4. Piaget and Cognitive Development

During this [early childhood] period magic, animism, and artificialism are completely merged. The world is a society of living beings controlled and directed by man. The self and the external world are not clearly delimited. Every action is both physical and psychical.

–Jean Piaget[1]

Piaget's Place in the History of Psychology

A ranking of the most eminent psychologists of the 20th century by professionals in the field listed the top three names as B. F. Skinner, Jean Piaget, and Sigmund Freud (Haggbloom and others, 2002). These three names also occupy places of prominence in this textbook. But although Skinner's impact on the field of psychology was enormous, interest in the kind of behaviorism he espoused has waned; and though many of Freud's contributions still influence the theory and practice of psychology, many of his major ideas have been duly rejected by his successors. Of these three psychologists, Piaget's ideas have probably fared the best over the years: they continue to influence research and theory in child development, and with some minor exceptions, his theories have stood the crucial test of time as well as any major theorist in psychology. Yet Piaget was not a psychologist by formal training. His two doctorates were in natural science (emphasizing biology; his early interests were in studying mollusks) and philosophy (emphasizing logic). But Piaget had many interests, including epistemology and the philosophy of science, both of which influenced his research.

In 1920, Piaget had an opportunity to work with Theodore Simon (who was the co-creator of the first intelligence test, along with Alfred Binet; Binet & Simon, 1905). Piaget found his job of helping to standardize intelligence tests rather uninteresting, but he

did become interested in studying the way that children reasoned when attempting to solve the problems presented to them by the tests. Often it was the child's production of *incorrect* answers that intrigued Piaget, and in attempting to discover how the children arrived at their answers, he embarked on a lifelong journey of studying the stages and growth of cognition in children. He was primarily interested in how children think, and how their thinking about solving problems changes *qualitatively* at different stages of development.

Although Piaget's early writings received some attention in the United States in the 1920s and 1930s, his influence waned with the rise of behaviorism. His research did not mesh well the methodological paradigms of his time, nor with the behavioristic ideas that were prevalent. Although Piaget did study behavior by direct observation, his ideas were perhaps too mentalistic for that that era – roughly the twenties through the fifties. Also, he often based his observations on very small and somewhat biased samples – including his own children! These factors raised questions about his objectivity: to American psychologists his methods were more like clinical observations or case studies than rigorous, scientific, laboratory kinds of procedures. Yet his observations have been verified in scientific research many times over. According to Wadsworth these criticisms of Piaget's methodology "diminish in importance if one accepts the assumption implicit in Piaget's theory: that the general course of development of intellectual structures is the same for all people" (1996, p. 9). But remember, Piaget was first a biologist; he believed that human behavior is adaptive; and further, that the general patterns of adaptation equally characterized all members of our species in the process of development. And why not? Except in the rarest of anomalies, a biologist studying the digestive system of one member of a species would expect that the anatomic and physiological principles would be the same in all other members of that species. Why shouldn't the same be said of basic psychological principles of growth and development as well, grounded as they are in biology?

Piaget: Some Biographical Facts

- Piaget had his first publication at age 10 in a nature magazine, on an albino sparrow.

- Between 15 and 18 years of age, he published a series of articles on shellfish. As a result, he was offered a position as curator of the mollusk collection at the Geneva museum of natural history. (He had to turn this down because he had yet to finish high school!)

- Piaget received his PhD in natural science at age 21 from the University of Neuchâtel. By this time he had already published 21 papers!

- His interest in epistemology (theory of knowledge) led him to study how children solve problems.

- At Albert Einstein's suggestion, Piaget investigated children's understanding of time, space, speed, and motion, resulting in two books on these subjects.

- During his long lifetime (Piaget died in 1980, at age 84) he wrote over 40 books and numerous articles. He was honored by the American Psychological Association with the Distinguished Scientist Award in 1969.

(For more information concerning Piaget's life and achievements, see Ginsburg and Opper, 1988.)

Basic Piagetian Concepts

Piagetian Conservation Tasks

Before plunging headlong into Piaget's sometimes abstract theoretical ideas about the ways in which children learn at different stages of development, it may be helpful – particularly to students with no familiarity with Piaget – to begin with a few examples of his well-known conservation tasks. These nicely illustrate Piaget's approach to observing children as they grapple with ordinary objects.

Piaget noticed that students below a certain level of maturity (prior to about age seven) had difficulty in comprehending certain problems involving invariants in quantity. In his famous water level task, for instance (see Fig. 4.1), a child is shown a large glass or pitcher of water. The water is poured into a different size container – one that is wider – so that the resulting water level is lower than it was for the original container. Young children simply did not see that the amount of water was unchanged. They might report that the glass with the lower level has less water, because the height is lower, or less commonly, that there is more water in the glass with the lower level because it is more spread out.

Similarly, if a large lump of clay is broken into several smaller lumps, the child may claim that there is now more clay, because the number of lumps has increase, or perhaps that there is less clay, because the lumps are smaller. Or, if the large lump of clay is flattened, they likewise believe that the amount has changed simply because of the change in shape of the mass. In these, and in other tasks illustrated in Figure 4.1, the child fails to see that the amounts are the same: that the quantities are preserved or ***conserved*** under these transformations (i.e., they do not actually change, even though their appearances change).

Piaget called the stage of development just before children reach the level where they can correctly solve the conservation tasks the ***preoperational stage*** (see Table 4.1). At this stage, children seem to have difficulty focusing on more than one aspect of a situation. He called this tendency to focus on just a single aspect of a situation ***centration***. For example, the child's attention

may be centered primarily on the height of the water level, yet the child fails to see that the width also changes, and compensates for the lowered height. A key feature of the preoperational stage is that the child's thinking process precludes the notion of reversibility in these mental operations: he or she cannot seem to grasp the notion that conservation requires (mentally) seeing that pouring the water back into the original container should result in the same, original quantity. Thus, preoperational thought is characterized by a certain kind of fixedness of thought that Piaget called ***irreversibility***.

Insert Figure 4.1 here.

The Piagetian Concept of Stages (Periods) in Cognitive Development

Piaget was a true stage theorist, in the tradition of Rousseau. Like Rousseau, he believed that children learn best the natural way: through experimentation and interaction with the environment in the course of play or ordinary activity. He therefore downplayed the importance of formal teaching in the earliest years, when the child is essentially her own best teacher. The young child forms mental representations of the world through the process of manipulating objects in the environment. He thought of the toddler as a "little scientist" trying to make sense of the world by learning through experimentation.

Piaget actually called his major stages ***periods*** of development. Within these periods he sometimes delineated what he called ***stages*** of growth as well (see Table 4.2). According to Piagetian theory these periods (and stages within periods) are characterized by the following properties (Kohlberg, 1968):

Invariant sequence. Stages are invariant in sequence: just as one must learn to crawl before learning to walk, a child must complete earlier stages before later ones can be achieved.

Generality. Each period can be described by very general properties. Thus, for example, the concrete operational period is not merely the period in which a child can solve water level problems, but more generally, the child has come to understand the concept of conservation, including reversibility, as well as the loss of centration.

Cognitive restructuring. Each period represents a cognitive restructuring in the sense that later periods represent qualitatively different ways of thinking; yet at the same time there is –

Hierarchical integration. Each period represents a hierarchical integration of lower stages into higher ones. Earlier thinking patterns are not lost; rather, they are incorporated into the higher levels.

Universality. Periods and stages are universal: all children in all cultures progress through the same periods and stages.

One may wonder, then, whether these periods and stages are genetically determined or "programmed into" the child's nervous system, as a maturationist might claim. The answer is no: only in the sense that a certain maturation of the nervous system is required before a child can move to a higher stage. Cognition and learning of particular tasks – say the conservation of volume in the water level task – are not in any sense genetically programmed into the child. Rather, children's brains have, through the process of evolution, the necessary flexibility to enable the solutions of certain kinds of problems at certain levels of development. This learning takes through natural interactions with the environment. Thus, Piaget was a true developmentalist as this term was described in the second chapter.

Another question often comes to mind with Piaget: exactly how discrete are these periods and stages – do changes in the child's abilities occur suddenly and abruptly? It is more or less true that a child who can solve one kind of conservation task – say the conservation of number (as when a large chunk of clay is divided into smaller lumps) – can also solve another – for instance, the

conservation of mass (such as when a large lump of clay is flattened or reshaped). However, development of cognitive skills is not always quite this clear cut. In the early concrete operational stage, a child may be able to do some tasks but not others. Piaget referred to this phenomenon as ***horizontal décalage***, meaning that developmental growth can be "spread out" (décalaged) within each period. In this sense, Piaget came to recognize that learning is actually somewhat continuous within a stage. Indeed, development within a stage continues until a kind of equilibrium (as discussed below) is achieved.

The notion of development by relatively discrete stages has always been controversial, and Piaget's ideas have been questioned and in some cases, modified, by other researchers. This research is considered in the evaluation of Piaget's theory, near the end of the chapter.

Piaget's Views on Cognitive Growth and Learning

Before presenting a detailed description of Piaget's periods and stages, it is necessary to define a few terms that relate to Piagetian principles of learning. These are illustrated with examples from his sensorimotor period.

Schemes. As previously seen, Piaget viewed learning as an active process in which the child learns naturally by interacting and experimenting with the environment. ***Schemes*** are organized psychological structures; they are children's ways of making sense of the world. (Sometimes the Latin ***schema*** is used rather than scheme; the plural is ***schemata***.) Earliest schemes in the sensorimotor period are simply action patterns based on little more than reflexes, whereas later schemes are less action based and more cognitive.

In Piaget's view, children are like intuitive logicians or mathematicians. A child forms schemes or mental categories which may be likened to a mathematician's concept of a "set". For example, a child develops an "animal" scheme and also forms intuitive rules about what belong in this particular category or set. At first, perhaps, all things that move qualify; but as the child matures and learns more, the schemes are refined: animals may

then be (more correctly) things that move of their own volition; they are distinguished from vegetation and inanimate objects. But because this knowledge is at first intuitive, the child cannot yet provide the "rules" by which an object falls into the "animal" category, though the child understands that a dog or cat is an animal, but a windup toy is not. Piaget also believed that such schematization by children did not always depend on language. Children could form rather complex schemes even before they developed strong verbal skills and a large vocabulary.

Often a child can develop a scheme to work out the mechanics of a problem ("plane of action") but yet cannot verbalize the solution ("plane of thought") for a number of months following the initial learning. Piaget called this lag between the two kinds of understanding ***vertical décalage***.

Adaptation. The first of Piaget's two kinds of processes for building schemes is called ***adaptation*** – Piaget's term, borrowed from biology – for the process of developing schemes through direct interaction and experimentation with the environment. Adaptation consists of two related processes, which he called assimilation and accommodation.

- ***Assimilation.*** In ***assimilation*** the child uses an existing scheme to cope with new challenges. Assimilation means, literally, taking in and (in a metaphorical sense), "digesting" something. Wadsworth states that "Assimilation is the cognitive process by which a person integrates new perceptual, motor, or conceptual matter into existing schemata or patterns of behavior" (1996, p. 17).

  Suppose an infant has developed a scheme for dropping, perhaps following the dropping a toy doll. Parents of small children will note that, as soon as the child recognizes he or she has this kind of power over an object, the child relishes repeating the behavior: a child may find great glee in dropping, or knocking off, objects placed on her high chair's fold down table – fun for the child, but frustrating for the parent. But yes, this is a necessary part of the child's learning. It is almost as if

the child reasons that if she can drop her doll, she can just as easily drop her spoon or plate. But it is still too early in her development to argue that reasoning (at least in the adult sense) is part of this dynamic.

In this example the child initially had developed a scheme for dropping, which she learned as though by accident. Assimilation occurs when the behavior is generalized to new objects and situations. It expands her learning, because the scheme grows, even though it remains the same basic scheme (dropping), not something entirely new. But in this sense of expansion, cognitive development takes place. This illustration of assimilation is but one of many that could be mentioned. The point is that this type of learning happens continually in infants; every day brings many new opportunities to expand on one's previously learned schemes.

- ***Accommodation. Accommodation*** involves the modification of schemes, or the creation of entirely new ones. Thus it requires bigger steps in cognitive learning than assimilation. Consider that baby Bonnie, lying in crib, has learned to pull a toy duck to her mouth, and then enjoys sucking on it. Whereas assimilation would explain Bonnie's tendency to draw other objects near and to suck on them (say a toy block), accommodation would describe a more elaborate new scheme, in which she must first push away an obstructing object (say a block) in order to grasp the duck.

  On prior occasions Bonnie has learned separate schemes for pushing, grasping, pulling, and dropping. (The scheme for sucking is more reflexive than learned.) Now she discovers that she must push the block away first in order to reach the desired object – the duck. In this way, one scheme is built upon another. This new, more complex behavior sequence is a bigger step in learning. Bonnie accommodates by combining two different and previously unrelated schemes – success!

  Or consider the example of an older child who has developed mental schemes for "cars" and "bicycles" in that he can correctly categorize these by sight. But when confronted with a motorcycle the child cannot assimilate this vehicle into an existing scheme; he must therefore accommodate by allowing for a new category.

  It should be obvious from these examples that assimilation and accommodation are complementary processes. In a day's worth of learning, the child oscillates between these two processes, first learning acquiring new schemes, then expanding on the repertoire of schemes.

Equilibrium and Equilibration. When a child reaches a point at which he is not making such big steps, learning has leveled off, and there is a balance between assimilation and accommodation, the child has reached what Piaget called a state ***equilibrium***. By the end of the concrete operational stage, for instance, the child can easily grasp all of Piaget's conservation tasks, and has a clear idea of the concept of reversibility; that is a state of equilibrium. But when a child is ready for new learning, and cannot seem to meet his environmental challenges, a state of ***disequilibrium*** ensues, in which the child experiences cognitive discomfort. In other words, the child has needs and is ready to take on more complex tasks, and may in fact be progressing toward a new stage of cognitive development, involving major new accommodations. ***Equilibration*** simply refers to the process of moving from a state of disequilibrium to equilibrium.

A Closer Look at the Concept of Equilibration

Piaget's use of the term equilibration in cognitive development differs from its use in physics, where equilibrium refers to a static state or state of balance between forces. Consider the example of room temperature, which is regulated by a thermostat. If the temperature fluctuates a few degrees higher or lower than is desirable (disequilibrium), it is brought back to its original state by an air conditioner if too hot or by a heater if too cool.

Psychological disequilibrium is similar in one sense, that the "system" (in the case, the child's need to better understand his/her

world) is out of balance, and the existing schemes are inadequate for an understanding of the child's world. But this disequilibrium is resolved not by returning to the peaceful and contented state of being that the child experienced prior to being faced with a new challenge; instead, equilibrium is only achieved by advancing to a new level of understanding. The child's sense of disequilibrium is the motivating factor which lies behind the child's attempts to adapt (through assimilation and/or accommodation). This advancement is only possible through the child's active engagement with her/his environment in which the child constructs new schemes, which are built on top of older ones. This concept, known as ***constructivism***, contrasts very sharply with traditional learning theory, in which the child is viewed in a much more passive manner (see Chapter 10). But today, the concept of constructivism is widely embraced by cognitive scientists (Wadsworth, 1996).

Miller (2002) further notes that Piaget used equilibration to refer to *three separate processes*, all of which represent different states of equilibrium. These can be summarized briefly as:

1. **Moment-to-moment equilibration**. In everyday activities, *temporary disequilibrium* occurs from the tension that arises when a child cannot deal with a problem that is beyond his current cognitive limits. But through assimilation and accommodation, the problem is solved (e.g., as in the above example of the obstructing block), and equilibrium is again restored.

2. **End-of-period (or stage) equilibration**. Equilibrium occurs, for example, at the end of the concrete operations stage, when the concepts of reversibility and decentration are firmly grasped (thus all of the conservation tasks are easily solved).

3. **General-cognitive-development equilibration**. "The entire course of development can be seen as a process of equilibration as the child proceeds through increasingly 'better' forms of equilibrium. The most complete equilibrium is achieved when formal operations bring fully reversible and abstract thought" (Miller, 2002, p. 67).

Miller concludes that "equilibration is the grand process that puts together all of the elements of development. Equilibration integrates and regulates the other three main factors of development: physical maturation, experience with the physical environment, and the influence of the social environment" (2002, p. 67).

Organization. Organization is the second Piagetian process for building schemes. It is more of a mental process than is adaptation. Rather than learning through manipulation of objects in the environment the child develops new mental concepts – not necessarily verbal ones – that connect existing schemes. Organization is therefore a process of integration. As an example, a child begins to develop a mental concept of distance based on many prior experiences of tossing or throwing and dropping. At a later age the child develops a more sophisticated concept of distance that he can put into words, representing yet a higher degree of organization.

Just as assimilation and accommodation are two complementary processes that define adaptation, Piaget emphasized that organization and adaptation are also quite complementary, and they are often difficult to separate in practice. In this sense Piaget thought of organization as the *internal* component of cognition and adaptation as the *external* portion.

Piaget's Periods and Stages[2]

Sensorimotor Period

Major periods are listed in Table 4.1. The first period, from birth to about two years, is called the ***sensorimotor period*** (see Table 4.2 for stages within this period). During this period most schemes are organizations of physical action patterns. Piaget's (1936/1974) account refers frequently to observations of his infant

son, Laurent, and daughters, Lucienne and Jacqueline.

Stage 1 (to about one month). Piaget noted that earliest schemes are based on reflexes, or modifications of reflexes based on trial and error. Some basic reflexes include sucking, grasping, and "looking." Much (though not all) learning is then by assimilation. Piaget very carefully observed (by taking fine physical measurements!) how Laurent learned to find his mother's nipple. Head movements are at first random, but eventually he can locate the correct breast, and then the correct area of the breast – until ultimately he accommodates, and does not have to have the breast presented directly in order to nurse.

Stage 2 (1 – 4 months). A ***primary circular reaction***[3] occurs when a chance behavior produces "interesting" results, thus it gets repeated – and eventually becomes a habit, organized as a scheme. Thumb-sucking is an example. A child will try to move its head to reach its fingers, or its fingers to reach its mouth, and by chance eventually manages to coordinate these two separate and very primitive schemes. (Better the hand should reach the mouth than vice versa!) The circularity comes with the repeated attempts, until eventually success is attained.

Children's curiosity at this stage is focused on familiar surroundings. Piaget (1936/1974) noted how Laurent looked intently at the hood over his bassinet until he seemed to grasp its contours (these observations actually go on for several days). When seemingly satisfied, Laurent notices other aspects of his crib environment. Here Piaget especially noted that children take a special interest in things that are "moderately novel" – not completely new and strange, nor thoroughly familiar. The object of attention must evidently be slightly discrepant from familiar objects, but not too much so: it must bear some relationship to the child's existing schemes. "It is not the object per se that attracts attention; instead, curiosity is a function of the *relation* between the new object and the [child's] previous experience" (Ginsburg & Opper, 1988, p. 39). The child, it seems, likes novelty and exploration, but must relate his or her experience to the familiar (i.e., to existing schemes).

It is also at this stage that children learn to imitate sounds made by adults – a kind of "vocal contagion" (Ginsburg & Opper, 1988, p. 40). The adult (usually a parent) becomes a model[4] for such imitation. Piaget tried (with eventual success) to make his daughter Lucienne repeat sounds like "aa."

A child's reality at this stage consists of the objects that are in plain sight or physical contact. Objects exist in the moment; it is as though they cease to exist when they are out of sight or touch.

Stage 3 (4 – 10 months). The baby's interest in the environment becomes more extended. A hanging mobile becomes an object of fascination, especially when the child can make it move by kicking or touching it. The child produces "interesting effects" by her/his own actions, and delights in the results, repeating the behavior over and over. Because these schemes involve actions that extend away from the child him/herself, Piaget called such schemes ***secondary circular reactions***. Although the child learns to anticipate that her/his actions will produce the desired effect, Piaget stopped short of characterizing such behavior as intelligent (the activity has been discovered by trial and error, not through a deliberate attempt to achieve a goal; Ginsburg & Opper, 1988).

Stage 4 (8 – 12 months). Infants now learn to coordinate and combine schemes. Behavior becomes more willful, or goal-directed. The example cited earlier (in which a child combines schemes for *grasping* for her toy duck, and *pushing* away the obstructing block) illustrates such accommodation.

Another important development at this stage is the concept of ***object permanence***. In earlier stages, objects that were not within sight seemed not to exist; but now, a child searches for hidden objects. Hide a toy behind a bigger toy, or under a blanket or sheet. If the child sees the toy being hidden, she now understands that she can reach for it, even though it is out of sight.

Stage 5 (12 – 18 months). The child at this stage becomes more intrinsically motivated (i.e., motivated to learn about things for their own sake), without necessarily being encouraged by

adults. Piaget termed this interest and willingness to explore ***tertiary circular reactions***. On one date in his observation log, Piaget noticed how Laurent experimented repeatedly with grasping toys and objects in his crib, then lifted them at various angles, dropped them, and seemed interested in the differences in the effects that he controlled. Laurent seemed very systematic in these attempts by dropping objects repeatedly from one arm position several times before trying a different position (Piaget, 1952; Ginsburg & Opper, 1988).

Stage 6 (18 months – 2 years). It is in this final stage of the sensorimotor period in which ***symbolic thought*** begins. Piaget did not believe that thinking requires language; in fact, the child's earliest thought consists of the non-linguistic use of symbols. In an interesting experiment, Piaget (1936/1974; Ginsburg & Opper, 1988) hid a watch chain from Lucienne in a match box. She sees the box drawer open and close, but this action sequence is new to her. Lucienne clearly wants to get the chain from the matchbox, but using existing schemes (turning the box and trying to reach her finger into the opening slit) fail. Piaget then notices his daughter opening and closing her mouth, wider and wider! Then she "gets" the idea of the matchbox drawer opening and closing – she is able to open the slot with her finger, then she can pull out the watch chain.

The interesting discovery about this observation is that Lucienne seemed to form the concept of a box drawer opening and closing not through verbal reasoning, but by "feeling out" the solution in a physical way – by opening and closing her mouth in order to "symbolize" the needed action scheme.

Increasingly throughout the sensorimotor period the child becomes more adept at imitating models (adults or other children), but at this final stage she becomes adept at ***deferred imitation*** (imitating an act that was observed on a prior occasion). Piaget (1952; Ginsburg & Opper, 1988) recounts that his daughter Jacqueline, having observed a boy throwing a temper tantrum, attempts one herself the following day.

Table 4.1
Piaget's Periods of Development

Period		Brief Summary
Sensorimotor	*Approximate ages:*	Birth to 2 years.
	Cognitive processes:	Schemes are related to reflexes and basic action sequences.
	Key terms:	Circular reactions, object permanence.
Preoperational	*Approximate ages:*	2 to 7 years.
	Cognitive processes:	Thought is unorganized, illogical.
	Key terms:	Egocentricity, centration, irreversibility.
Concrete operations	*Approximate ages:*	7 to 11 years.
	Cognitive processes:	Thought is more logical, but very concrete.
	Key terms:	Reversibility, compensation, conservation, class inclusion.
Formal operations	*Approximate ages*:	11 to adulthood.
	Cognitive processes:	Capable of truly abstract thought.
	Key terms:	Hypothetical thinking. Abstract logical reasoning.

The sense of object permanence is now firmly established and the child can infer the location of objects following several displacements. As an example, Jacqueline visually follows Piaget's movements in hiding a pencil. First, he moves his hand (holding the pencil, which is concealed) behind a beret, then behind a handkerchief, and finally behind a jacket. She actually last viewed the pencil when Piaget concealed it in his palm. But to find the pencil she goes directly to the final location (Piaget, 1936/1954; Ginsburg & Opper, 1988).

Preoperational Period

The young child at this stage is able to form symbols – mental representations of ideas and events although they are not very logical or well organized. Piaget believed that children form their first mental symbols as extensions of physical imitative gestures. In the last stage of the sensorimotor period the example of Piaget's daughter Jacqueline imitating the mechanics of a matchbox with her mouth (see above) was an example of deferred imitation; it was for Jacqueline a primitive kind of mental representation of a particular behavior. Note that there is nothing conscious about such a representation; the child does not have to be aware of a concept that she has formed in order to make use of it (in Jacqueline's case by mimicking). In time such physical action sequences become less pronounced and more subtle – the muscle movement may become faint – until the concept itself becomes completely nonphysical: the child merely imagines the physical motions.

Semiotic Functions. Mental representations of physical movements increase in the preoperational stage and they also become more sophisticated. Piaget referred to such representations as ***semiotic functions***, in which a word, or a mechanical motor sequence, or visual image (called a ***signifier***), comes to stand for an object or event. There are two kinds of signifiers: ***signs*** and ***symbols***. Signs are merely labels or images that do not in any way represent the object or event being conceived. For example, there is nothing inherent in words like "tree" or "animal" that represent these objects; these words are merely names. On the other hand, symbols have some lingering quality of that is inherent in the concept; a visual image of an outline of an animal, bird, or cloud, for instance, is a kind of symbol. Mental symbols (unlike some signs) are personal, whose meanings are not shared or communicated with others. Note that in these examples no language is needed in order to form a concept. In this sense Piaget believed that thought preceded language, and indeed, that children's rudimentary thinking is not at all dependent on language development.

Egocentricity. Egocentricity refers to the child's inability to see (or more generally, to perceive) the world from the perspective of another. It is not used in the ordinary sense to denote self-centeredness.

Table 4.2
Stages Within the Sensorimotor Period

Stage	Approximate Age	Cognitive Characteristics
1	0 – 1 month	Earliest schemes are based on reflexes.
2	2 – 4 months	Primary circular reactions. Curious about familiar aspects of environment. Imitates sounds made by adults.
3	4 – 10 months	Secondary circular reactions.
4	10 – 12 months	Coordination of secondary schemes. Beginning sense of object permanence.
5	12 – 18 months	Tertiary circular reactions; intrinsic motivation.
6	18 – 24 months	Beginning of symbolic thought. Deferred imitation. More sophisticated sense of object permanence.

Egocentricity is demonstrated in Piaget's "three-mountain" experiment. A three dimensional scene is arranged on a table which consists of three sculptured mountains of different sizes and colors, and each has a different symbol at the top of the peak (snow capped peak, house, or cross). A doll is placed on one side of the table, and then the child – who is placed on a different side – is asked to report what the doll sees. The preoperational child

typically reports the view from his own perspective, not from the doll's.

Young children at play do not communicate well; they appear to be engaged in a "collective monologue" instead of a true dialog. They lack the imagination to understand how the other children perceive them or others. It is not until the next (concrete operational) stage that children develop what developmental psychologists call a ***theory of mind*** (Flavell, 2000). In other words, they can't imagine what someone else is thinking, what motivates them, or how they perceive the world.

Thinking. The preoperational child's reasoning is ***semi-logical***. The child has difficulty generalizing or doing any sort of deductive reasoning. Thoughts are loosely linked and illogical, as when Lucienne reasoned that, because she did not have her afternoon nap, it could not be afternoon (Piaget, 1929/1951)!

Centration also illustrates the limitations on the child's cognitive abilities. As more specific manifestation of centration is the inability to grasp the concept of reversibility (e.g., how to mentally reverse the pouring of water from one container to a different sized one in the water level conservation task per Figure 4.1).

Morality. The child fails to grasp the importance of intention in behavioral transgressions. In Piaget's example, a preoperational child thinks that accidentally breaking 15 cups is more culpable than intentionally breaking one: "more is worse." Examples like these are important for Piaget's theory of moral development (discussed more fully in Chapter 7), but they also demonstrate, in a way, both egocentricity (especially regarding the lack of a theory of mind) and rigidity of thinking.

How Do Young Children Conceive of the World?

How does a young child perceive the world? Most of us can't recall our own early childhood but Piaget (1929/1951) provides a brief overview of the child's conception of reality in the quotation that begins this chapter. To discover the ways in which the child perceives reality Piaget used one of his favored techniques – simply questioning children about themselves and their views on nature, adults, and other objects and events in their daily lives as seen from their point of view. From these interviews he and his colleagues identified characteristics of young children's thinking and how the child's conceptions of reality differ from those of older children and adults. He identified three important concepts in children's thought which he termed ***realism***, ***animism***, and ***artificialism***. Each is discussed briefly in this section. (As an interesting exercise, readers might try to imagine viewing the world themselves as children do while reading this section!)

Realism

Realism is the failure to recognize the existence of a self that is separate from this external world; hence "regarding one's own perspective as immediate and absolute" (p. 34). Realism in the child represents a kind of ultra-naïve conception of reality in which there is not only no self-awareness but also no distinction between the subjective and the objective. There is no awareness that the perception of others differ from one's own. This is thus another example of the kind of egocentricity that characterizes pre-operational children. Young children have only a very rudimentary grasp of the very notion of thought, and probably none of the ideas of mind or brain (i.e., they lack a theory of mind.)

When asked about thought, the child at this stage is likely to identify thinking with the mouth, or with speech. Thus language is implicated in the child's conception of thought. In fact, Piaget claims that for the child, ". . . to think is to speak – either with the mouth or with a little voice in the head . . ." (p. 60).

The young child also fails to distinguish the *name* of an object (sun, moon, tree, etc.) from the object itself, hence the child is unable to appreciate the arbitrariness of language, perhaps even until the ages of 9 to 11 or so. It is also as though the name of a thing belongs exclusively to that object. The child sometimes fails to understand that names can arbitrarily be changed (e.g., if people began to refer to the Earth as Mars it could not possibly still really be the Earth). Piaget referred to this phenomenon as ***nominal realism***. Piaget concluded that "The child is a realist, since he supposes thought to be inseparable from its object, name from the things named, and dreams to be eternal" (p. 124).

Piaget states that preoperational children seem to believe in the reality of their dreams: they are "real" at one moment (while asleep), but gone the next (after awakening). The boogeyman in the room was really there, but now he's gone. And they seem to think that adults as well should have privy to their dreams ("didn't you see it too, Mom")?

Actually, Piaget believed that there were three stages in children's conceptions of dreaming. In the first, dreams seem to come from outside the child and remain external. In the second stage the dream seems external, yet the child realizes that it arises within him/herself. In the third stage the child realizes that the dream arises within and is entirely an internal phenomenon.

Animism

Animism refers to the attribution of human characteristics such as feelings, thoughts, actions, and intentions, to non-living objects. Objects that move, such as clouds, the sun and moon, or toy trains and trucks, all may be given such attributes by young children.

Here is an example of a dialog between one of Piaget's assistants and a young child (p. 197):

Q: Are you alive?
A: Yes, because I'm not dead.
Q: Is a fly alive?
A: Yes, because it's not dead.
Q: Is the sun alive?
A: Yes because it makes it daytime.

Q: Is a candle alive?
A: Yes, because you can light it.
Q: Is the wind alive?
A: Yes, because it makes people cold . . .
Q: Are clouds alive?
A: Yes, because they make it rain . . .

With questions like these concerning the "life" in various objects, Piaget noted that the youngest children (about ages 4 to 6 or 7) first associate life with activity of any kind, then as they mature, with movement generally (roughly ages 6 to 8), and finally only with animals and plants (from about age 8 onward). The age ranges cannot be precisely given because there is so much maturational variation among children.

Artificialism

For Piaget, "[Artificialism] consists in regarding things as the product of human creation, rather than in attributing creative activity to the things themselves" (p. 153). That is why when children ask such questions as "Who made the sun?" or "Who is it makes the stars twinkle?" (p. 256), it becomes clear that children simply assume that "someone" is responsible for such things. Children also often ask such questions about the origins of trees and mountains or the weather, such as it is on a given day. A child is likely to assume that a lake or sea has been carved out or created by an act of some being.

Relationship to Egocentricity

All three concepts – realism, animism, and artificialism – clearly reflect the young child's egocentric perceptions of the world. Perhaps this is most evident in the case of realism, in which the child is simply unable to separate her/his own self from the rest of what constitutes his or her reality. In the case of animism, the child believes that other objects, people, or animals, all function mentally in the same way as he or she does. With artificialism, the belief is that things have been made not by the child, but by "us," or other people, who by implication from the child's egocentric

perspective, are in fact like him or her.

Concrete Operational Period

Conservation Tasks. During this period thought becomes more logical, but is still quite concrete. The child who, toward the end of this stage, has achieved equilibrium can easily solve all of the conservation tasks (Figure 4.1). In the water level problem considered earlier, for example, the child is able to see more than one aspect of the problem (lack of centration), and clearly understands that the process is reversible: when the water is poured back into the original container the quantity is preserved. This understanding also involves the complementary process of ***compensation***, or being able to see that the water amount in the second container is the same because the container is wider rather than taller, thus compensating for the fact that the level is lower than in the first container. Another related concept the child attains in this period is that of ***identity***. The notion is that, since nothing has been added or removed, the quantities in the two containers must remain identical. In summary, reversibility, compensation, identity, and lack of centration all characterize the child's mental schemes during this period. Once again it is worth noting that Piaget believed that children were able to grasp these concepts intuitively and on their own, through experimentation.

Socialization and Egocentrism. In interacting with other children, youngsters learn cooperation and compromise, as the collective monologues that characterize preoperational children become more like dialogs as the child grows into the concrete operational period. Disputes and arguments between children are just a natural part of the process, ultimately enabling them to be able to see another's point of view. Piaget (1924/1972) believed that these social interactions between children were particularly important in learning to overcome egocentrism.

Class Inclusion. The child at the concrete operational stage

also begins to understand part-whole relations. Here is a problem posed by Piaget and Szeminska (1941/1952). A child sees that there are 20 brown and 2 white, wooden beads. He asks the child whether there are more brown beads or more wooden beads. A preoperational child of about 7 years of age will, curiously to adults, typically state that there are more brown beads. It is only at around eight years, in the concrete operations stage, that children can deal effectively with such problems of ***class inclusion*** (or part-whole relations). Once again, the problem with the preoperational child is centration, or the inability (in this case) to focus on the dual aspects of the situation: they cannot deal simultaneously with the parts of the situation and the whole.

Logical Relations. Children in this period are also capable of understanding some kinds of logical relations, such as order relations. Suppose Ann is taller than Mick, but Mick is taller than Betty. A child at the concrete operational stage can reason (unlike the preoperational child) that Ann is also taller than Betty.

Formal Operations

Most teachers would hesitate to attempt to teach algebra or geometry to children who are in the concrete operational stage. They have some necessary arithmetic skills, but they lack the ability to handle ***abstraction*** ("Let X be an unknown quantity") or ***hypothetical thinking*** ("Suppose cats glowed at night. How would this affect mouse ecology?"). Hypothetical (or propositional) thinking involves the ability to see possibilities, including abstract ones. ***Logical reasoning*** before this period is also rudimentary. A preoperational child might have difficulty understanding formal logic, as in this syllogism:

> All psychology classes are interesting;
> Statistics for psychologists is a psychology class;
> Therefore, statistics for psychologists is interesting.

(Note that one is not asked to evaluate the actual truth of the premises; the task in deductive reasoning is to determine the validity of the conclusion *given* the truth of the premises.)

At a further level of abstraction, a student of logic at the formal operational stage might see that the following argument is valid:

All pamplings are swerlies;
A gravine is a pampling;
Therefore, a gravine is a swerlie.

Note that the level of abstraction is compounded here by referring to objects or beings such as "swerlies" that are "made up" and have no basis in reality. Hypothesizing the relations between such abstract – and in fact, nonexistent – objects requires quite a conceptual leap from the understanding of relations between tangible objects at the concrete operations level.

For Piaget, the adolescent's reasoning is very much like a scientist's: she can grasp abstract concepts, reason logically, and imagine hypothetical outcomes to experiments. She can reason not only concretely (as with relations between physical objects; think of conservation tasks) but abstractly (as with relations between ideas). Egocentricity further decreases as well; not only can Rudy imagine what Jose might be thinking about him, but he can imagine that Jose is wondering what he is thinking about him (Jose) as well.

Adolescent Egocentricity. At each stage of development the child (and later, adolescent or adult) becomes less egocentric. However, adolescents still tend to be more self-focused than adults. Particularly in the early teenage years youngsters tend to exaggerate their own importance, or become excruciatingly self-conscious, thinking that others notice every physical blemish or shortcoming. Acne can be embarrassing, but is the appearance of a tiny pimple enough to ruin one's day? Elkind and Bowen (1979) refer to this kind of self-consciousness as concern for an ***imaginary audience***. It is the belief that one is the center of other's perceptions.

It's great for teens to have ambitions to succeed in life and to hope to excel at some form of work or activity. But Elkind (1994) also notes another form of adolescent egocentrism that he calls the ***personal fable***, in which teens imagine that they will have

extraordinary destinies and change the world in radical ways. A teen might, for example, believe he or she is destined to become a great actor, scientist, or political reformer. A slightly different form of this is generational: "they" – meaning older generations – have mucked things up pretty badly. "We" – meaning "our" teenage generation – will have to fix this mess. (But then, who would not hope otherwise?)

Educational Implications

Quite obviously, Piaget thought (as did Rousseau and Maria Montessori, founder of the Montessori schools) that children learned best by experimenting for themselves. Recall that, in his early experiences with intelligence testing, Piaget was more concerned with the way that children solve problems than with whether or not they arrived at a correct solution. To take this a step further, struggling with a problem can is in itself be seen as learning something, even if it is not the answer to the problem one began with. Teachers who are influenced by Piaget thus tend to believe that quality learning comes from being challenged naturally by problems, motivated intrinsically by curiosity, and attempting different solutions through experimentation. The Piagetian classroom is thus child centered, rather than being knowledge centered: solutions to problems should come from the child, not from the teacher. Learning is, for the child, an active process of discovery.

Also, the tasks presented to the child should be appropriate for that child's level of development. ***Readiness*** is an important factor in that one should not try to teach concepts that are beyond the child's period or stage of development (the child himself will learn such concepts when he is ready).

Needless to say, this approach is in very sharp contrast with educational practices in many (or perhaps most) schools. Many schools use a more Lockian model, in which learning is gradual, based on small increments in knowledge, with much of this based on rote memorization. Contingencies (external rewards and punishments) are also employed in the Lockian model; in other

words, motivation is largely extrinsic rather than intrinsic. Such a model is also compatible with the behavioristic tradition in psychology (as will be seen in Chapter 10).

Evaluating Piaget

The Concept of Developmental Stages

Models of development (as was seen in Chapter 1) vary with respect to the notion of stages. Piaget began with a very structured model in which discrete periods or stages characterize different levels of development. As his work progressed, he recognized that horizontal décalage not only occurred, but was also very commonplace, so that stages themselves were not entirely discreet.

Other psychologists – notably those in the behaviorist (or Lockian) tradition (Chapter 10) – believe that learning is a more or less continuous, incremental process. It may be characterized by sudden leaps of learning – times in which new learning seems rapid and accelerated – but this does not (for them) necessarily imply that discrete stages are anything more than points at which the child's nervous system matures enough to handle such bursts of learning.

A little thought suggests that both positions can be true in their own way. If one thinks in terms of the gradual and incremental increase in knowledge that takes place in *factual* learning (e.g., spelling; ordinary arithmetic), then the traditional position is reasonable. But if one considers instead the kind of learning espoused by Piaget, in which a reorganization of mental processes permits the learning of tasks that were previously unattainable, then the Piagetian position seems tenable. One must, of course, grant that the phenomenon of horizontal décalage makes this stage approach seem less like an abrupt shift in mentality than a somewhat more gradual one. But this still does not discount the notion that thinking becomes reorganized; and when equilibration occurs at the end of each period, the process of reorganization can be said to be consolidated, per Piaget's theory.

Gelman and Baillargeon (1983) have raised doubts about the notion that stages *always* unfold in the invariant sequence that

Piaget postulated. Such criticisms raise serious concerns, though they are not necessarily fatal, for Piaget's theory. Still, psychologists today view cognitive development as somewhat more continuous as did Piaget.

Piaget's Methodology

Potential weaknesses in Piaget's methodology have already been discussed: his research was based on clinical observations of a few case studies with small samples, and lack of statistical analysis. Piaget did do experiments (especially on his own children), but these were in no sense tightly controlled experiments.

The value of clinical research using case studies is never clear until the findings can be shown to hold using more traditional, experimental techniques with tight controls, and a sufficient number of cases to allow generality. Greater sophistication is also needed in providing improved measurement techniques (standardized psychometric tests; e.g., of conservation tasks). Many examples of theories based on case studies will be seen later in the text, including the chapters on Freud and the ethologists. In the case of Freud, results seem mixed to say the least. The ethologists, however, have made some valuable contributions that are experimentally verifiable. Piaget, too, was a shrewd observer whose observations have largely been verified. That Piaget has generated so much research is a great testament to him. This is true even when his theories required modification (as Piaget did himself); indeed, that is the way that scientific progress is made.

Some experimental research places certain Piagetian notions in question (see next section), but experimental research has largely favored at least some form of his stage sequences. Fleming and DeAvila (1980, p. 73) state: "It is inevitable, perhaps, in the evolution of scientific theory that insight [per Piaget's clinical observations] is gradually supplanted by refinement, as measurement assumes a greater and greater role." They suggest some precise psychometric and statistical methods to use for testing Piagetian stage sequences, including décalages within periods.

Are Children Smarter Than Piaget Thought? Can They Be Taught Beyond Their Level?

Recalling the "three mountains" egocentrism experiment, in which a child cannot see a scene from a hypothetical other's perspective, when researcher use more familiar objects and explain the task more clearly to the child, then children at a much younger age are able to view things from another's perspective (Baillargeon & De Vos, 1991; Borke, 1975; Gelman & Baillargeon, 1983). Thus, the task may have simply been too difficult, involving too many complexities for some children, who nonetheless seem less egocentric at an earlier stage (perhaps as early as four years) than Piaget originally thought. (This does not mean that young children are not egocentric, only less so than Piaget thought.)

Although it is very difficult to teach children conservation tasks while they are still operating at the concrete operational level, Gelman (1969) nevertheless had some success with conservation of length and number. However, the training was extremely intensive, lasting a couple of days, and not all the children could learn the tasks. But Crain (2005, p. 144) wondered "whether such methods accurately reflect the ways in which the children master conservation in their daily lives . . . When children solve problems on their own, they gain confidence in their abilities to make discoveries."

Are Stages and Periods Truly Universal?

It may be that people in tribal or isolated agrarian communities never actually reach formal operations. Even in our own culture, it may be that people who drop out of school early to work at a job that makes few cognitive demands never reach this stage. This does not mean that this final stage is out of their reach, but only that they may have no need for such abstract thinking. In some ways, this fact presents a problem for Piaget's theory in that he believed that children and adolescents advance from one stage to the next largely through their own natural experience. In the case of formal operations, however, it seems likely that cultural and societal demands may play a significant role in the adolescent's advancement. As will be seen in Chapter 5, Vygotsky better addressed the issue of culture on development.

Did Piaget Undervalue Social Factors in Cognitive Development?

As already seen, Piaget believed that social interactions among children helped them to overcome their egocentric tendencies. Beyond this, Piaget may have missed further opportunities to discover how interactions with peers and with adults can facilitate development. In the chapters on moral and sociocultural development, it will be seen how theorists like Kohlberg and Vygotsky filled some of this void. As for Piaget, perhaps it is enough that he stuck to cognitive development: one theorist can only do so much in a lifetime! Of course Piaget did concern himself mainly with cognitive development, and not with personality and social development, topics which occupy separate sections of this textbook. But the domain of cognitive development is certainly important enough to merit a grand theory of its own.

The Future of Cognitive Development

The Neo-Piagetians and Invormation Processing Theory. Piaget's psychology was largely (though not entirely) descriptive, but his observations were quite accurate; and they were very sophisticated. However, he did not discover the mental mechanisms that would show *how* children's learning is structured, nor did he entirely explain the different strategies that children employ in attempting to solve problems. Such tasks were left to others, particularly the ***Neo-Piagetians*** who tried to link mental structures to brain development and ***task analysis***: the examination of the strategies employed by children in solving problems. Robbie Case (1998), Kurt Fischer (1980), and Juan Pascual-Leone (1970) are notable among them. Their ideas flow naturally into an ***information processing*** approach to knowledge acquisition, which employs a technological analogy in which the person is seen as a processing system (like a computer; see Munakata, 2006, for a review of the more general information processing approaches). Information processing theorists analyze sensory input, mental processing, and neuronal or behavioral output: how information is coded, transformed, stored in human memory; and how it is retrieved, are aspects of the tracking problem for the flow of

information.

Cognitive Science. Closely related to the information processing approach is ***cognitive science*** – the two areas overlap, but the latter is more focused on brain physiology. Frank Keil (2006) reviews research on cognitive development from the interdisciplinary field of cognitive science, which includes theory and research from the fields of: "psychology, linguistics, computer science, neuroscience, anthropology, and philosophy" (p. 609). Developmental science has benefited from the convergence of findings from these varied disciplines, but Keil believes that the next decade or so will lead to new and productive ways of viewing old problems, with new answers to old questions.

Culture and Cognitive Development. Piaget, Lawrence Kohlberg, and other theorists have proposed that some stages of development are universal, cutting across cultural boundaries.

Piaget's Positive Contribution

Piaget remains a giant in the study of cognitive development, and the evaluation of any other work in the area inevitably begins with a comparison to his work. Piaget's approach was thoroughly original, and though some of his ideas seem flawed or in need of revision, his influence on developmental science cannot be overstated. In commenting on this influence, David Myers observed, "Piaget would not be surprised that today, as part of our own cognitive development, we are adapting his ideas to accommodate new findings" (2004, p. 145). Piaget's influence will continue, no doubt, for generations to come.

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For Thought or Discussion

1. Looking back on your reading of this chapter (and perhaps anticipating Chapter 13 on Attachment Theory), which of Piaget's findings would make you believe that a child needs some sense of consistency and familiarity in his/her environment in order to feel secure?
2. Many psychologists (including Piaget and Freud) have based their theories on their observations of clients or of children. How can this approach be justified when compared to a more experimental approach, in which specific hypothesis are tested in a controlled environment on a number of people, with statistically significant results?
3. In what sense are Piaget's periods of cognitive development really "qualitatively different"? (Give at least one example.)
4. Consider this joke about a transaction at a pizza parlor:

   Customer: Give me a large pizza, please.
   Clerk: Shall I cut it into six or eight slices?
   Customer: Better make it six – I'm not hungry enough to eat eight.

   At which period of development would a child first be able to truly appreciate this joke? Why?
5. Have you ever seen young children playing together who are engaged in a "collective monologue"? If so, recount your experience. How were conflicts between them (if any) handled?
6. Can you see any problems with the Piagetian approach to classroom learning in grade school as compared to the traditional (Lockian) approach? What are arguments in favor of each (think in terms of your own educational experience, or of your children's).
7. After the Soviet Union launched Sputnik, the first satellite to orbit the earth, educators believed that our falling behind in the "space race" was due in part to the failure of our educational system. As a consequence, schools began teaching the so-called "new math" in which children learned not just ordinary arithmetic, but the abstract set theoretical principles that

underlie mathematical theory. Piaget could have predicted the resulting failure, but why is this so?

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Chapter Notes

1. Piaget (1929/1951), p. 370.
2. When he first visited America in 1921, it was said that Einstein's work could only be understood by 12 living people (Paterniti, 2000). Piaget, like Einstein, was unquestionably brilliant, and though he wrote succinctly he, too, can be difficult reading (Inhelder, 1988). Piaget was so busy revising and extending his theory that he seldom stopped to try to pull it all together for the reader. I try to give a proper introduction to Piaget, and one that is lengthier than that of the average beginning textbook – but one could write an entire chapter on the stages of sensorimotor period alone. For an advanced treatment the reader is referred to Piaget's original works (especially Piaget, 1936/1974, 1936/1954); to Ginsburg and Opper (1988); or to Flavell, Miller, and Miller (2001).
3. Here as elsewhere, Piaget seems ahead of his time: note the importance of modeling in Bandura's social learning theory which comes much later in the history of American psychology (per Chapter 11).
4. The term "circular reaction" was coined by the American developmentalist James Mark Baldwin, whose work influenced Piaget, who frequently cited Baldwin in his writings.