CHAPTER 7

# Cognitive Development: Piaget's Theory and Vygotsky's Sociocultural Viewpoint

TEACHER (to a class of 9-year-olds): For artwork today, I'd like each of you to draw me a picture of a person who has three eyes.

BILLY: How? Nobody has three eyes!

If you were asked to account for the reaction of this 9-year-old, you might be tempted to conclude that he either lacks imagination or is being sarcastic. Actually, Billy's feelings about the art assignment are rather typical (see the box on page 274), because 9-year-olds think differently than adults do, and they often find it difficult to reflect on hypothetical propositions that have no basis in reality.

**cognition**
the activity of knowing and the processes through which knowledge is acquired.

Our next three chapters examine the growth of **cognition**—a term psychologists use to refer to the activity of knowing and the mental processes by which human beings acquire and use knowledge to solve problems. The cognitive processes that help us to understand and to adapt to the environment include such activities as attending, perceiving, learning, thinking, and remembering—in short, the unobservable events and undertakings that characterize the human mind (Bjorklund, 2005).

**cognitive development**
changes that occur in mental activities such as attending, perceiving, learning, thinking, and remembering.

The study of **cognitive development**—the changes that occur in children's mental abilities over the course of their lives—is one of the most diverse and exciting topics in all of the developmental sciences. In this chapter we begin our exploration of the developing mind, focusing first on the many important contributions of Swiss psychologist Jean Piaget, who charted what he (and others) believed to be a *universal* pattern of intellectual growth that unfolds during infancy, childhood, and adolescence. We then examine Lev Vygotsky's *sociocultural* viewpoint—a theory that claims that cognitive growth is heavily influenced by one's culture and may be nowhere near as universal as Piaget and his followers assumed (Wertsch & Tulviste, 1992).

Chapter 8 introduces a third influential perspective on the developing mind: *information processing,* a viewpoint that arose, in part, from questions left unanswered by Piaget's earlier work. Our attention then shifts in Chapter 9 to the *psychometric,* or intelligence testing, approach, where we discuss the factors that contribute to individual differences in children's intellectual performance.

## Piaget's Theory of Cognitive Development

You were introduced to Piaget in Chapter 2. By far the most influential theorist in the history of child development, Piaget combined his earlier interests in zoology and epistemology (the branch of philosophy concerned with the origins of knowledge) to develop a new science that he termed **genetic epistemology,** which he defined as the experimental study of the origin of knowledge. (Piaget used the term *genetic* in an older sense, meaning essentially developmental.)

**genetic epistemology**
the experimental study of the development of knowledge, developed by Piaget.

Piaget began his studies by carefully observing his own three children as infants: how they explored new toys, solved simple problems that he prepared for them, and generally came to understand themselves and their world. Later, Piaget studied larger samples of children through what became known as the *clinical method,* a flexible question-and-answer technique he used to discover how children of different ages solved various problems and thought about everyday issues. From these naturalistic observations of topics ranging from the rules of games to the laws of physics, Piaget formulated his grand theory of intellectual growth.

## What Is Intelligence?

**intelligence**
in Piaget's theory, a basic life function that enables an organism to adapt to its environment.

**cognitive equilibrium**
Piaget's term for the state of affairs in which there is a balanced, or harmonious, relationship between one's thought processes and the environment.

Piaget's background in zoology is quite apparent from his definition of **intelligence** as *a basic life function* that helps the organism adapt to its environment. We observe such adaptation as we watch a toddler figure out how to turn on the TV, a school-age child decide how to divide candies among friends, or an adolescent struggle to solve a geometry problem. Piaget proposed that intelligence is "a form of *equilibrium* toward which all cognitive structures tend" (1950, p. 6). His point was simply that all intellectual activity is undertaken with one goal in mind: to produce a balanced, or harmonious, relationship between one's thought processes and the environment. Such a balanced state of affairs is called **cognitive equilibrium,** and the process of achieving it is called *equilibration*. Piaget stressed that children are active and curious explorers who are constantly challenged by many novel stimuli and events that are not immediately understood. He believed that these imbalances (or *cognitive disequilibria*) between the children's modes of thinking and environmental events prompt them to make mental adjustments that enable them to cope with puzzling new experiences and thereby restore cognitive equilibrium. So we see that Piaget's view of intelligence is an "interactionist" model that implies that mismatches between one's internal mental schemes (existing knowledge) and the external environment stimulate cognitive activity and intellectual growth.

**constructivist**
one who gains knowledge by acting or otherwise operating on objects and events to discover their properties.

There is a very important assumption that underlies Piaget's view of intelligence: If children are to know something, they must *construct* that knowledge themselves. Indeed, Piaget described the child as a **constructivist**—an individual who acts on novel objects and events and thereby gains some understanding of their essential features. Children's constructions of reality (i.e., interpretations of objects and events) depend on the knowledge they have available to them: the more immature the child's cognitive system, the more limited his or her interpretation of an event. For example, 4-year-old Robin told his mom after school one day, "Mommy, today at recess, a big cold wind came and almost blew me down! I think it knew that I was hot and it came to cool me down!" This child is making an important assumption that dominates his attempt at understanding—namely, that inanimate things, in this case wind, have intentions. He does not make the distinction between animate and inanimate objects, at least not the type of distinction that adults make. As a result, he constructs a very different interpretation of "reality" than his mother does.

## How We Gain Knowledge: Cognitive Schemes and Cognitive Processes

**scheme**
an organized pattern of thought or action that one constructs to interpret some aspect of one's experience (also called cognitive structure).

According to Piaget, cognition develops through the refinement and transformation of mental structures, or **schemes** (Piaget & Inhelder, 1969). Schemes are unobservable mental systems that underlie intelligence. A scheme is a pattern of thought or action and is most simply viewed as some enduring knowledge base by which children inter-

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Infants develop a broad range of behavioral schemes that they can use to explore and "understand" new objects and to solve simple problems.

pret their world. Schemes, in effect, are representations of reality. Children know their world through their schemes. Schemes are the means by which children interpret and organize experience. For Piaget, cognitive development is the development of schemes, or structures. Children enter the world with some reflexes by which they interpret their surroundings, and what underlies these reflexes are schemes.

How do children construct and modify their intellectual schemes? Piaget believed that all schemes, all forms of understanding, are created through the workings of two inborn intellectual processes: *organization* and *adaptation*.

**organization**
an inborn tendency to combine and integrate available schemes into coherent systems or bodies of knowledge.

**adaptation**
an inborn tendency to adjust to the demands of the environment.

**assimilation**
the process of interpreting new experiences by incorporating them into existing schemes.

**accommodation**
the process of modifying existing schemes in order to incorporate or adapt to new experiences.

**Organization** is the process by which children combine existing schemes into new and more complex intellectual schemes. For example, an infant who has "gazing," "reaching," and "grasping" reflexes soon organizes these initially unrelated schemes into a more complex structure—*visually directed reaching*—that enables him to reach out and discover the characteristics of many interesting objects in the environment. Although cognitive schemes may assume radically different forms at different phases of development, the process of organization is unchanging. Piaget believed that children are constantly organizing whatever schemes they have into more complex and adaptive structures.

The goal of organization is to promote **adaptation,** the process of adjusting to the demands of the environment. According to Piaget, adaptation occurs through two complementary activities: *assimilation* and *accommodation*.

**Assimilation** is the process by which children try to interpret new experiences in terms of their existing models of the world, the schemes they already possess. The young child who sees a horse for the first time may try to assimilate it into one of her existing schemes for four-legged animals and thus may think of this creature as a "doggie." In other words, the child is trying to adapt to this novel stimulus by construing it as something familiar.

Yet truly novel objects, events, and experiences may be difficult to interpret in terms of one's existing schemes. For example, our young child may soon notice that this big animal she is labeling a doggie has funny-looking feet and a most peculiar bark, and she may seek a better understanding of the observations she has made. **Accommodation,** the complement of assimilation, is the process of modifying existing structures in order to account for new experiences. So the child who recognizes that a horse is not a dog may invent a name for this new creature or perhaps say "What dat?" and adopt the label that her companions use. In so doing, she has modified (accommodated) her scheme for four-legged animals to include a new category of experience—horses.

Piaget believed that assimilation and accommodation work together to promote cognitive growth. They do not always occur equally as in the preceding example; but assimilations of experiences that do not quite "jibe" with existing schemes eventually introduce cognitive conflict and prompt accommodations to those experiences. And the end result is adaptation, a state of equilibrium, or balance, between one's cognitive structures and the environment.

Table 7.1 provides one example of how cognitive growth might proceed from Piaget's point of view—a perspective that stresses that cognitive development is an *active* process in which children are regularly seeking and *assimilating* new experiences, *accommodating* their cognitive structures to these experiences, and *organizing* what they know into new and more complex schemes. So two inborn activities—organization and adaptation—make it possible for children to construct progressively greater understandings of the world in which they live.

**TABLE 7.1** A Small Sample of Cognitive Growth from Piaget's Perspective

| | Piagetian concept | Definition | Example |
|---|---|---|---|
| Start | Equilibrium | Harmony between one's schemes and one's experience. | Toddler who has never seen anything fly but birds thinks that all flying objects are "birdies." |
| | Assimilation | Tries to adapt to new experience by interpreting it in terms of existing schemes. | Seeing an airplane in the sky prompts child to call the flying object a birdie. |
| | Accommodation | Modifies existing schemes to better account for puzzling new experience. | Toddler experiences conflict or disequilibrium upon noticing that the new birdie has no feathers and doesn't flap its wings. Concludes it is not a bird and invents a new name for it (or asks, "What dat?"). Successful accommodation restores equilibrium—for the moment, at least. |
| Finish | Organization | Rearranges existing schemes into new and more complex structures. | Forms hierarchical scheme consisting of a superordinate class (flying objects) and two subordinate classes (birdies and airplanes). |

NOTE: As an exercise, you may wish to apply Piaget's concepts to chart the further elaborations of the child's schemes upon encountering a butterfly and a Frisbee.

## CONCEPT CHECK 7.1 Understanding Piagetian Assumptions and Concepts

Check your understanding of the basic assumptions and concepts of Piaget's theory by answering the following questions. Answers appear in the Appendix.

**Multiple Choice:** Select the best alternative for each question.

_____ 1. According to Piaget, *accommodation* refers to
   a. the modification or distortion of new information in order to incorporate it into current schemes
   b. the fact that every structure has its genesis in previous structures
   c. the tendency to integrate structures into higher-order systems of structures
   d. the changing of a current scheme in order to incorporate new information

_____ 2. According to Piaget, *cognitive equilibration* refers to the
   a. tendency to integrate structures into higher-order systems or structures
   b. individual seeking to stabilize his or her cognitive structures
   c. tendency to modify structures in order to incorporate new information into existing structures
   d. fact that every structure has its genesis (i.e., its origins) in earlier structures

_____ 3. Professor Johanson believes that children's thinking follows an invariant developmental sequence. It is likely that Professor Johanson generally
   a. agrees with Piaget and is a stage theorist
   b. agrees with Piaget and is *not* a stage theorist
   c. disagrees with Piaget and believes that children's thinking is uneven at different times in development
   d. disagrees with Piaget and believes that children's thinking strongly reflects sociocultural influence

**Matching:** Match the following concepts with their definitions.

a. schemes
b. constructivist
c. cognitive equilibration
d. intelligence
e. organization
f. assimilation

4. ________ In Piaget's theory, a basic life function that enables an organism to adapt to its environment.
5. ________ Piaget's term for the state of affairs in which there is a balanced, or harmonious, relationship between one's thought processes and the environment.
6. ________ The process of interpreting new experiences by incorporating them into existing schemes.
7. ________ One who gains knowledge by acting or otherwise operating on objects and events to discover their properties.
8. ________ An organized pattern of thought or action that one constructs to interpret some aspect of one's experience.
9. ________ An inborn tendency to combine and integrate available schemes into coherent systems or bodies of knowledge.

**Essays:** Provide a detailed answer to the following questions.

10. Discuss Piaget's concept of adaptation. How do assimilation and accommodation "work" together to result in adaptation?
11. How did Piaget define *intelligence?* How is this different from the way most people define the term?

# Piaget's Stages of Cognitive Development

**invariant developmental sequence**
a series of developments that occur in one particular order because each development in the sequence is a prerequisite for those appearing later.

Piaget identified four major periods, or stages, of cognitive development: the *sensorimotor stage* (birth to 2 years), the *preoperational stage* (2 to 7 years), the *stage of concrete operations* (7 to 11 years), and the *stage of formal operations* (11 years and beyond). These stages of intellectual growth represent qualitatively different levels of functioning and form what Piaget calls an **invariant developmental sequence;** that is, all children progress through the stages in the same order. Piaget argued that stages can never be skipped because each successive stage builds on the accomplishments of previous stages.

Although Piaget believed that the sequencing of intellectual stages is fixed, or invariant, he recognized that there are tremendous individual differences in the ages at which children enter or emerge from any particular stage. In fact, his view was that cultural factors and other environmental influences may either accelerate or retard a child's rate of intellectual growth, and he considered the age norms that accompany his stages (and substages) as only rough approximations at best.

## The Sensorimotor Stage (Birth to 2 Years)

**sensorimotor period**
Piaget's first intellectual stage, from birth to 2 years, when infants are relying on behavioral schemes as a means of exploring and understanding the environment.

During the **sensorimotor period,** infants coordinate their *sensory* inputs and *motor* capabilities, forming behavioral schemes that permit them to "act on" and to get to "know" their environment. How much can they really understand by relying on overt actions to generate knowledge? More than you might imagine. During the first 2 years, infants develop from reflexive creatures with very limited knowledge into planful problem solvers who have already learned a great deal about themselves, their close companions, and the objects and events in their everyday world. So drastic is the infant's cognitive growth that Piaget divided the sensorimotor period into six substages (see Table 7.2) that describe the child's gradual transition from a *reflexive* to a *reflective* being. Our review will focus on three important aspects of sensorimotor development: *problem-solving skills* (or means/ends activities), *imitation,* and the growth of the *object concept.*

**TABLE 7.2** Summary of Piaget's Account of Sensorimotor Development

| Substage | Methods of solving problems or producing interesting outcomes | Imitation | Object concept |
|---|---|---|---|
| 1. Reflex activity (0–1 month) | Exercising and accommodation of inborn reflexes. | Some reflexive imitation of motor responses.[1] | Tracks moving object but ignores its disappearance. |
| 2. Primary circular reactions (1–4 months) | Repeating interesting acts that are centered on one's own body. | Repetition of own behavior that is mimicked by a companion. | Looks intently at the spot where an object disappeared.[2] |
| 3. Secondary circular reactions (4–8 months) | Repeating interesting acts that are directed toward external objects. | Same as in Substage 2. | Searches for partly concealed object. |
| 4. Coordination of secondary schemes (8–12 months) | Combining actions to solve simple problems (first evidence of intentionality). | Gradual imitation of novel responses; deferred imitation of very simple motor acts after a brief delay. | Clear signs of emerging object concept; searches for and finds concealed object that has *not* been visibly displaced. |
| 5. Tertiary circular reactions (12–18 months) | Experimenting to find new ways to solve problems or reproduce interesting outcomes. | Systematic imitation of novel responses; deferred imitation of simple motor acts after a long delay. | Searches for and finds object that has been *visibly* displaced. |
| 6. Invention of new means through mental combinations (18–24 months) | First evidence of insight as the child solves problems at an internal, symbolic level. | Deferred imitation of complex behavioral sequences. | Object concept is complete; searches for and finds objects that have been hidden through *invisible* displacements. |

[1]Imitation of simple motor acts (such as tongue protrusions, head movements, and the opening and closing of one's lips or hands) is apparently an inborn, reflexlike ability that bears little relation to the voluntary imitation that appears later in the first year.
[2]Many researchers now believe that object permanence may be present very early and that Piaget's reliance on search procedures badly underestimated what young infants know about objects (see the box on page 258).

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Blowing bubbles is an accommodation of the sucking reflex and one of the infant's earliest primary circular reactions.

## Development of Problem-Solving Abilities

**Reflex Activity (Birth to 1 Month).** Piaget characterized the first month of life as a stage of **reflex activity**—a period when an infant's actions are pretty much confined to exercising innate reflexes, assimilating new objects into these reflexive schemes (e.g., sucking on blankets and toys as well as on nipples), and accommodating their reflexes to these novel objects. Granted, this is not high intellect, but these primitive adaptations represent the beginning of cognitive growth.

**Primary Circular Reactions (1 to 4 Months).** The first nonreflexive schemes emerge at 1 to 4 months of age as infants discover by chance that various responses that they can emit and control (e.g., sucking their thumbs, making cooing sounds) are satisfying and, thus, worth repeating. These simple repetitive acts, called **primary circular reactions,** are always centered on the infant's own body. They are called "primary" because they are the first motor habits to appear and "circular" because they are repetitive.

**Secondary Circular Reactions (4 to 8 Months).** Between 4 and 8 months of age, infants are discovering (again by chance) that they can make interesting things happen to objects beyond their own bodies, such as making a rubber duck quack by squeezing it. These new schemes, called **secondary circular reactions,** are also repeated for the pleasure they bring. According to Piaget, 4- to 8-month-olds' sudden interest in external objects indicates that they have begun to differentiate themselves from objects they can control in the surrounding environment.

Is an infant who delights in such repetitive actions as swatting a brightly colored mobile or making a toy duck quack engaging in *planful* or *intentional* behavior? Piaget said no: The secondary circular reaction is not a fully intentional response, because the interesting result it produces was discovered by chance and was not a purposeful goal the first time the action was performed.

**Coordination of Secondary Reactions (8 to 12 Months).** Truly planful responding first appears between 8 and 12 months of age, during the substage of the **coordination of secondary circular reactions,** as infants begin to coordinate two or more actions to achieve simple objectives. For example, if you were to place an attractive toy under a cushion, a 9-month-old might lift the cushion with one hand while using the other to grab the toy. In this case, the act of lifting the cushion is not a pleasurable response in itself, nor is it executed by chance. Rather, it is part of a larger *intentional* scheme in which two initially unrelated responses—lifting and grasping—are coordinated as a means to an end. Piaget believed that these simple coordinations of secondary schemes represent the earliest form of *goal-directed behavior,* and thus true problem solving.

**Tertiary Circular Reactions (12 to 18 Months).** Between 12 and 18 months of age, infants begin to actively experiment with objects and try to invent new methods of solving problems or reproducing interesting results. For example, an infant who had originally squeezed a rubber duck to make it quack may now decide to drop it, step on it, and crush it with a pillow to see whether these actions will have the same or different effects on the toy. Or she may learn from her explorations that flinging is more efficient than spitting as a means of getting food to stick to the wall. Although parents may be less than thrilled by such exciting new cognitive advances, these trial-and-error exploratory schemes, called **tertiary circular reactions,** reflect an infant's active curiosity—her strong motivation to learn about the way things work.

**reflex activity**
first substage of Piaget's sensorimotor stage; infants' actions are confined to exercising innate reflexes, assimilating new objects into these reflexive schemes, and accommodating their reflexes to these novel objects.

**primary circular reactions**
second substage of Piaget's sensorimotor stage; a pleasurable response, centered on the infant's own body, that is discovered by chance and performed over and over.

**secondary circular reactions**
third substage of Piaget's sensorimotor stage; a pleasurable response, centered on an external object, that is discovered by chance and performed over and over.

**coordination of secondary circular reactions**
fourth substage of Piaget's sensorimotor stage; infants begin to coordinate two or more actions to achieve simple objectives. This is the first sign of goal-directed behavior.

**tertiary circular reactions**
fifth substage of Piaget's sensorimotor stage; an exploratory scheme in which the infant devises a new method of acting on objects to reproduce interesting results.

**Symbolic Problem Solving (18 to 24 Months).** The crowning achievement of the sensorimotor stage occurs as infants begin to internalize their behavioral schemes to construct mental symbols, or images, that they can then use to guide future conduct. Now the infant can experiment *mentally* and may show a kind of "insight" in how to solve a problem. Piaget's son Laurent nicely illustrates this symbolic problem solving, or **inner experimentation:**

**inner experimentation**
in the sixth substage of Piaget's sensorimotor stage, the ability to solve simple problems on a mental, or symbolic, level without having to rely on trial-and-error experimentation.

> Laurent is seated before a table and I place a bread crust in front of him, out of reach. Also, to the right . . . I place a stick, about 25 cm. long. At first, Laurent tries to grasp the bread . . . and then he gives up. . . . Laurent again looks at the bread, and without moving, looks very briefly at the stick, then suddenly grasps it and directs it toward the bread . . . [he then] draws the bread to him (Piaget, 1952, p. 335).

Clearly, this is not trial-and-error experimentation. Instead, Laurent's problem solving occurred at an internal, symbolic level as he visualized the stick being used as an extension of his arm to obtain a distant object.

## Development of Imitation

Piaget recognized the adaptive significance of imitation, and he was very interested in its development. His own observations led him to believe that infants are incapable of imitating *novel* responses displayed by a model until 8 to 12 months of age (the same age at which they show some evidence of intentionality in their behavior). However, the imitative schemes of infants this young are rather imprecise. Were you to bend and straighten your finger, the infant might mimic you by opening and closing her entire hand (Piaget, 1951). Indeed, precise imitations of even the simplest responses may take days (or even weeks) of practice (Kaye & Marcus, 1981), and literally hundreds of demonstrations may be required before an 8- to 12-month-old will catch on and begin to enjoy sensorimotor games such as peekaboo or patty-cake.

Voluntary imitation becomes much more precise at age 12 to 18 months, as we see in the following example:

> At [1 year and 16 days of age, Jacqueline] 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 (Piaget, 1951, p. 56).

**deferred imitation**
the ability to reproduce a modeled activity that has been witnessed at some point in the past.

According to Piaget, **deferred imitation**—the ability to reproduce the behavior of an *absent* model—first appears at 18 to 24 months of age. Consider the following observation of the antics of Jacqueline, Piaget's 16-month-old daughter:

> Jacqueline had a visit from a little boy (18 months of age) 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, stamping her foot . . . several times in succession (Piaget, 1951, p. 63).

Piaget believed that older infants are capable of deferred imitation because they can now construct mental symbols, or images, of a model's behavior that are stored in memory and retrieved later to guide the child's re-creation of the modeled sequence.

Other investigators disagree with Piaget, arguing that deferred imitation (discussed in Chapter 5), and thus symbolic representation, begins much earlier. For example, research has shown that 6-month-olds are able to imitate very simple acts (e.g., button-pressing to activate a noise-making toy) after 24 hours (Collie & Hayne, 1999), and toddlers have been shown to imitate particularly memorable events up to 12 months after first witnessing them (Bauer et al., 2000; Meltzoff, 1995). So a capacity for deferred imitation—imitation requiring the infant to construct, store, and then retrieve mental symbols—is present much earlier than Piaget had thought; this finding questions Piaget's account of the nonsymbolic sensorimotor child.

## Development of Object Permanence

**object permanence**
the realization that objects continue to exist when they are no longer visible or detectable through the other senses.

One of the more notable achievements of the sensorimotor period is the development of **object permanence,** the idea that objects continue to exist when they are no longer visible or detectable through the other senses. If you removed your watch and covered it with a coffee mug, you would still know that the watch continues to exist. But because very young infants rely so heavily on their senses and their motor skills to "understand" an object, they seem to operate as if objects exist only if they can be immediately sensed or acted upon. Indeed, Piaget (1954) and others have found that 1- to 4-month-olds will not search for attractive objects that are hidden from view. If a watch that interests them is covered by a mug, they soon lose interest, almost as if they believe that the watch no longer exists or has been transformed into a mug. At age 4 to 8 months, infants will retrieve toys that are partially concealed or placed beneath a semitransparent cover; but their continuing failure to search for objects that are *completely* concealed suggested to Piaget that, from the infant's perspective, disappearing objects no longer exist.

Clearer signs of an emerging object concept appear by 8 to 12 months of age. However, object permanence is far from complete, as we see in Piaget's demonstration with his 10-month-old daughter:

> Jacqueline is seated on a mattress without anything to . . . distract her. . . . I take her [toy] parrot from her hands and hide it twice . . . under the mattress, on her left [point 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 [point B]. Jacqueline watches this movement . . . but at the moment when the parrot disappears [at point B] she turns to her left and looks where it was before [at point A] (Piaget, 1954, p. 51; italics added).

**A-not-B error**
tendency of 8- to 12-month-olds to search for a hidden object where they previously found it even after they have seen it moved to a new location.

Jacqueline's response is typical of 8- to-12-month-olds, who will search for a hidden object *where they found it previously* rather than where they saw it last (Markovitch & Zelazo, 1999). Piaget's account of this **A-not-B error** was straightforward: Jacqueline acted as if her *behavior* determines where the object will be found; consequently, she does not treat the object as if it exists independent of her own activity.

Between 12 and 18 months of age, the object concept improves. Toddlers now track the visible movements of objects and search for them *where they were last seen*. However, object permanence is not complete, because the child cannot make the mental inferences necessary to understand *invisible displacements*. So if you conceal a toy in your hand, place your hand behind a barrier and deposit the toy there, remove your hand, and then ask the child to find the toy, 12- to 18-month-olds will search *where the toy was last seen*—in your hand—rather than looking behind the barrier.

By 18 to 24 months of age, toddlers are capable of *mentally representing* such invisible displacements and using these mental inferences to guide their search for objects that have disappeared. At this point, they fully understand that objects have a "permanence" about them and take great pride at locating their objectives in sophisticated games of hide and seek.


Jean-Claude Le Jeune/Stock Boston

Playing peekaboo is an exciting activity for infants who are acquiring object permanence.

## Challenges to Piaget's Account of Sensorimotor Development: Neo-Nativism and Theory Theories

Piaget was an amazing observer of infants, and at the level of describing infant problem solving that most people (including parents) actually see, Piaget's account of infant development is generally accurate (see Table 7.2 for a summary), although somewhat incomplete (Bjorklund, 2005). Yet Piaget generally underestimated infants' cognitive capabilities, and many researchers today believe that new theories are needed to completely capture the richness of infant intelligence.

**neo-nativism**
the idea that much cognitive knowledge, such as object concept, is innate, requiring little in the way of specific experiences to be expressed, and that there are biological constraints, in that the mind/brain is designed to process certain types of information in certain ways.

**Neo-nativism.** The most articulate criticism of Piaget's infancy theory comes from **neo-nativists**—theorists who believe that infants are born with substantial innate knowledge about the physical world, which requires less time and experience to be demonstrated than Piaget proposed (Gelman & Williams, 1998; Spelke & Newport, 1998). This can be seen in the description of the work of Baillargeon (1987) on object permanence described in the box on page 258. As the research presented in this box indicates, infants know something about the permanency of objects very early on; such knowledge does not have to be "constructed" as Piaget proposed, but is part of an infant's genetic heritage. This does not mean that there is no development or that no experience is necessary for the mature expression of an ability, but rather that babies are prepared by evolution to make sense of certain aspects of their physical world that are universally experienced (such as the permanency of objects).

Similarly, others argue that not only do infants know more about physical properties of objects than we once expected, but, from the very earliest months of life, infants are symbolic beings, a perspective very different from the one argued by Piaget (Meltzoff, 1990). Research on deferred imitation (and neonatal imitation, discussed in Chapter 5) is consistent with this position, and caused Andrew Meltzoff (1990, p. 20) to argue that "in a very real sense, there may be no such things as a purely 'sensorimotor period' in the normal human infant."

The early display of symbolic ability is illustrated in innovative research by Karen Wynn (1992), who used techniques similar to those of Baillargeon (1987) presented in the box on page 258 to assess simple arithmetic abilities in infants. In Wynn's experiment, 5-month-old infants were shown a sequence of events that involved the addition or subtraction of elements. Two of these sequences are shown in Figure 7.1. One sequence (the "possible outcome") led to the conclusion that 1 + 1 = 2; the other sequence (the "impossible outcome") led to the conclusion that 1 + 1 = 1. Infants sat in front of a stage and watched as one object was placed in it (step 1 in Figure 7.1). A screen was then raised, hiding the object (step 2 in Figure 7.1). The infant then watched as a second object was placed behind

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FOCUS ON RESEARCH

## Why Infants Know More about Objects Than Piaget Assumed

Do very young infants really believe that vanishing objects cease to exist? Renee Baillargeon (1987) doubts it, and her research illustrates a theme that has been echoed by many contemporary researchers: young infants know more about objects than Piaget thought they did; in fact, they may never be totally ignorant about the permanence of objects.

The trick in demonstrating what very young infants know is to conduct tests appropriate to their developmental level. Unfortunately, 3- to 4-month-old infants have limited motor skills, so their inability to search for things (Piaget's tests) really says very little about their knowledge of objects.

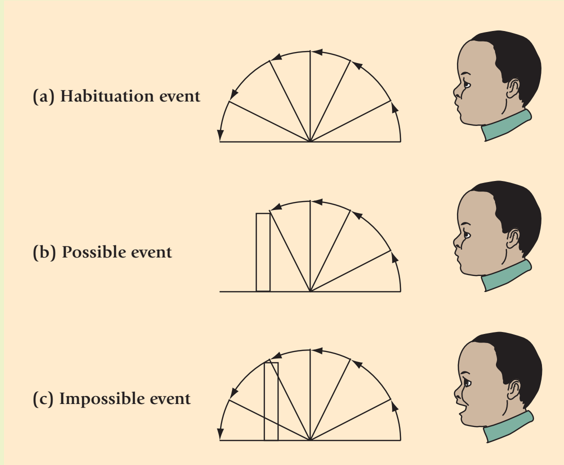
Baillargeon (1987; Baillargeon & De Voss, 1991) used the habituation/dishabituation paradigm to assess what 3½- to 4½-month-old infants may know about objects and their properties. Baillargeon (1987) first habituated each infant to a screen that moved 180 degrees, from being flat with its leading edge facing the infant, rising continuously through an arc until it rested in the box with its leading edge being farthest away from the infant (see panel *a* of figure). Once habituated to this event, infants were shown a colorful wooden block with a clown face painted on it, placed to the rear of the flat screen. (Actually, the block was an illusion created by a mirror.) Then, as illustrated in the figure, the screen was rotated to produce either a *possible* event (the screen would stop as if stopped by the box, panel *b*) or an *impossible* event (the screen rotated 180 degrees, passing through the box, panel *c*). Baillargeon reasoned that if babies thought the box still existed, even when hidden by the screen, they should stare longer at the screen and be more surprised when it appeared to pass through the solid box (impossible event) than when it bumped the box and stopped its forward motion (possible event). That is exactly what most of the 4½-month-olds and many of the 3½-month-olds did, taking great interest in the impossible event.

Infants' performance in the "impossible event" condition reflects not only a knowledge of the permanence of objects, but also a knowledge that one solid object cannot pass through another. Elizabeth Spelke (1991; Spelke et al., 1992) has similarly demonstrated in a series of experiments that infants as young as 2½ months of age have a knowledge of the solidity and continuity of objects (the fact that a moving object continues on its path), and more recent research by Baillargeon and her colleagues has illustrated young infants' understanding of support (an object must be supported or it falls), collisions (an object that is hit by another object moves) (Baillargeon, Kotovsky, & Needham, 1995), and containment (a larger object cannot fit into a smaller object) (Aguiar & Baillargeon, 1998). Baillargeon (2004) believes, like Spelke, that infants' general principles of solidity and continuity are innate. However, Baillargeon claims, infants' early representations of events they experience are impoverished and become more elaborated with experience.

It was once thought that memory deficits also explained the *A-not-B error* that 8- to 12-month-olds display. But we now know that infants this old have reasonably good memories and are actually quite surprised if a hidden object turns out *not* to be where they have last seen it (at point B) (Baillargeon & Graber, 1988). So 8- to 12-month-olds who commit A-not-B errors will often remember that an object has been hidden at new location B; what they may lack is the ability to *inhibit* the tendency to search where they have previously found the object. Indeed, Adele Diamond (1985) claims that some infants who search inappropriately for hidden objects at point A hardly look there at all, as if they realize this is not the right place to search but simply cannot stop themselves. Diamond (1985) tested 25 infants in the A-not-B task, beginning at about 7½ months and continuing until 12 months of age. She reported that the delay between hiding and searching that was necessary to produce an A-not-B error increased with age at a rate of about 2 seconds per month. That is, 7½-month-old infants searched for the hidden object at the erroneous A position after only a 2-second delay. By 12 months of age, infants made the error only if 10 seconds had passed between the hiding of the object and the beginning of the search.

Based on these and other data Diamond (1991, 1995) believes that maturational changes in the frontal lobes of the cerebral cortex during the second 6 months of life permit infants to gain more control over their motor responses, thus allowing them to inhibit an impulse to search for hidden objects at locations they know are incorrect. And she may be right. Martha Bell and Nathan Fox (1992) found that 7- to 12-month-olds who *avoid* making A-not-B errors show far more frontal lobe electrical activity while performing the task than their age-mates who search less appropriately.

Though we've considered only a portion of the evidence, it is clear that Piaget's reliance on active search procedures caused him (1) to badly underestimate what very young infants know about objects and (2) to misinterpret why infants display the A-not-B error.




*Representations of the habituation stimulus and the possible and impossible events shown to young infants in Baillargeon's (1987) experiment. Babies took great interest in the "impossible" event, thus suggesting that they knew that the block continues to exist and that the screen shouldn't have passed through it.* Based on Baillargeon, 1987.

the screen (steps 3 and 4 in Figure 7.1). The screen was then lowered, revealing either two objects (the "possible outcome") or one object (the "impossible outcome"). If infants have some primitive concept of addition, they should be surprised and thus spend more time looking at the "impossible outcome." This was exactly what occurred, both for the addition problem shown in Figure 7.1 and for a simple subtraction problem ($2 - 1 = 1$). Others (Simon, Hespos, & Rochat, 1995; Uller et al., 1999) have replicated these findings.

How can these results best be interpreted? Infants seem not to be making only a perceptual discrimination between two displays (i.e., telling the difference between a display with one item in it and another with two). Rather, when they watch as one item is added to another behind a screen, they expect to see two items when the screen is dropped. This requires a certain level of object permanence and memory, but also some rudimentary ideas about addition. They must infer that the second object was added to the first, without actually seeing that this was done (recall that the screen blocked their vision). These findings are provocative and suggest substantially greater quantitative (symbolic) knowledge in young infants than proposed by Piaget. However, others question Wynn's interpretation, and suggest that babies are not responding on the basis of *number* but, rather, to the total amount of *substance* present (Mix, Huttenlocker, & Levine, 2002). In other words, infants are not doing primitive (and unconscious) addition and subtraction, but are reacting to changes in the amount of "stuff" that is present in the various arrays. For example, rather than reflecting infants' abstract understanding of integers (i.e., there should be "1" or "2" objects behind the screen), their behavior may be based on representations of the actual objects (e.g., ♥ versus ♥♥), suggesting that decisions are based more on perceptual than conceptual relations (Uller et al., 1999; see Mandler, 2000). And regardless of which interpretation one prefers, it does not justify the conclusion that babies are born knowing basic arithmetic or that infants and toddlers should be able to learn complicated mathematics given proper instructions.

**Theory Theories.** There are other theorists who acknowledge that infants indeed come into the world with more knowledge than Piaget proposed, but who believe that, beyond the very early stages of sensorimotor development, Piaget's constructivist account is generally close to the truth. These are the *theory theorists,* who combine aspects of neo-nativism with Piagetian constructivism (Gopnik & Meltzoff, 1997; Karmiloff-Smith, 1992). The basic idea behind **theory theories** is that infants are prepared from birth to make sense of certain classes of information (about objects and language, for example), much as neo-nativists propose; but such innate knowledge is incomplete and requires substantial experience for infants to construct reality, much as Piaget proposed. Infants do this by constructing "theories" about how the world works and testing and modifying their theories, much as scientists do, until the models in their brains resemble the way the world is structured. Developmental change following theory theory is similar to that described by Piaget. According to Alison Gopnik and Andrew Meltzoff (1997, p. 63), "We will typically see a pattern in which the child holds to a particular set of predictions and interpretations for some time; the child has a particular theory. Then we may expect a period of disorganization, in which the theory is in crisis. And finally, we should see a new, equally coherent and stable theory emerge." This is reminiscent of Piaget's concept of equilibration, discussed earlier in this chapter.

**theory theories**
theories of cognitive development that combine neo-nativism and constructivism, proposing that cognitive development progresses by children generating, testing, and changing theories about the physical and social world.

One question that is fair to ask of the theory theory approach is that, if development is the process of testing and changing theories, why do children all over the globe end up with basically the same adult theories of the world? Experience plays an important role in this formulation, and experiences will surely vary considerably between children growing up in information-age societies and those growing up in traditional hunter-gatherer societies. And of course adults in these cultures do differ considerably in their thinking, but their understanding of the physical and social world is remarkably the same. How can a theory theory explain such similarity of cognitive functioning? Consistent with the ideas of evolutionary developmental psychologists (Bjorklund & Pellegrini, 2002; Hernández Blasi & Bjorklund, 2003), Gopnik and Meltzoff propose that children around the world are born with the same initial theories and that powerful mechanisms revise current theories when children are faced with conflicting evidence. That is, all infants start with the same ideas about how the world works and modify these theories as they grow. They also try to solve basically the same problems about how the physical and social worlds work, and they get similar information at about the same time in their lives. We will have more to say about a particular type of theory theory later in this chapter, namely, children's development of *theory of mind*.

## CONCEPT CHECK 7.2 Understanding Infant Intelligence

Check your understanding of Piaget's view of infant intelligence and what more recent research has found out about infant intelligence by answering the following questions. Answers appear in the Appendix.

**Multiple Choice:** Select the best alternative for each question.

______ 1. The first major period in Piaget's stage theory is the *sensorimotor stage*, which lasts from birth to approximately 2 years of age. According to Piaget, children at this stage
- a. are not able to comprehend the world yet, and must rely on others to do their thinking for them
- b. are able to think logically and comprehend their environment
- c. are of little interest to experimental psychologists because they are unable to verbalize fluently
- d. are able to comprehend the world around them through their actions on it

______ 2. According to Piaget, *imitation* is the purest example of
- a. accommodation
- b. assimilation
- c. the coordination of both assimilation and accommodation
- d. abstract representation

______ 3. Six-month-old Pedro is playing with his stuffed toy rabbit in his crib. He sets the rabbit down, and as he moves to reach his bottle, his blanket covers this toy. Pedro then turns to reach for his rabbit, but seeing only a bump in his blanket, he cries. According to Piaget, Pedro's actions in this situation reflect a lack of
- a. object permanence
- b. deferred imitation
- c. primary circular reactions
- d. assimilation

______ 4. Piaget's concept of *object permanence* refers to the
- a. knowledge that objects have an existence in space and time independent of one's perceptions of and action on them
- b. knowledge that an inanimate object (e.g., a ball) will remain in a given location when put there, although an animate object (e.g., a rabbit) may not
- c. tendency for semantic knowledge of objects to remain permanently in long-term memory
- d. ability to memorize the spatial location of permanent objects in the environment

**Matching:** Match the following concepts with their definitions.

- a. invariant developmental sequence
- b. coordination of secondary circular reactions
- c. A-not-B error
- d. neo-nativism
- e. theory theories
- f. primary circular reactions

5. ________ The tendency of 8- to 12-month-olds to search for a hidden object where they previously found it even after they have seen it moved to a new location.
6. ________ Second substage of Piaget's sensorimotor stage; a pleasurable response, centered on the infant's own body, that is discovered by chance and performed over and over.
7. ________ A series of developments that occur in one particular order because each development in the sequence is a prerequisite for those appearing later.
8. ________ Theories of cognitive development that combine neo-nativism and constructivism, proposing that cognitive development progresses by children generating, testing, and changing theories about the physical and social world.
9. ________ The fourth substage of Piaget's sensorimotor stage; infants begin to coordinate two or more actions to achieve simple objectives. This is the first sign of goal-directed behavior.
10. ________ The idea that much cognitive knowledge, such as object concept, is innate, requiring little in the way of specific experiences to be expressed, and that there are biological constraints, in that the mind/brain is designed to process certain types of information in certain ways.

**Essays:** Provide a detailed answer to the following questions.

11. Discuss the development of imitation through the sensorimotor period.
12. Discuss the development of object permanence through the sensorimotor period. What evidence is there to suggest that Piaget underestimated infants' knowledge of objects?

## Summing Up

Piaget's theory of infant cognitive development has been one of the most influential ever proposed. It uncovered previously unknown phenomena (e.g., object permanence) and generated nearly a century of research. However, it has become obvious in recent decades that new theories are necessary to account for the greater cognitive abilities that infants have been shown to possess. Yet, as new research accumulates, it also has become clear that we do not want to throw out Piaget with the baby's bath water. Many of Piaget's ideas, particularly *constructivism,* have been shown to have staying power and have become incorporated in contemporary theories of infant development.

# The Preoperational Stage (2 to 7 Years) and the Emergence of Symbolic Thought

**preoperational period**
Piaget's second stage of cognitive development, lasting from about age 2 to age 7, when children are thinking at a symbolic level but are not yet using cognitive operations.

**symbolic function**
the ability to use symbols (e.g., images and words) to represent objects and experiences.

**representational insight**
the knowledge that an entity can stand for (represent) something other than itself.

The **preoperational period** is marked by the appearance of the **symbolic function**—the ability to make one thing—a word or an object—stand for, or represent, something else. Judy DeLoache (1987, 2000) refers to the knowledge that an entity can stand for something other than itself as **representational insight.** This transition from the curious hands-on-everything toddler to the contemplative, symbolic preschool child is remarkable indeed. Consider, for example, that because 2- to 3-year-olds can use words and images to represent their experiences, they are now quite capable of reconstructing the past and thinking about or even comparing objects that are no longer present. And just how much does the ability to construct mental symbols transform a child's thinking? David Bjorklund (2005) answers by noting that the average, symbolic 3-year-old probably has more in common intellectually with a 21-year-old adult than with a 12-month-old infant. Although a 3-year-old's thinking will change in many ways over the next several years, it is similar to an adult's in that both preschool children and adults think by manipulating mental symbols such as images and language, with most "thinking" being done covertly, "in the head."

Language is perhaps the most obvious form of symbolism that young children display. Although most infants utter their first meaningful word by the end of the first year, it is not until about 18 months of age—the point at which they show other signs of symbolism such as inner experimentation—that they combine two (or more) words to form simple sentences. Does the use of language promote cognitive development? Piaget said no, arguing instead that language merely reflects what the child *already knows* and contributes little to new knowledge. In other words, he believed that cognitive development promotes language development, not vice versa. (We will have more to say about Piaget's ideas about the relationship between language and thought later in this chapter.)

A second major hallmark of the early preoperational period is the blossoming of *pretend* (or *symbolic*) play. Toddlers often pretend to be people they are not (mommies, superheroes), and they may play these roles with props such as a shoe box or a stick that symbolize other objects such as a baby's crib or a gun. Although some parents are concerned when their preschool children immerse themselves in a world of make-believe and begin to invent imaginary playmates, Piaget felt that these are healthy activities. According to Marc Bornstein and his colleagues (1996), "In symbolic play, young children advance upon their cognitions about people, objects, and actions and in this way construct increasingly sophisticated representations of the world" (p. 293). In the box on page 262, we focus briefly on children's play and see how these "pretend" activities may contribute in a positive way to the child's social, emotional, and intellectual development.

## New Views on Symbolism

Piaget's emphasis on the symbolic nature of preoperational children's thought has captured the attention of developmentalists. Judy DeLoache and her colleagues, for example, have explored preschool children's abilities to use scale models and pictures as symbols

APPLYING RESEARCH TO YOUR LIFE

## Play Is Serious Business

Play is an intrinsically satisfying activity—something young children do for the sheer fun of it (Rubin, Fein, & Vandenberg, 1983). In contrast to earlier views that childhood play activities were a frivolous waste of time, Piaget (1951) was fascinated by the young child's play. He believed that play provides a glimpse of the child's emerging cognitive schemes in action while allowing young players to practice and strengthen whatever competencies they possess.



*The reciprocal roles children enact during pretend play promote the growth of social skills and interpersonal understanding.*

Sensorimotor play begins very early and develops in much the same way in all cultures (Pellegrini & Smith, 1998). Infants progress from playing with their own bodies (e.g., sucking their thumbs), to manipulating external objects such as rattles and stuffed animals, to fully *functional play*—using objects to serve the functions they normally serve—which appears by the end of the first year. So a 12-month-old is now more inclined to push the buttons on a toy phone rather than merely sucking on or banging the toy.

Perhaps the most exciting breakthrough in play activities is the emergence of *symbolic* (or *pretend*) *play* at 11 to 13 months of age. The earliest "pretend" episodes are simple ones in which infants pretend to engage in familiar activities such as eating, drinking, or sleeping. But by 18 to 24 months of age, toddlers have progressed to a point where they will pretend to perform multiple acts in a meaningful sequence; they can also coordinate their actions with those of a play partner, making social games of imitating each other and sometimes even cooperating to achieve a goal (Brownell & Carriger, 1990; Howes & Matheson, 1992). Parents can foster this development by providing toddlers with a secure base of affection and by playing along with their child's little dramas (O'Reilly & Bornstein, 1993; Slade, 1987).

Symbolic play truly blossoms during Piaget's preoperational period. By age 2, toddlers can use one object (a block) to symbolize another (a car) and are now using language in inventive ways to create rich fantasy worlds for themselves. They clearly understand pretense: if you hand them a towel and suggest that they wipe up the imaginary tea you just spilled, they will do it (Harris, Kavanaugh, & Meredith, 1994). Think about this: Because there is no tea in sight, the child's willingness to clean it up suggests that he can construct a mental representation of someone else's pretend event and then act according to this representation. Pretend play becomes increasingly social and increasingly complex between ages 2 and 5. More importantly, children combine their capacity for increasingly social play and their capacity for understanding pretense to cooperate with each other at *planning* their pretend activities: They name and assign roles that each player will enact, propose play scripts, and may even stop playing to modify the script if necessary (Howes & Matheson, 1992). Indeed, play episodes are among the most complex social interactions that preschoolers have (Pellegrini & Bjorklund, 2004).

What good is play? Intellectually, play provides a context for using language to communicate and using the mind to fantasize, plan strategies, and solve problems. Children often show more advanced intellectual skills during pretend play than they do when performing other activities, suggesting that play fosters cognitive development (Lillard, 1993). Indeed, preschool children who engage in a great deal of pretend play (or who are trained to do so) perform better on tests of Piagetian cognitive development, language skills, and creativity than children who "pretend" less often (Fisher, 1992; Johnsen, 1991).

Preschool pretend activities may also promote social development. To be successful at social pretend play, children must adopt different roles, coordinate their activities, and resolve any disputes that may arise. Children may also learn about and prepare for adult roles by "playing house" or "school" and stepping into the shoes of their mothers, fathers, or nursery school teachers (Pellegrini & Bjorklund, 2004). Perhaps due to the social skills they acquire (e.g., an ability to cooperate) and the role-taking experiences they have, preschool children who participate in a lot of *social* pretend play tend to be more socially mature and more popular with peers than age-mates who often play without partners (Howes & Matheson, 1992).

Finally, play may foster healthy emotional development by allowing children to express feelings that bother them or to resolve emotional conflicts (Fein, 1986). If Latoya, for example, has been scolded at lunch for failing to eat her peas, she may gain control of the situation at play as she scolds her doll for picky eating or persuades the doll to "eat healthy" and consume the peas. Indeed, playful resolutions of such emotional conflicts may even be an important contributor to children's understanding of authority and the rationales that underlie all those rules they must follow (Piaget & Inhelder, 1969).

Let it never be said that play is useless. Although children play because it is fun, not because it sharpens their skills, players indirectly contribute to their own social, emotional, and intellectual development, enjoying themselves all the while. In this sense, play truly is the child's work—and is serious business indeed!

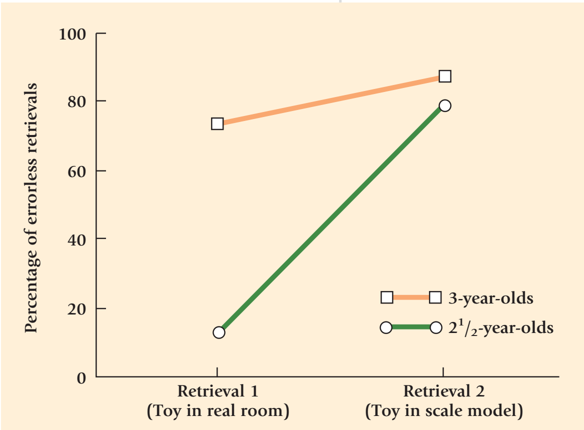



**Figure 7.2** The number of errorless retrievals (correctly locating the hidden toy) for 2½- (younger) and 3-year-olds (older) on a model task. Retrieval 1 involved locating the real toy in the real room; Retrieval 2 involved locating the miniature toy in the model. *From "Rapid Change in the Symbolic Functioning of Very Young Children," by J. S. DeLoache, 1987.* Science, 238, *1556–1557. Copyright © 1987 by the American Association for the Advancement of Science. Reprinted with permission from AAAS.*

(DeLoache, 1987, 2000; Uttal, Schreiber, & DeLoache, 1995). In DeLoache's studies, children are asked to find a toy hidden in a room. Prior to searching for the toys, children are shown a scale model of the room, with the experimenter hiding a miniature toy (Snoopy) behind a chair in the model. The miniature toy and the model chair correspond to a large Snoopy and real chair in the adjoining "real" room. Children are then asked to find the toy in the real room (Retrieval 1). After searching for the toy in the real room, they return to the model and are asked to find where the miniature toy was hidden (Retrieval 2). If children cannot find the large toy in the real room (Retrieval 1) but *can* find the miniature toy in the scale model (Retrieval 2), their failure to find the large toy cannot be due to forgetting where the miniature toy was hidden (see Figure 7.2). A better interpretation would be that the children have no representational insight and cannot use the model in a symbolic fashion to guide their search.

DeLoache reported that the 3-year-olds performed well in *both* retrieval tasks, indicating that they remembered where the miniature toy was hidden and used the information from the scale model to find the large toy in the real room. The 2½-year-olds showed good memory for where the miniature toy had been hidden, but performed very poorly when trying to find the large toy in the real room. Apparently, 2½-year-olds failed to recognize that the scale model was a symbolic representation of the large room.

**dual representation (dual encoding)**
the ability to represent an object simultaneously as an object itself and as a representation of something else.

It is not that 2½-year-olds have no representational insight. If given a *photo* that shows Snoopy's hiding place in the real room, 2½-year-olds (but not 2-year-olds) can find him when given the opportunity. Why do they do better with a two-dimensional photo than with an actual three-dimensional scale model? DeLoache believes that scale models are harder to use as symbols because 2½-year-olds lack **dual representation**—the ability to think about an object in two different ways at the same time. Dual representation is not required with photos because the primary purpose of a photo is to represent something else. But a scale model is an interesting object in its own right, and 2½-year-olds may not recognize that it is also a representation of the larger room. If DeLoache is right, then anything that induces young children to pay less attention to the scale model as an object should persuade them to use it as a symbol and thereby improve their search for the hidden toy. Indeed, DeLoache (2000) reports that 2½-year-olds who are not allowed to play with the scale model but only to look through its windows do focus less on the interesting qualities of the scale model itself, treating it more like a symbol that helps them to find the hidden toy in the real room.

Although representational insight and dual-representational abilities improve appreciably between 2½ and 3 years of age, they remain rather tentative and are easily disrupted. Consider, for example, that when 3-year-olds must wait 5 minutes after seeing a toy hidden in the scale model to make their initial search, they are typically unsuccessful at finding the toy in the larger room. It is not that they forget where the toy was hidden in the scale model. Instead, they don't seem to remember over a 5-minute delay that the scale model is a symbolic representation of the real room (Uttal et al., 1995). So dual representation—the ability to keep in mind the relationship between a symbol and its referent—is rather fragile in 3-year-olds but improves substantially over the preschool years.

## Deficits in Preoperational Reasoning

Despite important new strengths that the use of symbols provides, Piaget's descriptions of preoperational intelligence focused mainly on the limitations, or deficiencies, in children's thinking. Indeed, he called this period "preoperational" because he believed

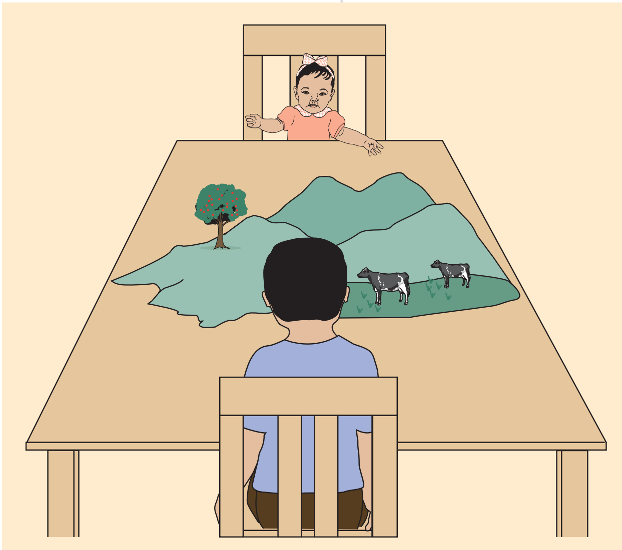


**Figure 7.3** Piaget's three-mountain problem. Young preoperational children are egocentric. They cannot easily assume another person's perspective and often say that another child viewing the mountain from a different vantage point sees exactly what they see from their own location.

that preschool children have not yet acquired the operational schemes that enable them to think logically. He claimed, for example, that young children often display **animism**—a willingness to attribute life and lifelike qualities (e.g., motives and intentions) to inanimate objects. The 4-year-old who believed that the wind blew on him to cool him off provides a clear example of the animistic logic that children are likely to display during the early preschool years.

According to Piaget, the most striking deficiency in children's preoperational reasoning—a deficiency that contributes immensely to the other intellectual shortcomings they display—is their **egocentrism,** a tendency to view the world from one's own perspective and to have difficulty recognizing another person's point of view. Piaget demonstrated this by first familiarizing children with an asymmetrical mountain scene (see Figure 7.3) and then asking them what an observer on the opposite side of the table would see as he gazed at the scene. Often, 3- and 4-year-olds said the other person would see exactly what they saw, thus failing to consider the other's different perspective. Other examples of this self-centered thinking appear in the statements young children make. Take the telephone conversation of 4-year-old Kelly with her uncle Dave:

DAVE: So you're going to a party today. Great. What are you wearing?

KELLY: This.

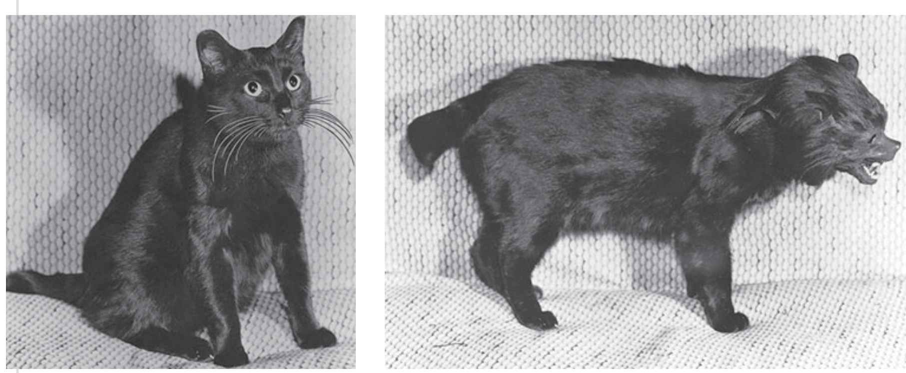
Kelly probably pointed to her new dress while talking into the phone, seemingly unaware that her uncle couldn't know what she was talking about. Consequently, her speech is not adapted to the needs of her listener, reflecting instead her egocentric point of view.

Finally, Piaget claimed that young children's egocentric focus on the way things appear to be makes it nearly impossible for them to distinguish appearances from reality. Consider Rheta DeVries's (1969) classic study of the **appearance/reality distinction.** Children 3 to 6 years of age were introduced to a cat named Maynard. After the children had petted Maynard, DeVries hid Maynard's head and shoulders behind a screen while she strapped a realistic mask of a dog's face onto Maynard's head (see Figure 7.4). The children were then asked questions about Maynard's identity, such as "What kind of animal is it now?" and "Does it bark or meow?" Even though Maynard's back half and tail remained in full view during the transformation, nearly all the 3-year-olds focused on Maynard's new appearance and concluded that he really was a dog. By contrast, most

**animism**
attributing life and lifelike qualities to inanimate objects.

**egocentrism**
the tendency to view the world from one's own perspective while failing to recognize that others may have different points of view.

**appearance/reality distinction**
ability to keep the true properties or characteristics of an object in mind despite the deceptive appearance the object has assumed; notably lacking among young children during the preconceptual period.



Courtesy of Rheta de Vries

**Figure 7.4** Maynard the cat, without and with a dog mask. Three-year-olds who met Maynard before his change in appearance nonetheless believed that he had become a dog.

6-year-olds could distinguish appearances from reality, correctly noting that Maynard the cat now merely looked like a dog.

Why do 3-year-olds fail to distinguish between the misleading visual appearance of an object and its actual identity? Their problem, according to John Flavell and his associates (1986), is that they are not yet proficient at *dual encoding*—at representing an object in more than one way at a time. Just as young children have difficulty representing a scale model as both an *object* and a *symbol* (DeLoache, 2000), they struggle to construct simultaneous mental representations of an object that looks like something other than what it really is.

To illustrate, Flavell and his colleagues (1983, 1989) found that 3-year-olds who were shown a toy sponge that looked like a rock were apt to say that not only does it look like a rock, but it "really and truly is a rock." Their representation of the object's identity was based on its single most salient feature—its deceptive appearance. Yet, when 3-year-old children are persuaded to play a trick on someone (e.g., "Let's trick Sally and make her think that this sponge really is a rock, and not just a sponge that looks like one"), many 3-year-olds are capable of this kind of pretense, forming dual representations of this object as a sponge (reality) that only looks like a rock (appearance) (Rice et al., 1997). Clearly, symbolic play activities, in which children pretend that objects (such as a large cardboard box) are something other than what they really are (e.g., a fort) are an important contributor to dual representation and to children's gradually emerging abilities to distinguish misleading appearances from reality (Golomb & Galasso, 1995). But, as we'll see in the next section, these abilities develop gradually over the preschool period.

Children become less egocentric and more proficient at classifying objects on the basis of shared perceptual attributes such as size, shape, and color over the preschool years. But their thinking still shows a number of limitations. Piaget described preschool children's thinking as intuitive because their understanding of objects and events is still largely based, or "**centered,**" on their single most salient perceptual feature—the way things appear to be—rather than on logical or rational thought processes.

**centration (centered thinking)**
in Piaget's theory, the tendency of preoperational children to attend to one aspect of a situation to the exclusion of others; contrast with *decentration.*

The most frequently cited examples of children's intuitive reasoning come from Piaget's famous conservation studies (Flavell, 1963). One of these experiments begins with the child adjusting the amounts of liquid in two identical containers until each is said to have "the same amount to drink." Next the child sees the experimenter pour the liquid from one of these tall, thin containers into a short, broad container. He is then asked whether the remaining tall, thin container and the shorter, broader container have the same amount of liquid (see Figure 7.5 for an illustration of the procedure). Children younger than 6 or 7 will usually say that the tall, thin receptacle contains *more* liquid than the short, broad one. The child's thinking about liquids is apparently *centered* on one perceptual feature—the relative heights of the columns (tall column = more liquid). In Piaget's terminology, preoperational children are incapable of **conservation:** They do not yet realize that certain properties of objects (such as volume, mass, or number) remain unchanged when the objects' appearances are altered in some superficial way.

**conservation**
the recognition that the properties of an object or substance do not change when its appearance is altered in some superficial way.

Why do preschool children fail to conserve? The answer, according to Piaget, is that these children lack two cognitive operations that would help them to overcome their perceptually based intuitive reasoning. The first of these operations is **decentration**—the ability to concentrate on more than one aspect of a problem at the same time. Children are unable to attend *simultaneously* to both height and width when trying to solve the conservation-of-liquids-problem. They center their attention on the difference in either height or width and make their decisions on the basis of differences in that single dimension. Consequently, they fail to recognize that increases in the width of a column of liquid compensate for decreases in its height to preserve (or conserve) its absolute amount. Preschoolers also lack **reversibility**—the ability to mentally undo or negate an action (see Figure 7.5). So an intuitive 5-year-old faced with the conservation-of-liquids problem is unable to mentally reverse what he has seen to conclude that the liquid in the short, broad beaker is still the same water and would attain its former height if it were poured back into its original container.

**decentration**
in Piaget's theory, the ability of concrete operational children to consider multiple aspects of a stimulus or situation; contrast with *centration.*

**reversibility**
the ability to reverse, or negate, an action by mentally performing the opposite action (negation).

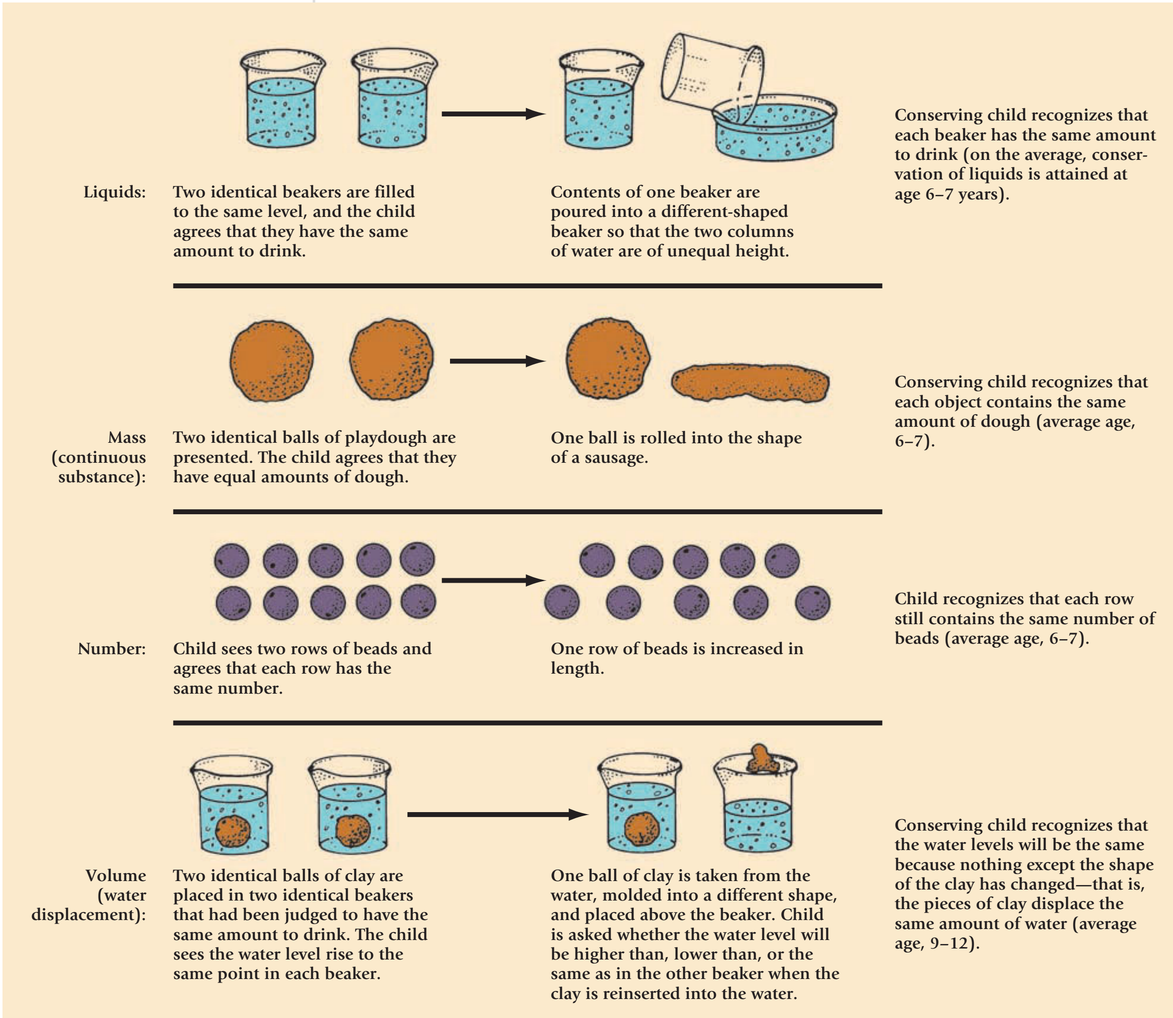



**Figure 7.5** Some tests of a child's ability to conserve.

## Did Piaget Underestimate the Preoperational Child?

Are preschool children really as intuitive, illogical, and egocentric as Piaget assumed? Can a child who has no understanding of cognitive operations be taught to conserve? Let's see what later research can tell us.

**New Evidence on Egocentrism.** Numerous experiments indicate that Piaget underestimated the ability of preschool children to recognize and appreciate another person's point of view. For example, Piaget and Inhelder's three-mountain task has been criticized as being unusually difficult, and more recent research has shown that children look much less egocentric when provided with less complicated visual displays (Gzesh & Surber, 1985; Newcombe & Huttenlocher, 1992). John Flavell and his associates (1981), for example, showed 3-year-olds a card with a dog on one side and a cat on the other. The card was then held vertically between the child (who could see the dog) and the experimenter (who could see the cat), and the child was asked which animal the experimenter could see. The 3-year-olds performed flawlessly, indicating that they could assume the experimenter's perspective and infer that he must see the cat rather than the animal they were looking at. Research on children's humor, as discussed in the box on page 267–268, illustrates just how much the differences between children's and adults' thinking influences aspects of their daily life and our ability to interact with them.

FOCUS ON RESEARCH

## Cognitive Development and Children's Humor

Developmental differences in the appreciation of humor have been hypothesized to be a function of children's level of cognitive development—specifically, their ability to deal with symbols—and have been interpreted in terms of Piaget's theory. Most developmental researchers have proposed that humor is reflected in the child's ability to perceive *incongruity,* noticing (or creating) a discrepancy between what is usual or expected and what is experienced (McGhee, 1979; Shultz & Robillard, 1980). Of course, incongruity can be defined only by what a child already knows, both world knowledge and general cognitive capabilities. Thus, a child's ability to make and understand jokes will depend on his or her level of cognitive development.

According to Paul McGhee (1976, 1979), incongruity is most likely to be perceived as humorous when the discrepancy is of some intermediate magnitude. The funniest jokes, for both adults and children, are those that take a little mental effort to figure out. Too easy, and they are boring; too difficult, and they are not worth the effort.

McGhee (1976) tested this theory by assessing children's appreciation of jokes as a function of their level of cognitive development. In one experiment, McGhee tested children in grades 1, 2, and 5 and college students. Within the first and second grades, half of the children were classified as conservers on conservation-of-weight tasks, and half were classified as nonconservers. All the fifth-grade and college students were conservers. The participants were read jokes requiring a knowledge of conservation for their appreciation. (For example: "Mr. Jones went into a restaurant and ordered a whole pizza for dinner. When the waiter asked if he wanted it cut into six or eight pieces, Mr. Jones said: 'Oh, you'd better make it six. I could never eat eight!'") After reading each joke, the experimenter asked each person to rate the joke on a five-point scale for how funny it was.

McGhee evaluated the children's appreciation of the jokes as a function of their level of cognitive development (i.e., conservers or nonconservers) and grade level. The children who found the jokes funniest were the first- and second-grade conservers. Nonconservers generally did not find the humor in the jokes, nor did the older children and adults, though for different reasons. For the nonconservers, there was nothing to laugh about. The response given by Mr. Jones in the example joke is one they might have given themselves. In contrast, the joke was trivial for the fifth-graders, taking little in the way of mental effort. Only for the young conservers was the joke funny. These children had only recently mastered conservation, making the challenge of interpreting the joke greatest for them.

Most critical for humor, according to McGhee, is the ability to represent objects and events symbolically. McGhee proposed that humor requires comparing some event with a similar event in memory, and he believes that children do not develop this ability sufficiently well until sometime between their first and second birthdays. He sees humor as a type of intellectual play that requires symbols.

McGhee proposed four stages of humor development, beginning when the capacity for fantasy and make-believe develops, sometime late in the second year with the transition from sensorimotor to preoperational thought. In stage 1, typifying children between 18 and 24 months, children substitute one object for another in a playful game of pretending. For example, Piaget (1951) observed his daughter Jacqueline at 15 months clutching a cloth that vaguely resembled her pillow. She held it in her hand, sucked her thumb, and lay down, closing her eyes. But while she was pretending to sleep, she was laughing hard. To this toddler, pretending the cloth was her pillow was funny.

Children's first verbal jokes occur in stage 2. The simplest of these jokes involves calling something by its wrong name. A 2-year-old finds great mirth in calling the family dog a cow, in labeling a hamburger macaroni and cheese, or in pointing to her eye and calling it a nose. Such humor might not seem all that sophisticated, but it requires greater abstraction than the object-dependent humor of stage 1. Children no longer need a physical prop to make a joke. The word is enough.

Soon, however, children's humor becomes more complex, usually beginning around age 3. Now, it is not enough merely to call a dog a cat. Because of 3-year-olds' increasing knowledge of things in their environment, distortions must be more drastic for something to be funny. So, for example, a cow that says "oink oink" and has a curlicue tail is funny, whether that cow is seen in a picture or is just imagined.

What is humorous to a stage 3 child is often a function of how absurd something looks. Consistent with Piaget's description of preoperational children, preschoolers' attention is often drawn to perceptual or literal stimulus features. This overreliance on appearance affects children's humor. A picture of an elephant sitting in a tree is funny to a 3-year-old, as is a picture of a fish swimming inside a car filled with water. These pictures are funny to 3-year-olds not because they defy logic but just because they are unusual. The incongruity is visual, not logical.

Beginning around 6 or 7 years of age with the advent of concrete operations, children's humor makes a more drastic change and starts to resemble the humor of adults. According to McGhee, the ability to understand double meanings of words and sentences is the hallmark of stage 4 and much of adult humor. A sentence with a serious (and obvious) meaning taken one way can be funny if viewed differently. A favorite of 6-year-old Heidi involved a woman mailing three socks to her son away in the army. Why did she mail three socks? Because he had written saying he had "grown another foot." Appreciation of the joke requires an understanding of the double meaning of "grown another foot." Most 7-year-olds have the ability to represent two meanings of a single word or phrase simultaneously, and from this time on, humor takes a distinctly adult form, although most adults are still likely to groan at jokes that have an 8-year-old rolling on the floor with laughter. (Such as this joke that 8-year-old Jeffrey thought was hilarious and apparently had made up himself: "Why did the brave chicken cross the road? 'Cause he wanted to prove that he wasn't chicken. Get it?")

Research has clearly demonstrated that children's understanding and appreciation of humor varies as a function of

CONTINUED

their level of cognitive development. Other factors, of course, affect humor. Some topics (aggression, sex) are more likely to be a source of humor than others, and humor plays an important role in greasing the gears of social interaction. Yet, the core of humor is cognitive. Simple visual jokes can be comprehended by 3-year-olds. But as the basis of jokes becomes more abstract and less dependent on visual cues, it becomes increasingly difficult for children to identify and resolve the conflict. Children's abilities to represent events, both real and unreal, and to view multiple meanings of a single situation determine what they find funny.

Flavell's study investigated young children's *perceptual* perspective taking—that is, the ability to make correct inferences about what another person can see or hear. Can preoperational children engage in *conceptual* perspective taking by making correct inferences about what another person may be thinking or feeling when these mental states differ from their own? The answer is a qualified yes. In one study (Hala & Chandler, 1996), 3-year-olds were asked to play a trick on a person (Lisa) by moving some biscuits from their distinctive biscuit jar to a hiding place, so that Lisa would be fooled. When later asked where Lisa will look for the biscuits and where she will think the biscuits are, children who helped plan the deception performed quite well, saying that Lisa would look in the biscuit jar. In contrast, children who merely observed the experimenter planning the deception did not perform so well. Rather, they were more likely to answer this *false-belief task* erroneously, stating that Lisa would look for the biscuits in the new hiding place. In other words, when they planned to deceive someone, 3-year-olds were later able to take the perspective of that person. When they were not actively involved in the deceit, however, they performed egocentrically, stating that the unsuspecting person would look for the biscuits where they knew them to be (see also Carlson, Moses, & Hix, 1998). Such tasks have been proposed to assess children's *theory of mind,* a topic we will discuss in greater detail shortly.

Clearly, preoperational children are not nearly as egocentric as Piaget thought. Nevertheless, Piaget was right in claiming that young children often rely on their own perspectives and thus fail to make accurate judgments about other people's motives, desires, and intentions; and they do often assume that if they know something, others will, too (Ruffman & Olson, 1989; Ruffman et al., 1993). Today, researchers believe that children gradually become less egocentric and better able to appreciate others' points of view as they learn more and more—particularly about other people and causes of their behavior. In other words, perspective-taking abilities are not totally absent at one stage and suddenly present at another; they develop slowly and become more refined from early in life into adulthood (Bjorklund, 2005).

**Another Look at Children's Reasoning.** Piaget was quite correct in stating that preschool children are likely to provide animistic answers to many questions and to make logical errors when thinking about cause-and-effect relationships. Yet Susan Gelman and Gail Gottfried (1996) find that 3-year-olds do *not* routinely attribute life or lifelike qualities to inanimate objects, even such inanimates as a robot that can be made to move. In addition, most 4-year-olds recognize that plants and animals grow and will heal after an injury, whereas inanimate objects (e.g., a table with a broken leg) will not (Backschneider, Shatz, & Gelman, 1993). Although preschool children do occasionally display animistic responses, these judgments stem not so much from a general belief that moving inanimates have lifelike qualities (Piaget's position) as from the (typically accurate) presumption that *unfamiliar* objects that appear to move *on their own* are alive (Dolgin & Behrend, 1984).

**Can Preoperational Children Conserve?** According to Piaget (1970b), children younger than 6 or 7 cannot solve conservation problems because they have not yet acquired the operation of reversibility—the cognitive operation that enables them to discover the constancy of attributes such as mass and volume. Piaget also argued that one cannot teach conservation to children younger than 6 or 7, for these preoperational youngsters are much too intellectually immature to understand and use logical operations such as reversibility.

However, many researchers have demonstrated that nonconservers as young as 4 years of age, and even children with mental retardation, can be *trained* to conserve by a variety of techniques (Gelman, 1969; Hendler & Weisberg, 1992). One approach that has proved particularly effective is **identity training**—teaching children to recognize that the object or substance transformed in a conservation task is still the same object or substance, regardless of its new appearance. For example, a child being trained to recognize identities on a conservation-of-liquids task might be told: "It may look like less water when we pour it from a tall, thin glass into this shorter one, but it is the same water, and there has to be the same amount to drink." Dorothy Field (1981) showed that 4-year-olds who received this training not only conserved on the training task but could also use their new knowledge about identities to solve a number of conservation problems on which they had not been trained. Field also reported that nearly 75 percent of the 4-year-olds who had received some kind of identity training were able to solve at least three (out of five) conservation problems that were presented to them 2½ to 5 months after their training had ended. So contrary to Piaget's viewpoint, many preoperational children can learn to conserve, and their initial understanding of this law of nature seems to depend more on their ability to recognize identities than on their use of reversibility and decentration.

**identity training**
an attempt to promote conservation by teaching nonconservers to recognize that a transformed object or substance is the same object or substance, regardless of its new appearance.

## The Development of Theory of Mind (TOM)

In discussing challenges to Piaget's theory of sensorimotor development, we introduced *theory theories,* which postulate, essentially, that infants possess some ideas of how the world is structured (theories) and modify these theories as a function of experience until their understanding of the world more resembles that of adults. The most investigated theory is not associated with infant intelligence, however, but develops during Piaget's preoperational period: **theory of mind (TOM).** In general, the phrase "theory of mind" is used to refer to children's developing concepts of mental activity—an understanding of how the human mind works and a knowledge that humans are cognitive beings whose mental states are not always shared with or accessible to others. Henry Wellman (1990) has proposed that adults' TOM is based on **belief-desire reasoning** (see Figure 7.6). We understand that our behavior, and the behavior of others, is based on what we know, or believe, and what we want, or desire. Such an understanding of intentional behavior is the basis of nearly all social interaction among people beyond preschool age, and it develops.

**theory of mind (TOM)**
a person's concepts of mental activity; used to refer to how children conceptualize mental activity and how they attribute intention to and predict the behavior of others; see also *belief-desire reasoning.*

**belief-desire reasoning**
the process whereby we explain and predict what people do based on what we understand their desires and beliefs to be.

Very young children may view desire as the most important determinant of behavior because desires so often trigger their own actions and they may assume that other people's

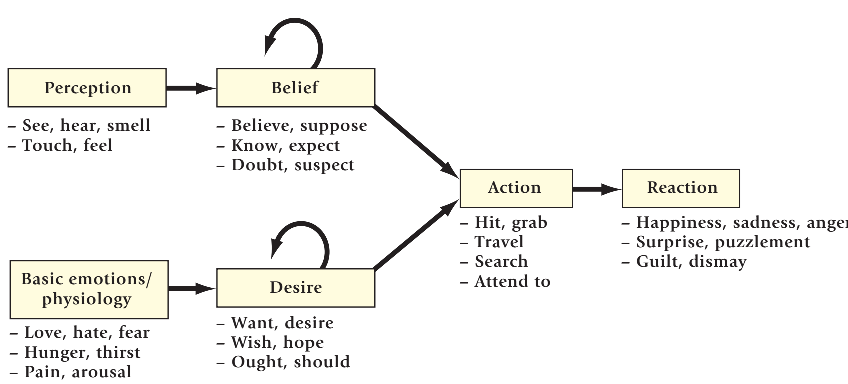



**Figure 7.6** A simplified scheme depicting belief-desire reasoning. Wellman, Henry J., The Child's Theory of Mind, 1 figure *"Simplified Scheme Depicting Belief-Desire Reasoning", Copyright © 1990 Massachusetts Institute of Technology, by permission of the MIT Press.*

conduct reflects similar motives. For example, when 14-month-olds have the options of giving a woman a food treat of either crackers or broccoli, they give her the crackers, even though they have just seen her express disgust at the crackers. Eighteen-month-olds, however, will offer the woman the vegetables, apparently realizing that the woman's desires are different from their own (Repacholi & Gopnik, 1997).

**false-belief task**
a type of task used in theory-of-mind studies, in which the child must infer that another person does not possess knowledge that he or she possesses (i.e., that the other person holds a belief that is false).

The most frequently used tool to assess children's theory of mind is the **false-belief task.** Consider the following scenario.

> Jorge puts some chocolate in a blue cupboard and goes out to play.
> In his absence, his mother moves the chocolate to the green cupboard.
> When Jorge returns, he wants his chocolate. Where does he look for it?

Three-year-olds say "in the green cupboard." They know where the chocolate is, and because beliefs represent reality, they assume that Jorge will be driven by his *desire* for chocolate to look in the right place. From a Piagetian perspective, children are making an egocentric response, believing that because they know where the chocolate is hidden, Jorge will know its location as well. In contrast, 4- to 5-year-olds display a belief-desire theory of mind: They understand that beliefs are merely mental representations of reality that may be inaccurate and that someone else may not share; thus, they know that Jorge will look for his chocolate in the blue cupboard where he *believes* it is (beliefs determine behavior, even if they are false) rather than in the green cupboard where they know it is (Wellman & Woolley, 1990).



Sibling interactions involving deception or trickery contribute to the development of a theory of mind.

It's not that younger children don't have the capacity to recognize a false belief or its implications. For example, if 3-year-olds collaborate with an adult in formulating a deceptive strategy in a hide-the-object game, their performance improves substantially on other false-belief tasks (Sodian et al., 1991). Nevertheless, between 3 and 4 years of age is when children normally achieve a much richer understanding of mental life and more clearly understand how beliefs and desires motivate their own behavior and also the behavior of other people (Wellman, Cross, & Watson, 2001; Wellman & Liu, 2004).

How do children manage to construct a theory of mind so early in life? One perspective is that human infants may be just as biologically prepared and as motivated to acquire information about mental states as they are to share meaning through language (Meltzoff, 1995). There are even those who believe that theory of mind is a product of evolution and that the human brain has specialized modules that allow children to construct an understanding of mental activities.

Why do 3-year-olds fail at the false-belief task? Some researchers have proposed that they lack a set of cognitive skills, collectively referred to as *executive function,* necessary to perform false-belief tasks properly. Executive functions refer to cognitive abilities involved in planning, executing, and inhibiting actions. Of the various components of executive function related to theory of mind, inhibition mechanisms have received the most attention (Carlson, Loses, & Claxton, 2004; Flynn, O'Malley, & Wood, 2004). *Cognitive inhibition* refers to the ability to inhibit certain thoughts and behaviors at specified times, and its development will be discussed in greater detail in Chapter 8. Inhibiting a preferred, or dominant, response is necessary to "pass" many false-belief tasks. For example, Joan Peskin (1992) showed preschool children a series of stickers, some more attractive than others. She then introduced "Mean Monkey," a hand puppet controlled by the experimenter, who played a game with the children. Mean Monkey would ask the children which of the stickers they really wanted and which stickers they did not want; he then selected the children's favorite sticker, leaving them with the least desirable ones. By 4 years of age, children understood the dynamics of the interchange and quickly learned to tell Mean Monkey the opposite of their true desires. Younger children rarely caught on and played most of the game telling Mean Monkey the truth and not getting the stickers they wanted. In other research, 3-year-old children were shown a series of windows, some of which had treats in them (Russell et al., 1991). Children had to select the *nontreat* window to get the treat, something that they had a difficult time doing, and repeatedly failed to get a treat, seemingly being unable to inhibit their "pick-the-treat" response.

Other, more social factors also seem to influence TOM development. Pretend play, for example, is an activity that prompts children to think about mental states. As toddlers and preschool children conspire to make one object represent another or to enact pretend roles such as cops and robbers, they become increasingly aware of the creative potential of the human mind—an awareness that beliefs are merely mental constructions that can influence ongoing behavior, even if they misrepresent reality (as they often do during pretend play) (Hughes & Dunn, 1999; Taylor & Carlson, 1997). Young children also have ample opportunity to learn how the mind works from family conversations centering on the discussion of motives, intentions, and other mental states (Sabbagh & Callanan, 1998), as well as on the resolution of conflicts among siblings and reasoning about moral issues (Dunn, 1994). Indeed, researchers have found that preschoolers with siblings, especially those with older siblings, do better on false-belief tasks and are quicker to acquire a belief-desire theory of mind than children without siblings are (see Ruffman et al., 1998, for a review). Having siblings may provide more opportunities for pretend play as well as more interactions involving deception or trickery—experiences that illustrate that beliefs need not reflect reality to influence one's own or another's behavior. However, preschoolers who perform especially well on false-belief tasks also interact with a larger number of adults, which implies that children are apprentices to a variety of tutors as they acquire a theory of mind (Lewis et al., 1996).

## Summing Up

Taken together, the evidence we have reviewed suggests that preschool children are not nearly as illogical or egocentric as Piaget assumed. Today, many researchers believe that Piaget underestimated the abilities of preschool children because his problems were too complex to allow them to demonstrate what they actually knew. If we were to ask you "What do quarks do?" you probably couldn't tell us unless you are a physics major. Surely, this is an unfair test of your "causal logic," just as Piaget's tests were when he questioned preschool children about phenomena that were equally unfamiliar to them (e.g., "What causes the wind?"). Even when they were thinking about familiar concepts, Piaget required children to verbally justify their answers—to state rationales that these young, relatively inarticulate preschoolers were often incapable of providing (to Piaget's satisfaction, at least). Yet, later research consistently indicates that Piaget's participants may have had a reasonably good understanding of many ideas that they couldn't articulate (e.g., distinctions between animates and inanimates) and would have easily displayed such knowledge if asked different questions or given nonverbal tests of the same concepts (Bullock, 1985; Waxman & Hatch, 1992).

Clearly, Piaget was right in arguing that preschool children are more intuitive, egocentric, and illogical than older grade-school children. Yet, it is now equally clear that (1) preschoolers are capable of reasoning logically about simple problems or concepts that are familiar to them, and (2) a number of factors other than lack of cognitive operations may account for their poor performances on Piaget's cognitive tests.

## The Concrete-Operational Stage (7 to 11 Years)

**concrete-operational period**
Piaget's third stage of cognitive development, lasting from about age 7 to age 11, when children are acquiring cognitive operations and thinking more logically about real objects and experiences.

During Piaget's **concrete-operational period,** children rapidly acquire cognitive operations and apply these important new skills when thinking about objects and events that they have experienced. A cognitive operation is an internal mental activity that enables children to modify and reorganize their images and symbols to reach a logical conclusion. With these powerful new operations in their cognitive arsenal, grade-school children progress far beyond the static and centered thinking of the preoperational stage. For every limitation of the preoperational child, we can see a corresponding strength in the concrete operator (see Table 7.3). Below we provide a couple of examples of operational thought: *conservation* and *relational logic.*

### Conservation

Concrete-operational children can easily solve several of Piaget's conservation problems. Faced with the conservation-of-liquids puzzle, for example, a 7-year-old concrete operator can *decenter* by focusing simultaneously on both the height and width of the two containers. She also displays *reversibility*—the ability to mentally undo the pouring process and imagine the liquid in its original container. Armed with these cognitive operations, she now knows that the two different containers each have the same amount of liquid; she uses logic, not misleading appearances, to reach her conclusion.

### Relational Logic

**mental seriation**
a cognitive operation that allows one to mentally order a set of stimuli along a quantifiable dimension such as height or weight.

An important hallmark of concrete-operational thinking is a better understanding of quantitative relations and relational logic. Do you remember an occasion when your gym teacher said, "Line up by height from tallest to shortest"? Carrying out such an order is really quite easy for concrete operators, who now are capable of **mental seriation**—the ability to mentally arrange items along a quantifiable dimension such as height or

**TABLE 7.3** A Comparison of Preoperational and Concrete-Operational Thought

| Concept | Preoperational thought | Concrete-operational thought |
|---|---|---|
| Egocentrism | Children typically assume that others share their point of view. | Children may respond egocentrically at times but are now much more aware of others' divergent perspectives. |
| Animism | Children are likely to assume that unfamiliar objects that move on their own have lifelike qualities. | Children are more aware of the biological bases for life and do not attribute lifelike qualities to inanimates. |
| Causality | Limited awareness of causality. Children occasionally display transductive reasoning, assuming that one of two correlated events must have caused the other. | Children have a much better appreciation of causal principles (although this knowledge of causality continues to develop into adolescence and beyond). |
| Perception-bound thought/centration | Children make judgments based on perceptual appearances and focus on a single aspect of a situation when seeking answers to a problem. | Children can ignore misleading appearances and focus on more than one aspect of a situation when seeking answers to a problem (decentration). |
| Irreversibility/reversibility | Children cannot mentally undo an action they have witnessed. They cannot think back to the way an object or situation was before the object or situation changed. | Children can mentally negate changes they have witnessed to make before/after comparisons and consider how changes have altered the situation. |
| Performance on Piagetian tests of logical reasoning | Their egocentrism and their perception-bound, centered reasoning means that children often fail conservation tasks, have difficulty grouping objects into hierarchies of classes and subclasses, and display little ability to order objects *mentally* along such quantitative dimensions as height or length. | Their declining egocentrism and acquisition of reversible cognitive operations permit concrete-cooperational children to conserve, correctly classify objects on several dimensions, and mentally order objects on quantitative dimensions. Conclusions are now based on logic (the way things *must* necessarily be) rather than on the way they appear to be. |

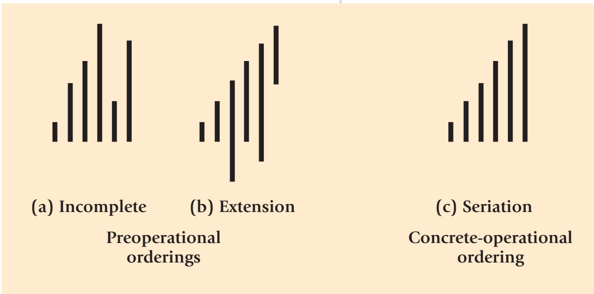



**Figure 7.7** Children's performance on a simple seriation task. If asked to arrange a series of sticks from shortest to longest, preoperational children often line up one end of the sticks from shortest to longest and create an incomplete ordering (a) or order them so the top of each successive stick extends higher than the preceding stick (b). Concrete operators, by contrast, can use the inverse cognitive operations "greater than" (>) and "less than" (<) to quickly make successive comparisons and create a correct serial ordering (c).

weight. By contrast, preoperational youngsters perform poorly on many seriation tasks (see Figure 7.7) and would struggle to comply with the gym teacher's request.

(Concrete-operational thinkers also have mastered the related concept of **transitivity,** which describes the necessary relations among elements in a series. If, for example, Juan is taller than Pedro, and Pedro is taller than Sam, who is taller, Juan or Sam? It follows logically that Juan must be taller than Sam, and the concrete operator grasps the transitivity of these size relationships. Lacking the concept of transitivity, the preoperational child relies on perceptions to answer the question and might insist that Juan and Sam stand next to each other so that she can determine who is taller. Preoperational children probably have a better understanding of such transitive relations than Piaget gave them credit for (Trabasso, 1975), but they still have difficulty grasping the logical necessity of transitivity (Chapman & Lindenberger, 1988; Markovits & Dumas, 1999).

**transitivity**
the ability to recognize relations among elements in a serial order (e.g., if A > B and B > C, then A > C).

**horizontal décalage**
Piaget's term for a child's uneven cognitive performance; an inability to solve certain problems even though one can solve similar problems requiring the same mental operations.

### The Sequencing of Concrete Operations

While examining Figure 7.5, you may have noticed that some forms of conservation (e.g., mass) are understood much sooner than others (volume). Piaget was aware of this and other developmental inconsistencies, and he coined the term **horizontal décalage** to describe them.

Why does the child display different levels of understanding of conservation tasks that seem to require the same mental operations? According to Piaget, horizontal décalage occurs because problems that appear quite similar may actually differ in complexity. For example, conservation of volume (see Figure 7.5) is not attained until ages 9 to 12 because it is a complex task that requires the child to simultaneously consider the operations involved in the conservation of both liquids *and* mass and then to determine whether there are any meaningful relationships between these two phenomena. Although we have talked as if concrete operations were a set of skills that appeared rather abruptly over a brief period, this was not Piaget's view. Piaget always maintained that operational abilities develop gradually and sequentially as the simpler skills that appear first are consolidated, combined, and reorganized into increasingly complex mental structures.

After reviewing some of the intellectual accomplishments of the concrete-operational period, we can see why many societies begin formal education at 6 to 7 years of age. According to Piaget, this is precisely the time when children are decentering from perceptual illusions and acquiring the cognitive operations that enable them to comprehend arithmetic, think about language and its properties, classify animals, people, objects, and events, and understand the relations between uppercase and lowercase letters, letters and the printed word, and words and sentences.

## The Formal-Operational Stage (11 to 12 Years and Beyond)

According to Piaget, the impressive thinking of concrete-operational children is limited because they can apply their operational schemes only to objects, situations, or events that are real or imaginable. The transitive inferences of concrete operators, for example, are likely to be accurate only for real objects that are (or have been) physically present. Seven- to 11-year-olds cannot yet apply this relational logic to abstract signifiers such as the Xs, Ys, and Zs that we use in algebra. By contrast, formal operations, first seen between the ages of 11 and 13 years of age, are mental actions performed on *ideas* and *propositions.* No longer is thinking tied to the factual or observable, for formal operators can reason quite logically about hypothetical processes and events that may have no basis in reality.

**formal operations**
Piaget's fourth and final stage of cognitive development, from age 11 or 12 and beyond, when the individual begins to think more rationally and systematically about abstract concepts and hypothetical events.

**hypothetico-deductive reasoning**
in Piaget's theory, a formal operational ability to think hypothetically.

## Hypothetico-Deductive Reasoning

The benchmark of **formal operations** is what Piaget referred to as **hypothetico-deductive reasoning** (Inhelder & Piaget, 1958). *Deductive reasoning,* which entails reasoning from the general to the specific, much as Sherlock Holmes would do in examining the clues to a crime to catch the villain, is not, in itself, a formal-operational ability. Concrete-operational children can arrive at a correct conclusion if they are provided with the proper concrete "facts" as evidence. Formal-operational children, on the other hand, are not restricted to thinking about previously acquired facts, but can generate hypotheses; what is possible is more important to them than what is real. In the box below we can see the differences between concrete-operational and formal-operational thinking as children consider a hypothetical proposition presented in the form of an art assignment.

Hypothetical thinking is also critical for most forms of mathematics beyond simple arithmetic. If $2X + 4 = 14$, what does $X$ equal? The problem does not deal with concrete entities such as apples or oranges, only with numbers and letters. It is an arbitrary, *hypothetical* problem that can be answered only if it is approached abstractly, using a symbol system that does not require concrete referents.

### FOCUS ON RESEARCH — Children's Responses to a Hypothetical Proposition

Piaget (1970a) argued that the thinking of concrete operators is reality-bound. Presumably, most 9-year-olds would have a difficult time thinking about objects that don't exist or events that could never happen. By contrast, children entering the stage of formal operations are said to be quite capable of considering hypothetical propositions and carrying them to a logical conclusion. Indeed, Piaget suspected that many formal operators would even enjoy this type of cognitive challenge.

Some years ago, a group of concrete operators (9-year-old fourth-graders) and a group of children who were at or rapidly approaching formal operations (11- to 12-year-old sixth-graders) completed the following assignment.

Suppose that you were given a third eye and that you could choose to place this eye anywhere on your body. Draw me a picture to show where you would place your extra eye, and then tell me why you would put it there.

All the 9-year-olds placed the third eye on the forehead between their two natural eyes. It seems as if these children called on their concrete experiences to complete their assignment: Eyes are found somewhere around the middle of the face in all people. One 9-year-old boy remarked that the third eye should go between the other two because "that's where a cyclops has his eye." The rationales for this eye placement were rather unimaginative. Consider the following examples:

JIM (age 9½): I would like an eye beside my two other eyes so that if one eye went out, I could still see with two.

VICKIE (age 9): I want an extra eye so I can see you three times.

TANYA (age 9½): I want a third eye so I could see better.

In contrast, the older, formal-operational children gave a wide variety of responses that were not at all dependent on what they had seen previously. Furthermore, these children thought out the advantages of this hypothetical situation and provided rather imaginative rationales for placing the extra eye in unique locations. Here are some sample responses:

KEN (age 11½): (draws the extra eye on top of a tuft of hair) I could revolve the eye to look in all directions.

JOHN (age 11½): (draws his extra eye in the palm of his left hand) I could see around corners and see what kind of cookie I'll get out of the cookie jar.

TONY (age 11): (draws a close-up of a third eye in his mouth) I want a third eye in my mouth because I want to see what I am eating.

When asked their opinions of the three-eye assignment, many of the younger children considered it rather silly and uninteresting. One 9-year-old remarked, "This is stupid. Nobody has three eyes." However, the 11- to 12-year-olds enjoyed the task and continued to pester their teacher for "fun" art assignments "like the eye problem" for the remainder of the school year (Shaffer, 1973).

So the results of this demonstration are generally consistent with Piaget's theory. Older children who are at or rapidly approaching the stage of formal operations are more likely than younger concrete operators to generate logical and creative responses to a hypothetical proposition and to enjoy this type of reasoning.


A systematic approach to problem solving is one of the characteristics of formal-operational thinking.

## Thinking Like a Scientist

In addition to the development of deductive reasoning abilities, formal-operational children are hypothesized to be able to think inductively, going from specific observations to broad generalizations. **Inductive reasoning** is the type of thinking that scientists display, where hypotheses are generated and then systematically tested in experiments.

Inhelder and Piaget (1958) used a series of tasks to assess scientific reasoning, one of which was the *pendulum problem*. Given strings of different lengths, objects of different weights to attach to one end of the strings, and a hook on which to hang the other end, the child's task is to discover which factor or factors influence how fast the string pendulum oscillates (i.e., swings back and forth during a set time period). Is it the length of the string that matters? The heaviness of the weight? The force with which the weight is pushed? The height from which the weight is released? Or might two or more of these variables be important?

**inductive reasoning**
the type of thinking that scientists display, where hypotheses are generated and then systematically tested in experiments.

The key to solving this problem is to first identify the four factors that might control the pendulum's oscillation and then to systematically test each of these hypotheses, varying one factor at a time while holding the others constant. Each successive hypothesis is tested in an if–then fashion: "If the weight on the string matters, then I should see a difference in oscillation when I compare a string with a heavy weight to a same-length string with a light weight, while holding other factors constant." Formal operators, who rely on this systematic approach to hypothesis generation and testing, eventually discover that the "weight hypothesis" is wrong and that the pendulum's oscillation depends on only one factor: the length of the string.

However, 9- to 10-year-old concrete operators are not able to generate and systematically test the full range of possibilities that would permit them to draw the appropriate conclusion. They often begin with a reasonable hypothesis ("Maybe string length matters"), but they can't isolate the effects of each variable. For example, they may test the string-length hypothesis without holding weight constant; should they find that a short string with a heavy weight oscillates faster than a longer one with a lighter weight, they are likely to erroneously conclude that both string length and weight control the pendulum's oscillation. Although subsequent research has not always supported Piaget's observations about scientific reasoning, it is generally agreed that it is a late-developing ability that is not easily demonstrated in many adults (Kuhn, Amsel, & O'Loughlin, 1988; Moshman, 1998). Older concrete operators can be trained to think more like formal operators when seeking solutions to problems (Adey & Shayer, 1992), but they are unable to generate these rational and methodical problem-solving strategies on their own. Even elementary school children can be trained to use scientific reasoning with explicit instructions, but transfer of such trained strategies is limited to older preadolescent children only (Chen & Klahr, 1999).

In sum, formal-operational thinking is rational, systematic, and abstract. The formal operator can now think in an organized way about thought and can operate on ideas and hypothetical concepts, including those that contradict reality.

## Personal and Social Implications of Formal Thought

Formal-operational thinking is a powerful tool that may change adolescents in many ways—some good, and some not so good. First the good news. As we will see in Chapter 12, formal operations may pave the way for thinking about what is possible in one's life, forming a stable identity, and achieving a much richer understanding of other people's psychological perspectives and the causes of their behavior. Formal-operational thinkers are also better equipped to make difficult personal decisions that involve weighing alternative courses of action and their probable consequences for themselves and other people (see Chapter 14, for example, on the development of moral reasoning). So advances in cognitive growth help to lay the groundwork for changes in many other aspects of development.

Now the bad news: Formal operations may also be related to some of the more painful aspects of the adolescent experience. Unlike younger children who tend to accept the world as it is and to heed the dictates of authority figures, formal operators, who can imagine hypothetical alternatives to present realities, may begin to question everything, from their parents' authority to impose strict curfews to the government's need for spending billions of dollars on weapons and the exploration of outer space when so many people are hungry and homeless. Indeed, the more logical inconsistencies and other flaws that adolescents detect in the real world, the more confused they become and the more inclined they are to become frustrated with or even to display rebellious anger toward the agents (e.g., parents, the government) thought to be responsible for these imperfect states of affairs. Piaget (1970a) viewed this idealistic fascination with the way things "ought to be" as a perfectly normal outgrowth of the adolescent's newly acquired abstract reasoning abilities, and he thus proclaimed formal operations the primary cause of the "generation gap."

Another way in which formal operations may be related to painful aspects of the adolescent experience is the resurgence of egocentrism that accompanies the intellectual tools of formal operations. The egocentrism of adolescence occurs in the form of personal self-consciousness. Young teens often believe that other people in their environment (home, school, sports, clubs) are as concerned with their feelings and behavior as they are themselves. David Elkind calls this the adolescent's **imaginary audience** (1967; Elkind & Bowen, 1979). Perhaps you can recall your middle- or high-school classrooms in which each adolescent believed (and acted on the belief) that every other person in the room was focused exclusively on him or her. This form of egocentrism can be very painful and difficult, but luckily most adolescents outgrow this error in thinking as their formal-operational skills develop.

**imaginary audience**
a result of adolescent egocentrism. Adolescents believe that everyone around them is as interested in their thoughts and behaviors as they are themselves.

## Does Everyone Reach Formal Operations?

Piaget (1970b) believed that the transition from concrete-operational to formal-operational reasoning takes place very gradually. For example, 11- to 13-year-olds who are entering formal operations are able to consider simple hypothetical propositions such as the three-eye problem mentioned in the box on page 274. However, they are not yet proficient at generating and testing hypotheses, and it may be another 3 to 4 years before they are capable of the planful, systematic reasoning that is necessary to deduce what determines how fast a pendulum will swing. Piaget never identified a stage of reasoning beyond formal operations, and he believed that most people show at least some signs of this highest level of intellect by ages 15 to 18.

Other investigators find that adolescents are much slower to acquire formal operations than Piaget had thought. In fact, Edith Neimark's (1979) review of the literature suggests that a sizable percentage of American adults do not often reason at the formal level, and apparently there are some cultures—particularly those where formal schooling is rare or nonexistent—in which no one solves Piaget's formal-operational problems. Why do some people fail to attain formal operations? Cross-cultural research provides one clue: They may not have had sufficient exposure to the kinds of schooling that stress logic, mathematics, and science—experiences that Piaget believed help the child to reason at the formal level (Cole, 1990; Dasen, 1977).

In the later stages of his career, Piaget (1972) suggested another possibility: Perhaps nearly all adults are capable of reasoning at the formal level, but do so only on problems that hold their interest or are of vital importance to them. Indeed, Steven Tulkin

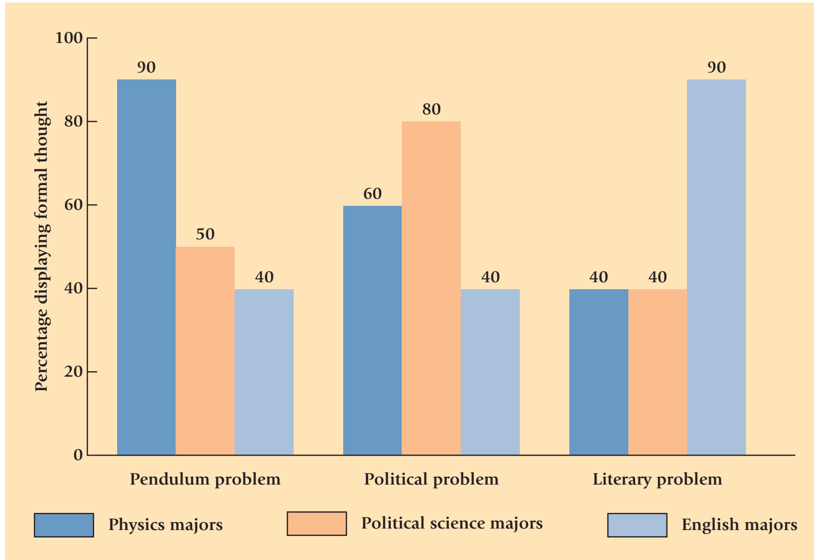



**Figure 7.8** Expertise and formal operations. College students show the greatest command of formal-operational thought in the subject area most related to their major. *Adapted from "Individual Differences in College Students' Performance on Formal Operations Tasks," by R. De Lisi & J. Staudt, 1980,* Journal of Applied Developmental Psychology, 1, *163–174. Reprinted with permission from Excerpta Medica, Inc.*

and Melvin Konner (1973) found that preliterate Bushman hunters who fail Piaget's test problems often do reason at the formal level on at least one task: tracking prey. Clearly, this is an activity of great importance to them that requires the systematic testing of inferences and hypotheses. A similar phenomenon has been observed among high school and college students. Not only do twelfth-graders reason more abstractly about relevant everyday issues with which they are already familiar (Ward & Overton, 1990), but as we see in Figure 7.8, physics, English, and social science majors are all more likely to perform at the formal level on problems that fall within their own academic domains (De Lisi & Staudt, 1980).

It seems likely, then, that each person has an optimal, or "highest," level of cognitive performance that will show itself in familiar or well-trained content domains (Fischer, 1980; Fischer & Bidell, 1998). However, performance is likely to be inconsistent across domains unless the person has had a chance to build knowledge and to practice reasoning in all these content areas (Marini & Case, 1994). So we must be careful not to underestimate the cognitive capabilities of adolescents and adults who fail Piaget's formal-operational tests, for their less-than-optimal performances on these physical-science problems may simply reflect either a lack of interest or a lack of experience with the subject matter rather than an inability to reason at the formal level.

One interesting (and perhaps counterintuitive for some) finding is that formal-operational abilities seem to be accelerated in contemporary adolescents relative to those of earlier generations (Flieller, 1999). Tests of formal-operational abilities given to groups of French adolescents between 1967 and 1996 reveal higher scores for the latter cohorts. This suggests that today's adolescents are cognitively more advanced than adolescents at the same age 25 and 30 years ago. This is similar to the phenomenon of increasing IQ scores found over the past 60 years (Flynn, 1987), the so-called Flynn effect, which will be discussed in Chapter 9.

## An Evaluation of Piaget's Theory

We have provided some evaluation of Piaget's theory of cognitive development throughout this chapter. In this section, we take a broader view of this monumental theory. Let us start by giving credit where credit is due before considering the challenges to Piaget's viewpoint.

## Piaget's Contributions

Piaget is a giant in the field of human development. As one anonymous scholar quoted by Harry Beilin (1992) put it, "assessing the impact of Piaget on developmental psychology is like assessing the impact of Shakespeare on English literature or Aristotle on philosophy—impossible" (p. 191). It is hard to imagine that we would know even a fraction of what we know about intellectual development had Piaget pursued his early interests in zoology and never worked with developing children.

So what exactly has Piaget contributed to the field of human development? The following list is a brief assessment of Piaget's major contributions made by several prominent researchers in honor of the 100th anniversary of Piaget's birth (see Brainerd, 1996):

1. Piaget founded the discipline we know today as cognitive development. His interest in children's thinking ensured that this field would be "developmental" and not merely apply to children the ideas and methods from the study of adult thinking.
2. Piaget convinced us that children are curious, active explorers who play an important role in their own development. Although Piaget's assumptions that children actively construct their own knowledge may seem obvious today, this viewpoint was innovative and contrary to the thinking of his time.
3. Piaget's theory was one of the first to try to *explain,* and not just *describe,* the process of development. Largely prompted by his theory, many theorists today have taken seriously the need to explain transitions in children's thinking (Fischer & Bidell, 1998; Nelson, 1996; Pascual-Leone, 2000; Siegler, 1996).
4. Piaget's description of broad sequences of intellectual development provides a reasonably accurate overview of how children of different ages think. He may have been wrong about some of the specifics, but, as Robert Siegler (1991, p. 18) notes, "His descriptions feel right. . . . The general trends . . . appeal to our intuitions and our memories of childhood."
5. Piaget's ideas have had a major influence on thinking about social and emotional development as well as many practical implications for educators.
6. Finally, Piaget asked important questions and drew literally thousands of researchers to the study of cognitive development. And, as often happens when heuristic theories such as Piaget's are repeatedly scrutinized, some of this research led to new insights while pointing to problems with his original ideas.

## Challenges to Piaget

Over the past 35 years, critics have pointed to several apparent shortcomings of Piaget's theory. We briefly consider four of these criticisms.

### Piaget Failed to Distinguish Competence from Performance

We have commented repeatedly throughout this chapter that Piaget underestimated the cognitive capabilities of infants, toddlers, and preschool children. One reason for this consistent underestimation of children's abilities is that Piaget was concerned with identifying the underlying *competencies,* or cognitive structures, that presumably determined how children perform on various cognitive tasks. He tended to assume that a child who failed in one of his problems simply lacked the underlying concepts, or thought structures, he was testing.

We now know that this assumption is not valid because many factors other than a lack of critical competencies might undermine one's performance on a cognitive test. We've seen, for example, that 4- and 5-year-olds who seem to know the differences between animates and inanimates failed Piaget's tests largely because Piaget required them to explain principles they understood (critical competency) but could not articulate. His tendency to equate task performances with competencies (and to ignore motivation, task familiarity, and all other factors that influence performance) is a major reason that his age norms for various cognitive milestones were often so far off target.

## Does Cognitive Development Really Occur in Stages?

Piaget maintained that his stages of intellectual development are *holistic structures,* that is, coherent modes of thinking that are applied across a broad range of tasks. To say that a child is concrete-operational, for example, implies that he relies on cognitive operations and thinks logically about the vast majority of intellectual problems that he encounters.

Recently this holistic-structures assumption has been challenged by researchers who question whether cognitive development is at all stagelike (Bjorklund, 2005; Siegler, 2000). From their perspective, a "stage" of cognitive development implies that abrupt changes in intellectual functioning occur as the child acquires several new competencies over a relatively brief period. Yet we've seen that cognitive growth doesn't happen that way. Major transitions in intellect occur quite gradually, and there is often very little consistency in the child's performance on tasks that presumably measure the abilities that define a given stage. For example, it may be years before a 7-year-old who can seriate or conserve number will be able to conserve volume (see Figure 7.5). Furthermore, it now appears that different concrete-operational and formal-operational problems are mastered in different orders by different children, a finding that suggests that there is less consistency and coherence to cognitive growth than Piaget assumed (Case, 1992; Larivée, Narmandeau, & Parent, 2000).

So is cognitive development truly stagelike? The issue is still hotly debated and far from being resolved. Some theorists insist that cognitive development is coherent and does progress through a series of stages, though not necessarily through the same stages that Piaget proposed (Case & Okamoto, 1996). Yet many other theorists believe that intellectual development is a complex, multifaceted process in which children gradually acquire skills in many different content areas such as deductive reasoning, mathematics, visual–spatial reasoning, verbal skills, and moral reasoning, to name a few (Bjorklund, 2005; Fischer & Bidell, 1998). Although development within each of these domains may occur in small, orderly steps, there is no assumption of consistency across domains. Thus, a 10-year-old who enjoys solving word puzzles and playing verbal games might outperform most age-mates on tests of verbal reasoning but function at a much lower level in less familiar domains, such as hypothesis testing or mathematical reasoning.

In sum, many aspects of cognitive development are orderly and coherent (and some would say stagelike) *within particular intellectual domains.* Yet there is very little evidence for strong consistencies in development across domains or for broad, holistic cognitive stages of the kind Piaget described.

## Does Piaget "Explain" Cognitive Development?

Even those researchers who claim that cognitive growth is stagelike are bothered by Piaget's account of how children move from one stage of intellect to the next. Recall Piaget's interactionist viewpoint: Presumably children are (1) constantly assimilating new experiences in ways that their level of maturation allows, (2) accommodating their thinking to these experiences, and (3) reorganizing their structures into increasingly complex mental schemes that enable them to reestablish cognitive equilibrium with novel aspects of the environment. As children continue to mature, assimilate more complex information, and alter and reorganize their schemes, they eventually come to view familiar objects and events in new ways and move from one stage of intellect to the next.

This rather vague explanation of cognitive growth raises more questions than it answers. What maturational changes are necessary before children can progress from sensorimotor to preoperational intellect or from concrete operations to formal operations? What kinds of experiences must a child have in order to construct mental symbols, use cognitive operations, or operate on ideas and think about hypotheticals? Piaget was simply not very clear about these or any other mechanisms that might enable a child to move to a higher stage of intellect. As a result, a growing number of researchers now look on his theory as an elaborate description of cognitive development that has limited explanatory power (Gelman & Baillargeon, 1983; Kuhn, 1992).

### Piaget Devoted Too Little Attention to Social and Cultural Influences

Children live in varied social and cultural contexts that affect the way their world is structured. Although Piaget admitted that cultural factors may influence the rate of cognitive growth, developmentalists now know that culture influences *how* children think as well (Gauvain, 2001; Rogoff, 1998, 2003). Piaget also paid too little attention to the ways in which children's minds develop through their *social interactions* with more competent individuals. It would be an overstatement to say that Piaget ignored social influences on cognitive development. As we will see in Chapters 12 and 14, Piaget felt that conflict

## CONCEPT CHECK 7.3 Understanding Operations

Check your understanding of older children's cognitive development by answering the following questions. Answers appear in the Appendix.

**Multiple Choice:** Select the best alternative for each question.

_____ 1. Glen's mother has dark hair and is short; Glen thinks that all mothers have dark hair and are short. This is an example of
   a. conservation
   b. disequilibrium
   c. egocentrism
   d. accommodation

_____ 2. The *preoperational* child is characterized by
   a. introspective and abstract thinking
   b. logical, concrete, and nonabstract thinking
   c. symbolic, intuitive, and egocentric thinking
   d. logical, abstract, and egocentric thinking

_____ 3. A 5-year-old child suggests that John, who is 6 feet tall, must be older than his Aunt Mary, who is only 5 feet tall. This approach of interpreting age based solely on the height of an individual can be attributed to this child's
   a. seeing events as specific states and ignoring transformations
   b. egocentricity
   c. inability to deal with a superordinate and subordinate concept simultaneously
   d. perceptual centration

_____ 4. Children's developing concepts of mental activity, including some coherent framework for organizing facts and making predictions, is referred to as
   a. dual encoding
   b. reflective abstraction
   c. theory of mind
   d. representational insight

**Matching:** Match the following concepts with their definitions.

a. representational insight
b. animism
c. conservation
d. theory of mind
e. horizontal décalage
f. hypothetico-deductive reasoning

5. ________ A person's concepts of mental activity; used to refer to how children conceptualize mental activity and how they attribute intention to and predict the behavior of others.
6. ________ The knowledge that an entity can stand for (represent) something other than itself.
7. ________ The recognition that the properties of an object or substance do not change when its appearance is altered in some superficial way.
8. ________ In Piaget's theory, a formal-operational ability to think hypothetically.
9. ________ Attributing life and lifelike qualities to inanimate objects.
10. ________ Piaget's term for a child's uneven cognitive performance; an inability to solve certain problems even though one can solve similar problems requiring the same mental processes.

**Essays:** Provide a detailed answer to the following questions.

11. What are some of the cognitive abilities that differentiate preoperational from concrete-operational children?
12. How are false-belief tasks used to assess belief-desire reasoning in children?

among peers was a major contributor to cognitive disequilibrium and intellectual growth, particularly the growth of perspective-taking skills and moral reasoning. Nevertheless, Piaget's descriptions emphasized the *self-directed* character of cognitive growth, almost as if children were isolated scientists, exploring the world and making critical discoveries largely on their own. Today, we know that children develop many of their most basic (and not so basic) competencies by collaborating with parents, teachers, older siblings, and peers. Indeed, the belief that social interaction contributes importantly to cognitive growth is a cornerstone of the *sociocultural perspective* on cognitive development offered by one of Piaget's contemporaries, Lev Vygotsky.

# Vygotsky's Sociocultural Perspective

**sociocultural theory**
Vygotsky's perspective on cognitive development, in which children acquire their culture's values, beliefs, and problem-solving strategies through collaborative dialogues with more knowledgeable members of society.

**ontogenetic development**
development of the individual over his or her lifetime.

**microgenetic development**
changes that occur over relatively brief periods of time, in seconds, minutes, or days, as opposed to larger-scale changes, as conventionally studied in ontogenetic development.

**phylogenetic development**
development over evolutionary time.

**sociohistorical development**
changes that have occurred in one's culture and the values, norms, and technologies such a history has generated.

In order to view Piaget's work from a new vantage point, let's consider a perspective on cognitive development that has been arousing a great deal of interest lately—the **sociocultural theory** of Lev Vygotsky (1934/1962; 1930–1935/1978; and see Gauvain, 2001; Rogoff, 1990, 1998, 2003; Wertsch & Tulviste, 1992). This Russian developmentalist was an active scholar in the 1920s and 1930s when Piaget was formulating his theory. Unfortunately, Vygotsky died at the age of 38 before his work was complete. Nevertheless, he left us with much food for thought by insisting that (1) cognitive growth occurs in a sociocultural context that influences the form it takes, and (2) many of a child's most noteworthy cognitive skills evolve from social interactions with parents, teachers, and other more competent associates.

## The Role of Culture in Intellectual Development

The crux of the sociocultural perspective as advocated by Vygotsky was that children's intellectual development is closely tied to their culture. Children do *not* develop the same type of mind all over the world, but learn to use their species-typical brain and mental abilities to solve problems and interpret their surroundings consistent with the demands and values of their culture. For Vygotsky, human cognition, even when carried out in isolation, is inherently *sociocultural,* affected by the beliefs, values, and tools of intellectual adaptation passed to individuals by their culture. And because these values and intellectual tools may vary substantially from culture to culture, Vygotsky believed that neither the course nor the content of intellectual growth was as universal as Piaget assumed.

Vygotsky proposed that we should evaluate development from the perspective of four interrelated levels in interaction with children's environments—*microgenetic, ontogenetic, phylogenetic,* and *sociohistorical*. **Ontogenetic development** refers to development of the individual over his or her lifetime, and is the topic of this book and the level of analysis for nearly all developmental psychologists. **Microgenetic development** refers to changes that occur over relatively brief periods of time, such as the changes that one may see in a child solving addition problems every week for 11 consecutive weeks (Siegler & Jenkins, 1989), or even the changes in the use of memory strategies that children use over five different trials in the course of a 20-minute session (Coyle & Bjorklund, 1997). This is obviously a finer-grained analysis than that afforded by the traditional ontogenetic level. **Phylogenetic development** refers to changes over evolutionary time, measured in thousands and even millions of years. Here, Vygotsky anticipated the current evolutionary psychology perspective, believing that an understanding of the species' history can provide insight into child development (Bjorklund & Pellegrini, 2002; Ellis & Bjorklund, 2005). Finally, **sociohistorical development** refers to the changes that have occurred in one's culture and the values, norms, and technologies such a history has generated. It is this sociohistorical perspective that modern-day researchers have emphasized most about Vygotsky's ideas.

## Tools of Intellectual Adaptation

**tools of intellectual adaptation** Vygotsky's term for methods of thinking and problem-solving strategies that children internalize from their interactions with more competent members of society.

Vygotsky proposed that infants are born with a few *elementary mental functions*—attention, sensation, perception, and memory—that are eventually transformed by the culture into new and more sophisticated *higher mental functions.* Take memory, for example. Young children's early memorial capabilities are limited by biological constraints to the images and impressions they can produce. However, each culture provides its children with **tools of intellectual adaptation** that permit them to use their basic mental functions more adaptively. For example, children in information-age societies might enhance their memory by taking notes, whereas their age-mates in preliterate societies might represent each object they must remember by tying a knot in a string. Such socially transmitted memory strategies and other cultural tools teach children how to use their minds—in short, *how* to think. And because each culture also transmits specific beliefs and values, it teaches children *what* to think as well.

One subtle difference in cultural tools of intellectual adaptation that can make a noticeable difference in children's cognitive task performance is found in how a language names its numbers. For example, in all languages, the first ten digits must be learned by rote. However, after that, some languages take advantage of the base-10 number system and name numbers accordingly. English does this beginning at 20 (twenty-one, twenty-two, and so on). However, the teen numbers in English are not so easily represented. Rather, "eleven" and "twelve" also must be memorized. Not until 13 does a base-10 system begin (three + ten = "thirteen"), and even then, several of the number names do not correspond to the formula digit + ten. "Fourteen," "sixteen," "seventeen," "eighteen," and "nineteen" do, but the number names for "13" and "15" are not as straightforward (i.e., they are not expressed as "threeteen" and "fiveteen"). Moreover, for the teen numbers, the digit unit is stated first ("*four*teen," "*six*teen"), whereas the decade unit is stated first for the numbers 20 through 99 ("*twenty*-one," "*thirty*-two"). Thus, the number system becomes regular in English beginning with the 20s.

Other languages, such as Chinese, have a more systematic number-naming system. In Chinese, as in English, the first ten digits must be memorized. However, from this point, the Chinese number-naming system follows a base-10 logic, with the name for 11 translating as "ten one," the name for 12 translating as "ten two," and so on. Table 7.4 shows the names for the numbers 1 to 20 in both Chinese and English. Kevin Miller and his colleagues (1995) reasoned that differences in the number-naming systems between English and Chinese might be associated with early mathematical competence, specifically counting. They tested 3- through 5-year-old children in Champaign-Urbana, Illinois, and Beijing, China. They asked each child to count as high as possible. There were no cultural differences for the 3-year-olds, but the Chinese children began to show an advantage by age 4, and this advantage was even larger at age 5. Further analyses indicated that cultural differences were limited to the teens decade. Although almost all children could count to 10 (94 percent of the American children and 92 percent of the Chinese children), only 48 percent of the American children could count to 20, compared with 74 percent of the Chinese children. Once children could count to 20, there were no cultural differences for counting to 100. These findings indicate how differences in the number-naming system of a language can contribute to early differences in a cognitive skill. This early difference in a tool of intellectual adaptation might contribute to later differences in mathematical abilities found between Chinese and American children (Stevenson & Lee, 1990).

# The Social Origins of Early Cognitive Competencies and the Zone of Proximal Development

Vygotsky agreed with Piaget that young children are curious explorers who are actively involved in learning and discovering new principles. However, unlike Piaget, Vygotsky believed that many of the truly important "discoveries" that children make occur within

**TABLE 7.4** Chinese and English Number Words from 1 to 20

| Number | Chinese word | English word |
|---|---|---|
| 1 | yee | one |
| 2 | uhr | two |
| 3 | sahn | three |
| 4 | suh | four |
| 5 | woo | five |
| 6 | lyo | six |
| 7 | chee | seven |
| 8 | bah | eight |
| 9 | jyo | nine |
| 10 | shi | ten |
| 11 | shi yee | eleven |
| 12 | shi uhr | twelve |
| 13 | shi shan | thirteen |
| 14 | shi suh | fourteen |
| 15 | shi woo | fifteen |
| 16 | shi lyo | sixteen |
| 17 | shi chee | seventeen |
| 18 | shi bah | eighteen |
| 19 | shi jyo | nineteen |
| 20 | ershi | twenty |

NOTE: The more systematic Chinese numbering system follows a base-10 logic (i.e., 11 translating as "ten one" ["shi yee"]) requiring less rote memorization, which may explain why Chinese-speaking children learn to count to 20 earlier than English-speaking children.

the context of cooperative, or collaborative, *dialogues* between a skillful tutor—who models the activity and transmits verbal instructions, and a novice pupil—who first seeks to understand the tutor's instruction and eventually internalizes this information, using it to regulate his or her own performance.

To illustrate collaborative (or guided) learning as Vygotsky viewed it, let's imagine that Tanya, a 4-year-old, has just received her first jigsaw puzzle. She attempts to work the puzzle but gets nowhere until her father sits down beside her and gives her some tips. He suggests that it would be a good idea to put together the corners first, points to the pink area at the edge of one corner piece, and says, "Let's look for another pink piece." When Tanya seems frustrated, he places two interlocking pieces near each other so that she will notice them, and when Tanya succeeds, he offers words of encouragement. As Tanya gradually gets the hang of it, he steps back and lets her work more and more independently.

## The Zone of Proximal Development

**zone of proximal development** Vygotsky's term for the range of tasks that are too complex to be mastered alone but can be accomplished with guidance and encouragement from a more skillful partner.

How do collaborative dialogues foster cognitive growth? First, Vygotsky would say that Tanya and her father are operating in what he called the **zone of proximal development**—the difference between what a learner can accomplish independently and what he or she can accomplish with the guidance and encouragement of a more skilled partner. This zone is where sensitive instruction should be aimed and where new cognitive growth can be expected to occur. Tanya obviously becomes a more competent puzzle-solver with her father's help than without it. More importantly, she will internalize the problem-solving techniques that she uses in collaboration with him and ultimately use them on her own, rising to a new level of independent mastery.

**scaffolding**
process by which an expert, when instructing a novice, responds contingently to the novice's behavior in a learning situation, so that the novice gradually increases his or her understanding of a problem.

One feature of social collaboration that fosters cognitive growth is **scaffolding,** the tendency of more expert participants to carefully tailor the support they provide to the novice learner's current situation so that he can profit from that support and increase his understanding of a problem (Wood, Bruner, & Ross, 1976). Scaffolding occurs not just in formal educational settings, but any time a more expert person adjusts his input to guide a child to a level near the limits of his or her capabilities. The behavior of Tanya's father in the preceding example reflects not only working in the zone of proximal development but also scaffolding.

All the responsibility for determining the extent of adult involvement is not on the adult. Both adults and children jointly determine the degree to which children can function independently. For example, children who are less able to solve problems on their own will elicit more support from adults than will more capable children. More skilled children need less adult support, or scaffolding, to solve a problem (Plumert & Nichols-Whitehead, 1996).

**guided participation**
adult–child interactions in which children's cognitions and modes of thinking are shaped as they participate with or observe adults engaged in culturally relevant activities.

**context-independent learning**
learning that has no immediate relevance to the present context, as is done in modern schools; acquiring knowledge for knowledge's sake.

We have been careful not to use the word "competence" in describing children's problem-solving abilities. In Vygotsky's sociocultural perspective, learning and development are the result of interacting in specific culturally defined tasks that have specific rules. Unlike other theories of cognitive development (e.g., Piaget's), "competence" is not an absolute level beyond which a child cannot exceed, but rather is task-specific (Fischer & Bidell, 1998). A child can show an elevated level of ability on one highly practiced task but be less adept on a very similar, perhaps even objectively less demanding, task. A child's level of intellectual functioning is always evaluated by performance on specific tasks or in specific culturally determined situations.

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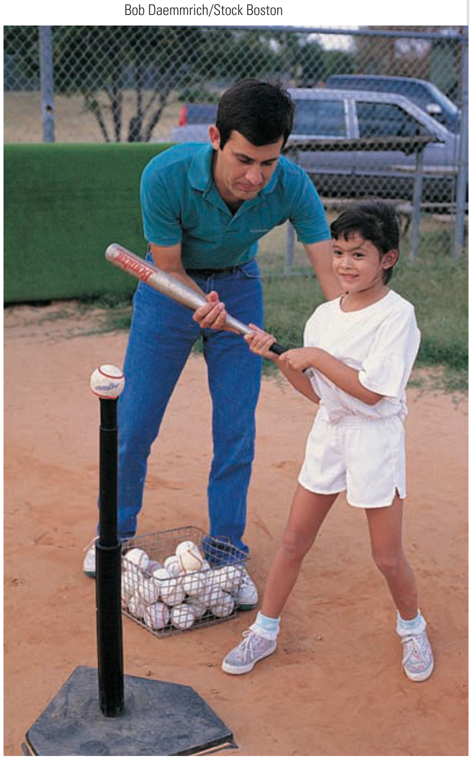

According to Vygotsky, new skills are easier to acquire if children receive guidance and encouragement from a more competent associate.

## Apprenticeship in Thinking and Guided Participation

In many cultures, children do not learn by going to school with other children, nor do their parents formally teach such lessons as weaving and hunting. Instead, they learn through **guided participation**—by actively *participating* in culturally relevant activities alongside more skilled partners who provide necessary aid and encouragement (Gauvain, 2001; Rogoff, 1998). Guided participation is an informal "apprenticeship in thinking" in which children's cognitions are shaped as they partake, alongside adults or other more skillful associates, in everyday culturally relevant experiences. Barbara Rogoff believes that cognitive growth is shaped as much or more by these informal adult–child transactions as it is by more formal teaching or educational experiences.

The idea of an apprenticeship, or guided participation, may seem reasonable in cultures where children are integrated early into the daily activities of adult life, such as the agrarian Mayans of Guatemala and Mexico, or the !Kung of Africa, whose hunting-and-gathering lifestyle has remained virtually unchanged for thousands of years. But this idea is not as easily grasped for a culture such as our own, because many aspects of cognitive development in Western culture have shifted from parents to professional educators, whose job it is to teach important cultural knowledge and skills to children. Nevertheless, learning certainly occurs at home in modern societies, particularly during the preschool years. And in many ways, these home-learning experiences prepare children for the schooling that will follow. For example, formal education in the United States and Europe involves children responding to adults' questions when the adults already know the answers. It also involves learning and discussing things that have no immediate relevance—knowledge for knowledge's sake. Such **context-independent learning,** foreign to so many cultures, is fostered from infancy and early childhood in our own culture (Rogoff, 1990). Consider the following interchange between 19-month-old Brittany and her mother:

Mother: Brittany, what's at the park?
Brittany: Babyswing.
Mother: That's right, the babyswing. And what else?

Brittany: (shrugs)
Mother: A slide?
Brittany: (smiling, nods yes)
Mother: And what else is at the park?
Brittany: (shrugs)
Mother: A see . . .
Brittany: Seesaw!
Mother: That's right, a seesaw.

This type of conversation is typical for an American mother and her child, and it is a good example of Vygotsky's zone of proximal development. Brittany, in this case, was not only learning to recall specific objects with her mother's help, but was also learning the importance of remembering information *out of context* (mother and daughter were in their living room at the time, miles from the park). Brittany was learning that she could be called upon to state facts to her mother that her mother already knew. She was also learning that she could depend on her mother to help provide answers when she was unable to generate them herself. Figure 7.9 provides a list of some of the functions that such "shared remembering" between parent and child can have on memory development.

## Siblings as Creators of the Zone of Proximal Development and Scaffolding

What positive roles might siblings play in one another's lives? One important contribution that older siblings make is to provide *caretaking* services for younger brothers and sisters. A survey of child-rearing practices in 186 societies found that older children were the *principal* caregivers for infants and toddlers in 57 percent of the groups studied (Weisner & Gallimore, 1977). Even in industrialized societies such as the United States, older siblings (particularly girls) are often asked to look after their younger brothers and sisters (Brody, 1998). Of course, their role as caregivers provides older children with opportunities to influence their younger siblings in many ways, by serving as their teachers, playmates, and advocates, and as important sources of emotional support.

In addition to the caretaking and emotional support they may provide, older siblings often teach new skills to younger brothers and sisters, either by modeling these competencies or by providing direct instruction (Brody et al., 2003). Even toddlers are quite attentive to older siblings, often choosing to imitate their behaviors as they actively participate with siblings at play, infant care, and other household routines (Maynard, 2002; see also Downey & Condron, 2004).

Younger children tend to admire their older siblings, who continue to serve as important models and tutors throughout childhood (Buhrmester & Furman, 1990). Given a problem to master, children are likely to learn more when they have an older sibling

- ☑ **Children learn about memory process, for example, strategies**
- ☑ **Children learn ways of remembering and communicating memories with others, for example, narrative structure**
- ☑ **Children learn about themselves, which contributes to the development of the self-concept**
- ☑ **Children learn about their own social and cultural history**
- ☑ **Children learn values important to the family and the community, that is, what is worth remembering**
- ☑ **Promotes social solidarity**

**Figure 7.9** Some functions of shared remembering in children's memory development. *Gauvain, M. (2001).* The Social Context of Cognitive Development. *New York: Guilford, p. 111. Copyright © 2001 by Guilford Press. All rights reserved. Reproduced by permission.*

available to guide them than when they have access to an equally competent older peer (Azmitia & Hesser, 1993). Why? Because (1) older siblings feel a greater responsibility to teach if the pupil is a younger *sibling,* (2) they provide more detailed instructions and encouragement than older peers do, and (3) younger children are more inclined to seek the older sibling's guidance. This kind of informal instruction clearly pays off: when older siblings play school with younger brothers and sisters, teaching them such lessons as the ABCs, younger siblings have an easier time learning to read (Norman-Jackson, 1982). What's more, older siblings who often tutor younger ones may profit as well, for they score higher on tests of academic aptitude than peers who have not had these tutoring experiences (Paulhus & Shaffer, 1981; Smith, 1990).

## Working in the Zone of Proximal Development in Different Cultures

Although the process of guided participation may be universal, how it is carried out varies from culture to culture. Rogoff and her colleagues (1993) classified cultures into two general types: (1) cultures such as ours, where, beginning in the preschool years, children are often segregated from adults and receive much culturally important information in school; and (2) cultures where children are in close contact most of the day with adults, observing and interacting with them while they perform culturally important activities. Rogoff then observed 14 families with toddlers in each of four communities, two where culturally important information is transmitted mainly "out of context," through formal schooling (Salt Lake City, in the United States, and Keçiören, a middle-class community in Turkey), and two where culturally important information is transmitted mainly in context (the Guatemalan Mayan town of San Pedro and Dhol-Ki-Patti, a tribal village in India). Toddlers and their caregivers were observed while performing routine activities (e.g., feeding, dressing), playing social games (e.g., peekaboo), and playing with novel objects (e.g., an embroidery hoop, a jumping jack—a marionette that kicks its legs). The following excerpts are two examples of guided participation, one from the middle-class community in Salt Lake City, and the other from the tribal Indian village of Dhol-Ki-Patti.

> SALT LAKE CITY: *A 21-month-old boy and his mother, exploring a glass jar that contains a peewee doll.*
>
> Sandy's mother held the jar up and chirped excitedly, "What is it? What's inside?" and then pointed to the peewee doll inside. "Is that a little person?" When Sandy pulled down on the jar, she suggested, "Can you take the lid off?"
>
> Sandy inspected the round knob on top and said, "Da ball."
>
> "Da ball, yeah," his mother confirmed. "Pull the lid," she encouraged, and demonstrated pulling on the knob. "Can you pull?" Sandy put his hand on hers, and they pulled the lid off together triumphantly. "What's inside?" asked his mother, and took the peewee out. "Who is that?"
>
> Sandy reached for the lid, and mother provided running commentary. "OK you put the lid back on." And when Sandy exclaimed "Oh!" his mother repeated "Oh!" after him. When Sandy lost interest, his mother asked with mock disappointment, "Oh, you don't want to play anymore?" and suggested, "We could make him play peekaboo."
>
> When Sandy took the peewee out, she asked, "Where did she go?" and sang, "There, she's all gone," as she covered the peewee with her hands, "Aaall gone." (Rogoff et al., 1993, p. 81)

---

> DHOL-KI-PATTI, INDIA: *An 18-month-old girl and her mother, playing with a jumping jack.*
>
> Roopa was not holding the top and bottom strings taut enough to cause the jumping jack to jump, so her mother took Roopa's hand in her own, grasped the bottom string with both hands, and pulled on the string twice, saying, "Pull here,

> pull here," as she demonstrated. She then released her hold of Roopa's hand to enable Roopa to do it on her own.
>
> But the jumping jack fell to the ground because Roopa was not holding it tight. The mother, quick to help, lifted the jumping jack as Roopa reached for it. Twice again, she pulled on the bottom string with her left hand, repeating, "Pull it here." Then she released her hold, letting Roopa take the object. She held her hands close to (but not touching) Roopa's, ready to help if necessary. (Rogoff et al., 1993, p. 114)

Although toddlers and caregivers in all communities interacted in ways permitting all participants to develop an understanding of the task at hand, there were important differences between the middle-class and more traditional communities. As illustrated in these examples, parents in Salt Lake City (and the Turkish town) placed a far greater emphasis on verbal than on nonverbal instruction, with the adults providing a good deal of structure to foster children's involvement in learning, including praise and other techniques to motivate their charges. By contrast, parents in the Mayan and Indian villages used more explicit *nonverbal* communication and only occasionally instructed their children in a particular task. In these communities, children are around adults most of the day, and they can observe competent adult behavior and interact with adults while they perform the important tasks of their society. Rogoff and her colleagues concluded that children's observation skills are more important and better developed in traditional than in middle-class communities, with children in the traditional communities being better at learning by emulating adult behavior.

Rogoff's findings make it clear that there is not one single path to becoming an effective member of society and that different forms of guided participation are likely to be used depending on the requirements a culture places upon adults and children. One form is not necessarily better than another. It depends on how a competent adult in a society is expected to behave and on what skills a competent child is expected to acquire.

## "Playing" in the Zone of Proximal Development

Another important behavior that is often guided by older, more expert associates is children's pretend, or symbolic, play. Investigators have found that young children are more likely to engage in symbolic play when they are playing with someone else rather than alone, and that mothers in particular bring out high levels of symbolic play in their children (Bornstein et al., 1996; Youngblade & Dunn, 1995). Close examination of play episodes between mothers and their 21-month-old toddlers reveal that many mothers adjust their level of play to that of their child. What's more, mothers who know the most about the development of play provide the most challenging play interactions by adjusting their own playful behavior to a level just beyond the child's own. Consistent with Vygotsky's idea of a zone of proximal development and Rogoff's idea of guided participation, young children who interact with a more skilled partner who structures the situation appropriately advance in their skills faster than those who lack that support (Damast, Tamis-LeMonda, & Bornstein, 1996).

Similar mother–child play patterns are found across cultures, attesting to the universality of play development, but there are also differences between cultures. For example, Chinese children are more likely to engage in pretend play with their caregivers than with other children, whereas the reverse is true for Irish American children (Haight et al., 1999). In other research, Argentine mothers were more likely than American mothers to involve their 20-month-old children in symbolic play, whereas the opposite pattern was found for exploratory play (Bornstein et al., 1999).

Why might it be important to facilitate symbolic play, and what might the consequences for cognitive development be of different play styles in different cultures? Children learn about "people, objects, and actions" through symbolic play, and research indicates that such play might be related to other aspects of cognitive development. Researchers have found a relationship between the amount of cooperative social play preschoolers engage in (often with a sibling or parent) and later understanding of other peoples' feelings and beliefs (Astington & Jenkins, 1995; Youngblade & Dunn, 1995). Indeed, an understanding that other people have thoughts, feelings, and beliefs other than one's own reflects a *theory of mind,* discussed earlier in this chapter. Developing an advanced theory of mind is necessary if children are to succeed in any society, and it appears that the guided participation of parents, siblings, and other more expert partners during symbolic play contributes to this development.

It is easy to think of cognitive development as something that "just happens" exactly the same way for children worldwide. After all, evolution has provided all humans with a uniquely human nervous system. Yet intelligence is also rooted in the environment, particularly in the culture. Understanding how cultural beliefs and technological tools influence cognitive development through child-rearing practices helps us better comprehend the process of development and our role as guides in fostering that process.

## Implications for Education

Vygotsky's theory has some rather obvious implications for education. Like Piaget, Vygotsky stressed active rather than passive learning and took great care to assess what the learner already knew, thereby estimating what he was capable of learning. The major difference in approaches concerns the role of the instructor. Whereas students in Piaget's classroom would spend more time in independent, discovery-based activities, teachers in Vygotsky's classroom would favor guided participations in which they structure the learning activity, provide helpful hints or instructions that they carefully tailor to the child's current abilities, and then monitor the learner's progress, gradually turning over more of the mental activity to their pupils. Teachers may also arrange cooperative learning exercises in which students are encouraged to assist each other; the idea here is that the less competent members of the team are likely to benefit from the instruction they receive from their more skillful peers, who also benefit by playing the role of teacher (Palinscar, Brown, & Campione, 1993).

Is there any evidence that Vygotsky's collaborative-learning approach might be a particularly effective educational strategy? Consider what Lisa Freund (1990) found when she had 3- to 5-year-olds help a puppet decide which furnishings (e.g., sofas, beds, bathtubs, and stoves) should be placed in each of six rooms of a dollhouse that the puppet was moving into. First, children were tested to determine what they already knew about proper furniture placement. Then each child worked at a similar task, either alone (as might be the case in Piaget's discovery-based classroom) or with his or her mother (Vygotsky's guided learning). Then to assess what they had learned, children performed a final, rather complex furniture-sorting task. The results were clear: Children who had sorted furniture with help from their mothers showed dramatic improvements in sorting ability, whereas those who had practiced on their own showed little improvement at all, even though they had received some corrective feedback from the experimenter.

Similar advances in problem-solving skills have been reported when children collaborate with peers, as opposed to working alone (Azmitia, 1992; Johnson & Johnson, 1987), and the youngsters who gain the most from these collaborations are those who were initially less competent than their partners (Tudge, 1992). David Johnson and Roger Johnson (1987) conducted an analysis of 378 studies that compared achievement of people working alone versus cooperatively and found that cooperative learning resulted in superior performance in more than half of the studies; in contrast, working alone resulted in improved performance in fewer than 10 percent of the studies.

There appear to be at least three reasons why cooperative learning is effective (Johnson & Johnson, 1989). First, children are often more motivated when working problems together. Second, cooperative learning requires children to explain their ideas to one another and to resolve conflicts. These activities help young collaborators to examine their own ideas more closely and to become better at articulating them so that they can be understood. Finally, children are more likely to use high-quality cognitive strategies while working together—strategies that often lead to ideas and solutions that no one in the group would likely have generated alone.

As with other aspects of sociocultural theory, the effectiveness of collaborative learning varies by culture. American children, accustomed to competitive "do your own work" classrooms, sometimes find it difficult to adjust to the shared decision making found in cooperative learning (see Rogoff, 1998), although they get better at cooperative decision making with practice (Socha & Socha, 1994). As the structure of schools changes to support peer collaboration, with teachers' roles being those of active participants in the children's learning experiences and not simply directors of it, the benefits of cooperative learning are sure to increase (Rogoff, 1998).

## The Role of Language in Cognitive Development

From Vygotsky's viewpoint, language plays two critical roles in cognitive development, by (1) serving as the primary vehicle through which adults pass culturally valued modes of thinking and problem solving to their children, and (2) eventually becoming one of the more powerful "tools" of intellectual adaptation in its own right. As it turns out, Vygotsky's perspective on language and thought contrasts sharply with that of Piaget.

### Piaget's Theory of Language and Thought

As Piaget (1926) recorded the chatterings of preschool children, he noticed that they often talked to themselves as they went about their daily activities, almost as if they were play-by-play announcers ("Put the big piece in the corner. Not that one, the pink one"). Indeed, two preschool children playing close to each other sometimes carried on their own separate monologues rather than truly conversing, something Piaget referred to as *collective monologues.* Piaget called these self-directed utterances **egocentric speech**—talk not addressed to anyone in particular and not adapted in any meaningful way so that a companion might understand it.

**egocentric speech**
Piaget's term for the subset of a young child's utterances that are nonsocial—that is, neither directed to others nor expressed in ways that listeners might understand.

What part might such speech play in a child's cognitive development? Very little, according to Piaget, who saw egocentric speech as merely reflecting the child's ongoing mental activity. However, he did observe that speech becomes progressively more social and less egocentric toward the end of the preoperational stage, which he attributed to children's increasing ability to assume the perspective of others and thus adapt their speech so that listeners might understand. So here was another example of how cognitive development (a decline in egocentrism) was said to promote language development (a shift from egocentric to communicative speech), rather than the other way around.

### Vygotsky's Theory of Language and Thought

Vygotsky agreed with Piaget that the child's earliest thinking is prelinguistic and that early language often reflects what the child already knows. However, he argued that thought and language eventually merge and that many of the nonsocial utterances that Piaget called "egocentric" actually illustrate the transition from prelinguistic to verbal reasoning.

Vygotsky noticed that preschool children's self-directed monologues occur more often in some contexts than in others, specifically as they attempt to solve problems or achieve important goals (such as in Figure 7.10), and that this nonsocial speech increased substantially whenever these young problem solvers encountered obstacles in pursuing their objectives. He concluded that nonsocial speech is not egocentric but communicative; it is a "speech for self," or **private speech,** that helps young children to plan strategies and regulate their behavior so that they are more likely to accomplish their goals. Viewed through this theoretical lens, language may thus play a critical role in cognitive development by making children more organized and efficient problem solvers. Vygotsky also observed

**private speech**
Vygotsky's term for the subset of a child's verbal utterances that serve a self-communicative function and guide the child's thinking.

that private speech becomes more abbreviated with age, progressing from the whole phrases that 4-year-olds produce, to single words, to simple lip movements that are more common among 7- to 9-year-olds. His view was that private speech never completely disappears; it serves as a **cognitive self-guidance system** and then goes "underground," becoming silent, or *inner speech*—the covert verbal thought that we use to organize and regulate our everyday activities.

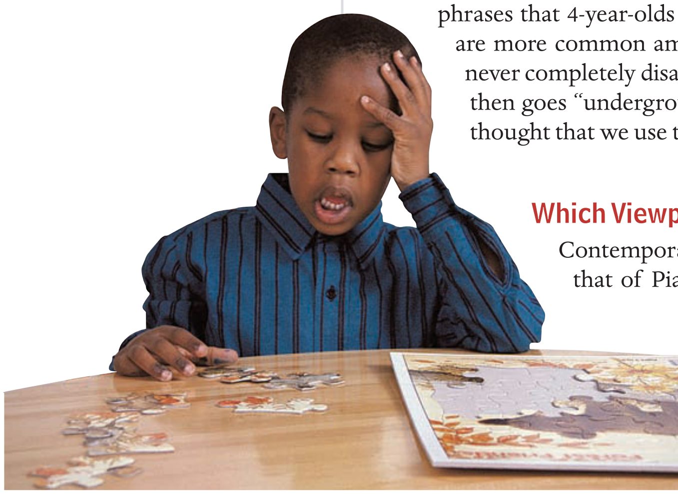

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**Figure 7.10** According to Vygotsky, private speech is an important tool used by preschool and young grade-school children to plan and regulate their problem-solving activities.

### Which Viewpoint Should We Endorse?

Contemporary research sides squarely with Vygotsky's theory over that of Piaget (see Berk, 1992). It seems that the *social speech* that occurs during guided learning episodes (e.g., the conversation between Tanya and her father as they worked jointly on a puzzle) gives rise to much of the *private speech* (Tanya's talking aloud as she tries to work the puzzle on her own) that preschool children display. Also consistent with Vygotsky's claims, children rely more heavily on private speech when facing difficult rather than easy tasks and deciding how to proceed after making errors (Berk, 1992), and their performance often improves after using self-instruction (Berk & Spuhl, 1995). Furthermore, it is the brighter preschool children who rely most heavily on private speech, a finding that links this "self-talk" to cognitive *competence* rather than the cognitive immaturity (egocentrism) that Piaget claimed it represents (Berk, 1992). Finally, private speech does eventually go underground, progressing from words and phrases to whispers and mutterings, to inner speech (Bivens & Berk, 1990), although it persists on problem-solving tasks into adolescence, even though such speech is not associated with improved task performance (Winsler, 2003).

**cognitive self-guidance system** in Vygotsky's theory, the use of private speech to guide problem-solving behavior.

So private speech does appear to be an important tool in intellectual adaptation—a means by which children plan and regulate their mental activities to solve problems and make new discoveries.

## Vygotsky in Perspective: Summary and Evaluation

Vygotsky's sociocultural theory offers a new lens through which to view cognitive development by stressing the importance of specific social processes that Piaget (and others) largely overlooked. According to Vygotsky, children's minds develop as they (1) take part in cooperative dialogues with skilled partners on tasks that are within their zones of proximal development, and (2) incorporate what skillful tutors say to them into what they say to themselves. As social speech is translated into private speech and then inner speech, the culture's preferred methods of thinking and problem solving—or tools of intellectual adaptation—work their way from the language of competent tutors into the child's own thinking.

Unlike Piaget's theory which stressed *universal* sequences of cognitive growth, Vygotsky's theory leads us to expect wide variations in cognitive development across cultures that reflect differences in children's cultural experiences. So children in Western cultures acquire context-independent memory and reasoning skills that prepare them for highly structured Western classrooms, whereas children of Australian aborigines and African Bushmen hunters acquire elaborate spatial reasoning skills that prepare them to successfully track the prey on which their lives depend. Neither set of cognitive capacities is necessarily more "advanced" than the other; instead, they represent alternative forms of reasoning, or "tools of adaptation," that have evolved because they enable people to adapt successfully to cultural values and traditions (Rogoff, 1998; Vygotsky, 1978).

As we see in Table 7.5, Vygotsky's theory challenges many of Piaget's most basic assumptions and has attracted a lot of attention lately among Western developmentalists, whose own research efforts tend to support his ideas. Yet many of Vygotsky's writings are only now being translated from Russian into other languages (Wertsch & Tulviste, 1992), and his theory has not received the intense scrutiny that Piaget's has. Nevertheless, at least some of his ideas have already been challenged. Barbara Rogoff (1990, 1998), for example, argues that guided participations that rely heavily on the kinds of verbal instruction that Vygotsky emphasized may be less adaptive in some cultures or less useful for some forms of learning than for others. A young child learning to stalk prey in Australia's outback or to plant, care for, and harvest rice in Southeast Asia may profit more from observation and practice than from verbal instruction and encouragement. Other investigators are finding that collaborative problem solving among peers does not always benefit the collaborators and may actually undermine task performance if the more competent collaborator is not very confident about what he knows or if he fails to adapt his instruction to a partner's level of understanding (Levin & Druyan, 1993; Tudge, 1992). But despite whatever criticism his theory may generate in the years ahead, Vygotsky has provided a valuable service by reminding us that cognitive growth, like all other aspects of development, is best understood when studied in the cultural and social contexts in which it occurs.

The reader may get the impression that, compared to Piaget, Vygotsky got off pretty easy in the "criticism" department. As we mentioned earlier, this is due in part to the fact that Vygotsky's theory and the sociocultural approach in general are relatively new to Western psychologists and have thus received less scrutiny than Piaget's theory. But there is another reason that Vygotsky's approach has received less criticism than Piaget's. Unlike Piaget theory's, which generated many testable hypotheses that could be disproved, Vygotsky's approach may not truly deserve the label "theory," but better be thought of as a general perspective used to guide research and interpret children's intellectual development. A sociocultural perspective tells us that context matters—that the environments in which children grow up will influence how they think and what they think about. This is considered a general truism today, much as Piaget's view of the child as an intellectually active being is viewed as "a known fact." And although researchers from a sociocultural perspective can and do formulate specific testable hypotheses, disconfirmation of these hypotheses rarely implies disconfirmation of the underlying theory. Cultural context matters, but how it matters is to be discovered. In other words, Vygotsky's sociocultural perspective does not provide as many specific hypotheses to test as did Piaget's theory, making its refutation difficult, if not impossible.

**TABLE 7.5** Comparing Vygotsky's and Piaget's Theories of Cognitive Development

| Vygotsky's sociocultural theory | Piaget's cognitive developmental theory |
|---|---|
| 1. Cognitive development varies across cultures. | Cognitive development is mostly universal across cultures. |
| 2. Cognitive growth stems from social interactions (from guided learning within the zone of proximal development as children and their partners "co-construct" knowledge). | Cognitive development stems largely from independent explorations in which children construct knowledge on their own. |
| 3. Social processes become individual-psychological processes (e.g., social speech becomes private speech and, eventually, inner speech). | Individual (egocentric) processes become social processes (e.g., egocentric speech is adapted in ways to allow more effective communication). |
| 4. Adults are especially important as change agents (by transmitting their culture's tools of intellectual adaptation that children internalize). | Peers are especially important as change agents (because peer contacts promote social perspective-taking, a topic we will explore in detail in Chapter 12). |

We do not mean to lessen the contribution of Vygotsky and his followers. We believe that such a perspective is inherently correct—that children's intellects are influenced by the culture in which they develop. However, this perspective does not eliminate a need to look at developmental universals (such as Piaget proposed) or the role of biology in development. Vygotsky himself was clearly aware of this, listing sociohistorical develop-

## CONCEPT CHECK 7.4 Understanding Vygotsky's Sociocultural Theory

Check your understanding of Vygotsky's concepts and theory by answering the following questions. Answers appear in the Appendix.

**Multiple Choice:** Select the best alternative for each question.

______ 1. Vygotsky discussed four perspectives of development that should be considered in any theory of intellectual development. Which one of the following is *not* one of the perspectives proposed by Vygotsky?
   a. microgenetic development
   b. phylogenetic development
   c. sociocultural development
   d. prenatal development

______ 2. Miller and his colleagues observed that Chinese children learn to count to 20 before American children. They attribute this difference to differences in
   a. the number words used in Chinese and English
   b. the amount of instruction in counting that Chinese and American children receive
   c. the amount of scaffolding that Chinese and American children receive
   d. genetic dispositions, with Chinese children being genetically disposed to better arithmetic abilities than most American children

______ 3. Five-year-old Erin sits on the floor with her mother as they play a board game. Erin rolls a 2 and a 3 on the dice. She picks up her game piece, a small toy dog, moving it along the board as she says, "I move my doggie one, two . . . then I move my doggie one, two, three." Erin's behavior reflects
   a. Piaget's perspective, that private speech reflects the child's egocentricity of thought and represents the child's unsuccessful attempt at social speech
   b. Piaget's perspective, that private speech is a necessary precursor to social speech in that it serves as preparation (practice) for successful social communication
   c. Vygotsky's perspective, that private speech serves as a cognitive self-guidance system for young children
   d. both Piaget's and Vygotsky's perspectives, that private speech is presymbolic and serves only to initiate or inhibit overt motor actions and has no influence on cognition

**Matching:** Match the following concepts with their definitions.

a. tools of intellectual adaptation
b. zone of proximal development
c. scaffolding
d. ontogenetic development
e. microgenetic development
f. guided participation

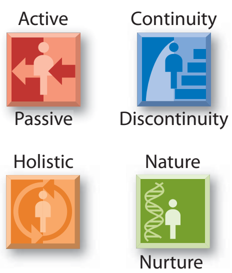
4. ________ Vygotsky's term for the range of tasks that are too complex to be mastered alone but can be accomplished with guidance and encouragement from a more skillful partner.
5. ________ Development of the individual over his or her lifetime.
6. ________ Adult-child interactions in which children's cognitions and modes of thinking are shaped as they participate with or observe adults engaged in culturally relevant activities.
7. ________ Changes that occur over relatively brief periods of time, in seconds, minutes, or days, as opposed to larger-scale changes, as conventionally studied in ontogenetic development.
8. ________ Process by which an expert, when instructing a novice, responds contingently to the novice's behavior in a learning situation, so that the novice gradually increases his or her understanding of a problem.
9. ________ Vygotsky's term for methods of thinking and problem-solving strategies that children internalize from their interactions with more competent members of society.

**Essays:** Provide a detailed answer to the following questions.

10. Discuss the concepts of the zone of proximal development and apprenticeship in thinking as they relate to cognitive development.
11. How can Vygotsky's sociocultural theory be applied to education?

ment as only one of four levels of analysis that must be used to evaluate behavior (the others being microgenetic, ontogenetic, and phylogenetic development). Cognitive development (like development in general) results from the continuous and bidirectional interaction between a child and his or her environment over time at all levels of organization, beginning at conception and the genetic level and progressing through the cultural level. Vygotsky's approach provides a valuable perspective to this view of development, but, like Piaget's theory, by itself it is not the whole answer.

## Applying Developmental Themes to Piaget's and Vygotsky's Theories




Now that we've learned about the cognitive developmental theories of Piaget and Vygotsky, let's consider how these theories address our four developmental themes: the active child, nature and nurture interactions, quantitative and qualitative developmental changes, and the holistic nature of development. Consider first the theme of the active child. This theme is particularly important in Piaget's theory. In fact, it was Piaget who brought to developmental psychologists' attention the fact that infants and children are active, hands-on creatures—in many ways the sculptors of their own development. Unlike the views that were fashionable in psychology in the early decades of the 20th century, Piaget did not see the child as molded by environmental pressures and his or her parents, nor as the inevitable product of the unfolding of a genetic plan. Rather, Piaget viewed the child as playing a primary role in development. It is because of Piaget that we can no longer give serious consideration to either the environmentalist view of children shaped by external forces or the maturationalist view of children as products of their heredity. Vygotsky also advocated the idea of an active child, although his emphasis on the role that significant others in a child's world play in cognitive development contrasts sharply with Piaget's views.

Piaget's and Vygotsky's theories also emphasize the interaction of nature and nurture in development. Piaget's "active child" follows a species-typical course of cognitive development, influenced by the common biological inheritance shared by all human beings. But this course is also influenced by the child's surroundings. The experiences children have as they explore their environment and their social and educational worlds especially affect the rate of their development.

Vygotsky placed greater weight on the influence that adults and other cultural agents have on children's thinking, believing that nurture plays a greater role in cognitive development than that proposed by Piaget. But in addition to emphasizing the sociocultural influences on children's development, Vygotsky also made it clear that one must consider the evolutionary past in explaining contemporary behavior and development. This focus on the ancient origins of behavior illustrates Vygotsky's recognition that one cannot account for children's cognitive development by sociocultural factors alone; one must also take "human nature" into consideration.

With respect to the issue of qualitative versus quantitative changes, Piaget's theory heavily emphasizes qualitative changes. For Piaget, children's thinking is different in type or kind at each major stage in development, with smaller changes within a stage also occurring in a step-by-step fashion (recall Piaget's description of sensorimotor development). In fact, this is one area for which Piaget has been criticized. Although Piaget's account of children's thinking is valuable, it tends to overstate how stagelike cognitive development truly is. Contemporary developmentalists generally believe that cognitive development consists of both qualitative and quantitative changes. Piaget's description of qualitative changes is generally accurate, but it is also limited because he basically ignored more quantitative types of changes. Vygotsky's theory was less concerned with the qualitative or quantitative nature of developmental changes and focused more on the source of the change (mainly from the social environment). Nevertheless, it is fair to say that Vygotsky was more apt to see changes as less stagelike than Piaget.

In this chapter devoted to cognitive development, it is not surprising that there has been less emphasis on the holistic nature of development. However, both Piaget's and Vygotsky's theories were intended to apply to more than children's thinking. Piaget believed that children's cognitive development influenced their social and emotional development. We'll see in later chapters that Piaget's theory has been applied to issues far removed from intelligence, including gender identification and moral development. And Vygotsky's emphasis on the sociocultural influences on children's thinking makes it clear that cognitive development cannot be viewed in isolation. The social environment, starting with the family, extending to peers and eventually to the entire culture, is the context in which cognition develops.

## SUMMARY

- This and the following two chapters are devoted to an examination of **cognition,** the mental processes by which humans acquire and use knowledge, and to **cognitive development.**

### Piaget's Theory of Cognitive Development

- Piaget's theory of **genetic epistemology** (cognitive development) defines **intelligence** as a basic life function that helps the child to adapt to the environment.
- Piaget described children as active explorers who construct **schemes** to establish **cognitive equilibrium** between their thinking and their experiences.
- Schemes are **constructed** and modified through the processes of **organization** and **adaptation.**
- Adaptation consists of two complementary activities: **assimilation** (attempts to fit new experiences to existing schemes) and **accommodation** (modifying existing schemes in response to new experiences).
- Cognitive growth results as assimilations stimulate accommodations, which induce the reorganization of schemes, which permit further assimilations, and so on.

### Piaget's Stages of Cognitive Development

- Piaget claimed that intellectual growth proceeds through an **invariant sequence** of stages that can be summarized as follows:
  - **Sensorimotor period** (age 0–2). From basic **reflex activity,** infants over the first 2 years come to know and understand objects and events by acting on them. Subsequent substages involve the construction of schemes via **primary** and **secondary circular reactions,** the **coordination of secondary circular reactions** (which are the first signs of goal-directed behavior), and **tertiary circular reactions.** These behavioral schemes are eventually internalized to form mental symbols that support such achievements as **inner experimentation.**
  - Although Piaget's general sequences of sensorimotor development have been confirmed, recent evidence indicates that Piaget's explanation of **A-not-B errors** was incorrect and that infants achieve such milestones as **deferred imitation** and **object permanence** earlier than Piaget had thought.
- Alternative approaches, such as **neo-nativism** and **theory theories,** assume, contrary to Piaget's theory, that infants possess innate knowledge that directs their early development.
- **Preoperational period** (roughly 2 to 7 years). Symbolic reasoning increases dramatically as children in the **preoperational period** rely on the **symbolic function** and display **representational insight.** Symbolism gradually becomes more sophisticated as children acquire a capacity for **dual representation** (or **dual encoding**).
- Piaget described the thinking of 2- to 7-year-olds as **animistic** and **egocentric,** characterized by **centration.**
- Although preoperational children often fail to make **appearance/reality distinctions,** recent research indicates that they are much more logical and less egocentric when thinking about familiar issues or about simplified versions of Piaget's tests.
- Procedures such as **identity training** enable preoperational children to solve **conservation** tasks, indicating that preschool children possess an early capacity for logical reasoning that Piaget overlooked.
- During the preoperational period, children acquire **belief-desire reasoning,** a reflection of **theory of mind (TOM),** in which children come to understand that their behavior and the behavior of others is based on what they know or believe, and what they want or desire. TOM is usually assessed using **false-belief tasks.**
- Children's ability to perform TOM tasks is influenced by the development of executive functions, such as inhibition, and by social factors, such as interacting with siblings.
- **Concrete operations** (age 7 to 11 years). During concrete operations, children acquire such cognitive operations as **decentration** and **reversibility**, which enable them to think logically and systematically about tangible objects, events, and experiences.
- Becoming operational in their thinking permits children to conserve, **mentally seriate,** and display **transitivity.** However, concrete operators can only apply their logic to real or tangible aspects of experience and cannot reason abstractly.

- Piaget noted that children's cognitive accomplishments were often uneven, with children being unable to solve certain problems even though they could solve similar problems requiring the same mental operations, a phenomenon he referred to as **horizontal décalage**.
- **Formal operations** (age 11 or 12 and beyond). Formal-operational reasoning is rational, abstract, and involves both **hypothetico-deductive** and **inductive reasoning.**
- Attainment of formal operations may sometimes contribute to confusion and idealism. Formal operations may elude those adolescents and adults who have not been exposed to educational experiences that foster this reasoning. And even at this highest level, performance is uneven: Adults are most likely to display formal operations in areas of special interest or expertise.

## An Evaluation of Piaget's Theory

- Piaget founded the field of cognitive development, discovered many important principles about developing children, and influenced thousands of researchers in psychology and related fields.
- Although Piaget seems to have adequately described general sequences of intellectual development, his tendency to infer underlying competencies from intellectual performances often led him to underestimate children's cognitive capabilities.
- Some investigators have challenged Piaget's assumption that development occurs in stages, whereas others have criticized his theory for failing to specify how children progress from one "stage" of intellect to the next, and for underestimating social and cultural influences on intellectual development.

## Vygotsky's Sociocultural Perspective

- Vygotsky's **sociocultural theory** emphasizes social and cultural influences on intellectual growth.
- He proposed that we should evaluate development from the perspective of four interrelated levels in interaction with children's environments—**microgenetic, ontogenetic, phylogenetic,** and **sociohistorical.**
- Each culture transmits beliefs, values, and preferred methods of thinking or problem solving—its **tools of intellectual adaptation**—to each successive generation. Thus, culture teaches children what to think and how to go about it.
- Children acquire cultural beliefs, values, and problem-solving strategies in the context of collaborative dialogues with more skillful partners as they gradually internalize their tutor's instructions to master tasks within their **zone of proximal development.**
- Learning occurs best when more skillful associates properly **scaffold** their intervention.
- Much of what children acquire from more skillful associates occurs through **guided participation**—a process that may be highly **context-independent** (in Western cultures) or may occur in the context of day-to-day activities (as is most common in traditional cultures).
- Unlike Piaget, who argued that children's self-talk, or **egocentric speech,** plays little if any role in constructing new knowledge, Vygotsky claimed that a child's **private speech** becomes a **cognitive self-guidance system** that regulates problem-solving activities and is eventually internalized to become covert, verbal thought. Recent research favors Vygotsky's position over Piaget's, suggesting that language plays a most important role in children's intellectual development.
- Vygotsky provided a valuable service by reminding us that cognitive growth is best understood when studied in the social and cultural contexts in which it occurs. Although this theory has fared well to date, it has yet to receive the intense scrutiny that Piaget's theory has.

# CHAPTER 7 PRACTICE QUIZ

**Multiple Choice:** Check your understanding of Piaget's and Vygotsky's theories of cognitive development by selecting the best choice for each question. Answers appear in the Appendix.

**1.** Before learning about Piaget's theory, you understood the terms "assimilation" and "accommodation" as they are used in conversation. After learning about Piaget's theory, you understood these terms as processes of intellectual development. This new understanding is most specifically known as
   **a.** organization
   **b.** assimilation
   **c.** accommodation
   **d.** epistemology

**2.** A most basic assumption of Piaget's theory is that children progress through developmental stages ________.
   **a.** in an invariant sequence
   **b.** at specific ages
   **c.** dependent upon their sociocultural experiences
   **d.** as they acquire increasingly complex understandings of imitation

**3.** Developmental research has confirmed the basic sequence of development that Piaget proposed for the sensorimotor period, but some of the milestones are reached *earlier* than he proposed, including all of the following *except*

**a.** A-not-B errors
**b.** deferred imitation
**c.** primary circular reactions
**d.** object permanence

**4.** Which of the following competencies is acquired in Piaget's *preoperational stage*?

**a.** symbolic function
**b.** decentration
**c.** reversibility
**d.** transitivity

**5.** Piaget noted that children's cognitive competencies were often uneven, with children being unable to solve certain problems even though they could solve similar problems requiring the same mental operations. He referred to this phenomenon as

**a.** genetic epistemology
**b.** decentration of operations
**c.** mental seriation
**d.** horizontal decalage

**6.** Tamara is beginning to use hypothetico-deductive reasoning and inductive reasoning in her thinking. She is becoming quite idealistic in her thinking about world politics and even her parents' behavior. In addition, she imagines that other people are as interested in her thoughts and behaviors as she is. Tamara is most likely in the ________ stage of development.

**a.** sensorimotor
**b.** preoperational
**c.** concrete-operational
**d.** formal-operational

**7.** Developmental psychologists criticize Piaget's cognitive developmental theory for all of the following reasons *except*

**a.** the assumption that development occurs in stages
**b.** failing to adequately describe different stages of cognitive development
**c.** failing to specify how children progress from one stage of development to the next
**d.** underestimating social and cultural influences on cognitive development

**8.** Vygotsky proposed that we should evaluate development from the perspective of four interrelated levels in interaction with children's environments. These four levels include all of the following *except*

**a.** microgenetic
**b.** ontogenetic
**c.** phylogenetic
**d.** sociogenetic

**9.** Text messaging to communicate using cell phones is so common in today's generation of teenagers and young adults that it has become what Vygotsky would call a

**a.** zone of proximal development
**b.** tool of intellectual adaptation
**c.** scaffold
**d.** guide of participation

**10.** ________ argued that children's self-talk was a form of egocentric speech. ________ argued that children's self-talk was a cognitive self-guidance system that regulates problem-solving activities.

**a.** Piaget; Vygotsky
**b.** Piaget; Piaget
**c.** Vygotsky; Piaget
**d.** Vygotsky; Vygotsky

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intelligence 250
cognitive equilibrium 250
constructivist 250
scheme 250
organization 251
adaptation 251
assimilation 251
accommodation 251
invariant developmental sequence 253
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reflex activity 254
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secondary circular reactions 254
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