than they do. Frequently unaware of the possibility of varying perspectives, the preoperational child is an unknowing prisoner of his or her own point of view.

Egocentrism in preoperational thought
In the classic demonstration of egocentrism (Piaget and Inhelder, 1956, Chapter _) children were seated on one side of a display consisting of three toy mountains of unequal heights and were asked to show how the display looked to a doll seated elsewhere in relation to the display. Piaget and Inhelder found that children under the age of seven or eight generally indicated that the doll saw what they themselves saw. Egocentrism diminishes during the preoperational period by the thrust of contact with friends, siblings, and classmates who convey the fact of their own differing perspectives (Piaget and Inhelder, 1969, Flavell, 1974).

Much recent research has explored the extent of egocentrism in children's thought (Hoy, 1974 : Shantz and Wason, 1970 : Brodzinsky, Jackson, and Overton, 1972 : Masangkay, McClusky, McIntyre, Sims-Knight, Vaughn and Flavell, 1974).In one study Liben (1975) asked children to describe what a white card looked like both to themselves and to an experimenter (a) when the children wore yellow-tinted sunglasses and the experimenter wore green-tinted sunglasses and the children wore none, and (c) when the children wore yellow-tinted sunglasses and the experimenter woe green-tinted sunglasses. Almost half of the three-year –olds tested answered correctly, and the four, five-, six-, and seven-year-olds tested were extremely successful. These results indicate that where the problem is simple enough even three-year-olds show some ability to take another's perspective, though with more difficulty than older children.

The preoperational child's generally limited perspective on the world is not only evident when he or she asked to take another's point of view. It is a general characteristic of thought processes at this age, reflected in all the child's efforts to solve problems. To better understand just how the preoperational child thinks; let us examine the so-called conservation problems.

The conservation problem
In classical physics there is a law that states that the amount of matter in the universe remains the same through all time, regardless of the form it takes. A similar idea, if on a less grand scale, is held by most adults. If we start with a sack containing exactly ten pounds of sand, and the sack accidentally falls to the floor and breaks, the amount of sand will remain the same – will be conserved – regardless of the change in its location and form. If there were ten pounds of sand in the sack before, there must be ten pounds of sand on the floor now. Piaget's work on the development of the conservation concept has attracted more attention

than perhaps any other aspect of his work because he has demonstrated that young children do not reason this way. They fail to appreciate that some features of objects (such as number and length) will remain invariant despite changes in other features (such as shape and position). Children, Piaget posits, fail to understand this idea, the principle of conservation, during the preoperational period and remain uncertain about some of its applications until well into the concrete operational period. Let us consider a research example.

Piaget, Inhelder, and Szeminska (1960) showed four-and five-year-olds two straight sticks of equal length placed on a table with ends carefully aligned. When asked about the relative length of the sticks, the children judged them to be equal, however, when one of the sticks was moved forward a little it was judged to be longer than the other. Finally, when the sticks were realigned, they were again judged to be equal, and, interestingly, the children were not bothered by their inconsistency even when it was pointed out to them. Six-and seven-year-olds, on the other hand, correctly described the sticks as equal in length throughout each of the phases of the procedure.

What distinguishes the two age groups in this situation? According to Piaget's terminology, older children are able to show conservation. They understand, at least in this situation, that no change necessarily occurs in one or more aspects of an object or relationship simply because of changes in other independent features or aspects.

Conservation of lenteur in only one of a number of « types » of transformations in the physical universe that reveal cognitive differences in children's understanding, studies of conservation of amount, for example, begin by showing the child two equal-sized balls of plasticene clay. Then, while the subject watches, one of the balls is transformed in shape (e.g., rolled up like a sausage, made into a flat pancake, or divided into several pieces). Children up to about five years of age usually are unable to « see » that the quantity of plasticene has remained constant despite these changes and will identify one of the shapes as now having more clay than the other. By the age of seven or eight they understand that no change in amount occurred (Piaget and Inhelder, 1941).

In tests of conservation of liquid quantity, children are presented with two identically shaped beakers of milk and adjustments are made until they agree that each contains the same amount to drink. Then the content of one of the beakers is poured into a third beaker, which differs in shape from the other two. The transition, which occurs entirely in the child's presence, is depicted in Figure 7-3. The preoperational child is likely to say that beakers A and C do not have the same amount of milk.

Why does the preoperational child fail to conserve? Piaget and his associates have suggested that the preoperational child fails to conserve because he or she unable to recognize the operation of certain processes in the physical world. We shall consider three of these processes. First, the preoperational child apparently **fails to see the reversibility** of certain physical operations. If adults were asked how they know that the amount of fluid remains the same in the example provided in Figure 7-3, they might say that if the operation were reversed (if the fluid in beaker C were poured back into beaker B), then the equality would be obvious. The preoperational child, on the other hand, does not appear to recognize this.

A second characteristic of preoperational children that appears to prevent their conserving is **centration**. This notion refers to the tendency to center or focus on a single detail of a question or problem and sub-sequently to be unable to shift to another detail or dimension. In the conservation of liquid, for example, the child may attend either to the height of the beaker (and thus say that the taller beaker has the greater volume) or to the width (and thus say that the wider and squatter beaker has the larger quantity of fluid). To solve the problem correctly, the child must decenter – that is, attend simultaneously to both the height and the width of the beakers – in order to see the relationship between the changes in one of these dimensions and the compensatory changes in the other. Because the column of fluid becomes wider as its gets lower (or taller as it gets narrower), the overall quantity remains the same. Although it is quite plausible to assume that the preoperational child tends to center upon one of the stimulus dimensions in a conservation problem, there is more than one possible interpretation of why this should occur. Inasmuch as the problems typically involve the use of relational terms (i.e., the experimenter asks: « which one is bigger? », it is possible that the child's responses result from misunderstanding of the words rather than from deficiencies in logic or perception. The child may, for example, interpret the word « bigger » or « more » to mean « taller » (Braine and Shanks, 1965).

Do younger children fail to conserve simply because they do no understand the meaning of relational terms, or is there a real difference between there mental processes and those of older children and adults? To find out, Kempler (1971) designed a test of conservation in which potentially confusing relational terms were not used at all. He constructed a set of one hundred rectangles of varying shapes and areas, so that almost all the possible combinations of height and which were represented in the set. For example, there were tall, narrow rectangles; short, wide ones; and even rectangles that were in effect perfectly square. The subjects of the study, six-through thirteen-year-old-children, were shown the rectangles one at a time and were simply asked to indicate whether each was large or small. Using an ingenious mathematical technique, Kempler was able to take these data and calculate the relative importance children of each age group gave to height and to width in making their judgments of large or small. As seen in Figure 7-4, all the younger children overestimated the importance of height, and equal reliance on height and width not appear except in the twelve – and thirteen-year-old group. This finding suggests strongly that the general problem that Piaget identified in his conservation problems is not reducible to confusion in word usage on the part of younger children.

A third characteristic of preoperational children that prevents the solving of conservation problems appears to be that they **perceive states rather than transformations**. That is, they attend to the series of successive conditions that are displayed in the experiment rather than the process by which the researcher changes or transforms one display into another. It is as if the nonconserving child sees a series of still pictures, whereas a more advanced observer sees a moving picture. The difference is critical for only be appreciating the transformation or continuous character of conservation problems can we be confident that quantity has remained the same.

To illustrate the preoperational child's tendency to perceive states rather than transformations, one Piagetian experiment involved the use of drawing to identify the perception of successive movements of a bar as it falls from the vertical to the horizontal position. Older children and adults given individual drawings such as those in Figure 7-5 in a « mixed up » order will immediately arrange them in the correct order of the transformation (i, e., A-F). In contrast, the preoperational child is unable to produce the sequence and may not even recognize the correct sequence when it is presented by the experimenter.

Can children learn to conserve? Piaget considers an understanding of conservation to be « a necessary condition for all rational activity. » To the extent that such an assertion is even partially accurate, there would be important educational advantages in speeding the acquisition of conservation. Moreover, the paradox of children contending that the amount of milk changes when an experimenter merely pours it from one glass to another has proved an irresistible challenge, especially for those interested in the development of intelligence.