As you read this chapter, look for the questions that ask you to think about what you’re learning from Diana’s perspective.

Last week, Diana took her 10-month-old daughter Jamie to play in the neighborhood park. As the birds chirped, Jamie’s eyes seemed to search everywhere for the source of the sound. As some children ran by, calling loudly to one another, Jamie looked and smiled at them, reaching out to touch them as they waved and said hello to her. Like most babies, Jamie seems eager to touch things, experiment, and experience the world. A friend told Diana that babies of this age don’t even realize that something continues to exist if they can’t see or touch it. Just as her friend predicted, it worked when Diana distracted Jamie from playing with the pinecones scattered on the ground at the park by hiding them under their blanket. But in other ways, Jamie seems very skilled. Even though she hasn’t said any “real” words yet, Diana has no trouble understanding what Jamie needs, when she’s happy, and when she wants another bit of her cereal.

Diana wonders what babies this age understand about their world. Do infants connect the sounds they hear with what they see? Do toys that move and make sounds encourage development, or does all the clamor just confuse the young baby? How do babies come to realize that objects exist whether one can see them or not? And why does it seem so easy for babies to communicate, even before they are able to produce any words? Most important, Diana wonders what she can do to support her daughter’s cognitive development.
Like Diana, you might have wondered what infants really understand about the world. How do babies put together the information from their senses and think about the things they experience? And how do they communicate their needs and thoughts to others? As you will learn in this chapter, even young infants have surprisingly well-developed capabilities in some areas (such as perceptual skills), and they are able to quickly and easily develop other complex skills (such as understanding the permanence of objects and using language). As you might recall from Chapter 1, cognitive refers to mental processes such as perceiving, thinking, remembering, solving problems, and communicating with language. While sensation is the physical process of detecting information about a stimulus in the environment through the five senses and transmitting that information to the brain, perception is the cognitive process of organizing, coordinating, and interpreting that information. Perception is an important part of cognition; it enables people to use sensory input to think, solve problems, and function in their environments. In this chapter, we will describe the perceptual, cognitive, and language abilities of infants and toddlers, and we will introduce you to some of the major theories that explain these areas of development.

Perceptual Development

As you saw in Chapter 4, the human nervous system is relatively immature at the time of birth. Most of the synapses in the brain have not yet formed, and many of the neurons have not yet acquired the myelin sheath that insulates the axons and speeds transmission of neural impulses. Newborns can move their eyes to locate and track objects in their surroundings, but until they gain better control of the intricate muscles in and around their eyes, infants have trouble focusing on a target and coordinating the images coming from each eye. It is no wonder that John Locke and other early philosophers claimed that the newborn’s mind was a “blank slate.” According to this view, infants need to learn by trial and error to use their senses to form meaningful perceptions. One of the founders of psychology, William James (1890/1950), claimed that the mental experience of the infant was “one great blooming, buzzing confusion” (p. 488).

Do infants really begin life this helpless? Clearly, they do not. As we mentioned in Chapter 4, newborns come equipped with an array of sensory capabilities. In the 1950s, the emergence of reliable nonverbal techniques for testing infants opened the floodgates for research. Since then, scientists have learned an impressive amount about the perceptual capabilities of infants. It is apparent that, far from experiencing a “blooming, buzzing confusion,” even young infants have a tremendous ability to organize and use sensory information in a meaningful way.

As you study this section, ask yourself these questions:

- How do researchers know what infants can see and hear?
- What kinds of information do infants prefer?
- Do infants take a long time to learn to coordinate information from different senses, or do they show this capability soon after birth?
Robert Fantz and the Early Work in Testing Visual Preferences

As early as 1951, Robert Fantz was conducting experiments with newly hatched chickens and infant chimpanzees to determine whether perception of different forms (e.g., distinguishing squares from circles) was innate or learned (see Fantz, 1956, 1961). To study human infants, Fantz and his associates used a looking chamber (Figure 5.1). The researchers placed infants on the sliding tray at the bottom. A researcher, standing over the chamber, could slide patterns on cards through slots in the top of the chamber. Peering through a hole, the researcher could also observe the infants’ eyes and use electronic devices to record the time infants spent fixating on (i.e., looking at) each pattern. “If an infant consistently turns its gaze toward some forms more often than toward others, it must be able to perceive form” (Fantz, 1961, p. 67). This became the logic of the preferential-looking technique, a simple but powerful procedure that many researchers have since used to investigate infant perception.

Figure 5.2 shows the results from one of Fantz’s early experiments. Newborns who were only 2 to 5 days old looked more at a drawing of a face than at a bull’s-eye or newsprint, but they preferred any of these detailed patterns over plain colored disks (Fantz, 1963). Infants spent approximately equal time looking at the colored disks, especially the yellow and white disks, so the experiment didn’t show whether the infants could distinguish between these colors. Using this preferential-looking technique, Fantz collected some of the first scientific data that demonstrated conclusively that human infants are able to perceive form and pattern. Hundreds of researchers, in laboratories all around the world, have followed with their own studies investigating the kinds of visual information human infants can detect and process. Researchers have adapted Fantz’s logic and procedures to assess perception in other senses as well.

Using Fantz’s preferential-looking technique and similar techniques, researchers have discovered that newborn babies prefer the following types of visual information (see Bjorklund, 1989, for a review):

- Moving stimuli
- Outer contours or edges
- Sharp color contrasts (e.g., where black meets white or where red meets white)
- Patterns with some complexity or detail (but not too complex)
- Symmetrical patterns
- Curved patterns
- Patterns that resemble the human face

Some of these preferences are evident in Figure 5.2. Notice that infants preferred the bull’s-eye over the plain disks, and they preferred the face most of all. Parents can use these preferences in shaping their babies’ environments. To capture the infant’s attention, crib mobiles, baby books, blocks, and other infant toys should feature sharp color...
contrasts, symmetrical patterns, curves, and even human face patterns. As infants explore these and other patterns, their sensory systems get the input they need to stimulate further growth and development.

One of the more intriguing findings is that infants tend to prefer patterns that resemble the human face. One group of researchers entered the delivery room when babies were born and showed newborns the patterns in Figure 5.3 (Goren, Sarty, & Wu, 1975). One at a time, in a random series, they placed the patterns about 6 to 10 inches in front of each newborn’s nose, then moved the patterns slowly toward the left or right. Although the newborns were only a few minutes old, they reliably turned their heads farther to follow the pattern that most resembled the human face. Because people in the delivery room were wearing surgical masks, the newborns had had no opportunity to see a real human face before the testing began. Some researchers speculate that at birth, babies are already equipped with an innate schema, or mental framework, for the structure of the human face. However, other researchers remind us that these newborns might not recognize the patterns as “faces” per se. Instead, they might be responding to particular features that happen to be contained in faces—left-right symmetry and more details in the top than bottom half, for example. It might not be until 3 to 5 months of age that infants begin recognizing perceptual cues specific to faces (such as the location of the eyes and the space between them) (Bhatt et al., 2005; Turati et al., 2002; Turati et al., 2005).

The “specialness” of the human face has received much attention in the research literature (Cohen & Cashon, 2006; Kellman & Arterberry, 2006). Even newborns are able to recognize individual faces, and one study found that 3-month-old girls looked longer at photographs of their own mothers’ faces than at photos of other adult females (Barrera & Maurer, 1981a; Turati et al., 2006). Interestingly, 3-month-old boys did not show the same pattern.

Beyond recognizing their mothers’ faces, when do you think infants begin to judge the physical attractiveness of faces? Would you believe that they do this by 2 months of age? In an intriguing study, Judith Langlois and her colleagues asked college students to rate the attractiveness of photos of female adults. Then they slide-projected the photos in pairs on a large screen in front of infants (Langlois et al., 1987). When an “attractive” photo was paired with an “unattractive” photo, 2-month-olds looked longer at the attractive
photo. Langlois and her colleagues (1987) concluded that “the tendency to detect and prefer certain faces over others is present very early in life, long before any significant exposure to contemporary standards, definitions, and stereotypes” (p. 367). If beauty is in the eye of the beholder, it’s there at a surprisingly early age!

Infant scanning of faces changes significantly from 1 to 2 months of age (Maurer & Salapatek, 1976). As Figure 5.4 shows, 1-month-olds tend to fixate more on the external features of faces (the chin and hairline), whereas 2-month-olds tend to focus on the internal features (especially the eyes and mouth). This change might help to explain why it is in the 2- to 3-month period that infants begin to show recognition of familiar faces (e.g., their mothers) and a preference for attractive faces: It’s the internal features that help us to recognize people the most.

Habituation–Dishabituation Research

Recall from Figure 5.2 that young infants preferred to look at the face over the newsprint and any kind of detail over plain colors but did not show a preference among the plain colored disks. Can infants see the differences among these colors? On the basis of this test alone, it’s not possible to know whether infants can visually discriminate between the colors. This is an important limitation of the preferential-looking technique: To show visual discrimination, infants not only must be able to see the difference between the stimuli, but also must have some reason to prefer one over the other. What if infants can see the difference but find both stimuli to be equally interesting?

To solve this problem, a more stringent test of visual discrimination involves the habituation–dishabituation technique. This technique capitalizes on infants’ tendency to look longer at novel (new) stimuli than at familiar (old) stimuli. As an example, consider the experiment conducted by Cohen, Gelber, and Lazar (1971). Imagine that you show a red circle to a 4-month-old infant for several seconds, and you record the amount of time the infant spent looking at the circle. Then you remove the circle, and then you show it again. Repeat this procedure, each time recording how long the infant looks at the circle. Plotting the looking times, you might notice a trend, as shown in Figure 5.5. That is, the infant’s interest in the stimulus has likely decreased across trials. The infant has shown habituation—the tendency to reduce a response to a stimulus that is presented repeatedly. Habituation indicates that the infant processed the stimulus and recognized it on its repeated appearances. Now look at what happens during the dishabituation trials in Figure 5.5. Here, the same infant sees a series of stimuli with familiar or novel forms and colors. Fixation time for the same familiar red circle remains low, continuing the trend shown in habituation trials. The infant continued to show habituation to the familiar color and form. But a change in color (to a green circle) or a change in form (to a red triangle) produces an increase in fixation time. Changing both color and form (to a green triangle) produces an even greater increase. These increases reflect dishabituation—the recovery or increase in response when a new stimulus replaces a familiar stimulus. Dishabituation indicates that the infant can see the difference between the novel familiar stimuli. In this case, the infant can obviously see the difference between colors (red versus green) and forms (circle versus triangle).

Notice that at the outset of the experiment, there was no reason for the infants to prefer green over red or triangle over circle but that habituating infants to “red” and “circle” induced such preferences. The habituation–dishabituation technique thus avoids one of the problems with the preferential-looking technique because it can...
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demonstrate visual discrimination even when there is no chance that infants might have an already established preference for one stimulus over another.

An important practical application of these methods of studying infant perception is their use to predict later cognitive skills, even IQ (Fagan, 2000; Kavšek, 2004). To read more about issues surrounding the use of these techniques to predict cognitive skills, read the Social Policy Perspective box entitled “Assessing Infant Intelligence: A Good Idea?”

Intermodal Perception: Putting It All Together

Although we have treated the different sensory systems separately so far, in reality, most experiences involve multiple senses. For example, as you walk down the sidewalk, you feel the breeze on your face, see the colors of the sky, hear the voices of people walking around you, and smell the food in restaurants you walk by. In short, you experience the world through combined or integrated sensory inputs, or what researchers refer to as intermodal perception.

Do human beings need to learn to combine sensory information into unified impressions? According to the constructivist view, they do. Jean Piaget (1952b), for example, believed that young infants are not aware that what they see is related to what they hear. He hypothesized that infants need to learn, through experience, to coordinate their sensory systems. (We will discuss Piaget’s constructivist theory of cognitive development in the next section.) At the other end of the spectrum, T. G. R. Bower (1974) speculated that infants have to learn to separate their sensory impressions. In the beginning, infants confuse their sensory impressions—they do not know whether they are seeing or hearing, tasting or smelling. Bower concluded that “the initial primitive unity [of the sensory systems] must go, leaving differentiated sensory systems in place of a unitary perceptual world” (p. 151). In a more moderate view, Eleanor Gibson pointed out that important features in the environment (she called them invariants) can be detected by multiple sensory systems (Gibson & Walker, 1984; Rose & Ruff, 1987). For example, you can see that a sidewalk is a solid surface (because its texture continues into the distance), and you can also feel its solidity beneath your feet. Similarly, infants can both smell and taste the sweetness of breast milk or formula and can both see and hear the movement of the rattle. Can infants...
Chapter 5. Cognitive Development in Infants and Toddlers

For decades, researchers, educators, and policymakers have tried to find reliable ways to predict intelligence from early childhood, with limited success. Although intelligence test scores change over time, they are reasonably stable starting at about age 5 years of age. But correlations of scores for younger children and infants have typically shown low relationships to later IQ scores. The habituation–dishabituation procedures that are used to study infant perception have shown promise in predicting cognitive skills later in childhood (Fagan, 2000; Kavšek, 2004; Neisser et al., 1996). Summary studies have found average correlations of about 0.45 between young infants’ degrees of dishabituation and the same children’s intelligence test scores at 1 to 8 years of age (McCall & Carriger, 1993). This correlation means that infants who show more dishabituation tend to score higher on IQ tests. The memory, discrimination, and recognition skills involved in habituation–dishabituation are related to the kinds of cognitive skills measured in typical intelligence tests. The habituation–dishabituation technique therefore can help researchers to assess cognitive functioning in early infancy and perhaps identify infants who are at risk for developmental delays. Infants who were exposed prenatally to cocaine, for example, show depressed habituation and dishabituation (Mayes et al., 1993). In one study, half of the 3-month-olds who were cocaine-exposed failed to achieve habituation at all (Mayes & Bornstein, 1995). Recent modifications of the procedure have even found that the rate of habituation even before birth is related to being at higher risk of cognitive problems at 6 months of age (Gaultney & Gingras, 2005).

Critics point out, however, that researchers do not completely understand what the infant assessments are measuring and how they relate to later cognitive skills. Habituation scores may reflect differences in cognitive speed of processing, but it is also possible that they are measuring differences in temperament or inhibition instead (Neisser et al., 1996). Some studies find that the aspect of the test that correlates with later cognitive skills (i.e., time to habituate versus degree of dishabituation) might be different for different types of infants (Kavšek, 2004). And while the infant assessments do predict later scores reasonably well, some studies have found that they do not show good test-retest reliabilities—that is, an individual baby’s score changes if more than a few weeks go by before a second test (Anderson, 1996; Slater, 1997; Tasbihsazan, Nettelbeck, & Kirby, 2003). These apparent inconsistencies make it difficult to interpret correlations with later IQ scores. Some critics argue that the best predictor is already known: the home environment. Assessment of early processing abilities might help in understanding specific difficulties, but effective prevention and intervention programs must address multiple factors, including home environments (Meisels & Atkins-Burnett, 2000). Finally, although the researchers who develop these assessments have the best of intentions, the possibility of unfair discrimination against those who are found to be most at risk for later cognitive problems cannot be ignored.

What do you think? Should policymakers pursue the development of predictive infant assessments? How could this information be useful in developing effective early interventions for children who are at risk? What guidelines would you suggest for the use of these interventions?

A social policy perspective
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One of the classic demonstrations was an experiment conducted by Meltzoff and Borton (1979). These researchers placed a smooth or a “nubby” pacifier in the mouths of 1-month-old infants. They then removed the pacifier and showed both types of pacifiers simultaneously to the infants. The 1-month-olds looked significantly longer at the shape that had been in their mouths—they matched the shape they saw with the one they had felt. Also, Elizabeth Spelke and her colleagues found that infants can match the dynamic features of moving objects across senses. In one
study, infants saw two films side by side (Spelke, 1979). One showed a kangaroo (or donkey) puppet bouncing quickly up and down. In the other film, the puppet bounced more slowly. At the same time the researchers played a slow or fast “thump” or “gong” sound that was synchronized with the bouncing in one of the films. Four-month-old infants looked significantly longer at the film that matched the pace of the sound. Of course, kangaroos do not normally make “thump” or “gong” noises when they jump, and it can be assumed that the infants had no prior experience with kangaroo activities. Still, these young infants matched the pace of the sound with the pace of the bouncing, showing that infants are quite capable of detecting features shared across the different senses.

In related research, 5-month-old infants matched the sound of an engine increasing or decreasing in volume with a video of an automobile coming toward or moving away from them (Walker-Andrews & Lennon, 1985). Five-and-a-half-month-old infants can use information about the hardness or softness of a ball that they touched but did not see to correctly judge which would fit through a tunnel opening that they saw but did not touch (Schweinle & Wilcox, 2004). Infants 6 to 8 months old matched the number they heard with the number they saw (Starkey, Spelke, & Gelman, 1983). For example, when they heard two drumbeats, they looked longer at a photo of two household objects; when they heard three drumbeats, they preferred to look at three objects. Again, these findings demonstrate intermodal perception of a variety of complicated events. Intermodal perception is sufficiently evident during infancy that its strength can serve as a reliable indicator of later cognitive functioning. For infants born preterm, scores on intermodal matching at 12 months of age predict cognitive abilities all the way through 6 years of age (Rose & Wallace, 1985). It takes a healthy nervous system to integrate the information flowing to the infant from multiple perceptual modalities.

As you can see, researchers have learned a lot about the perceptual capabilities of human infants. At birth, newborns can locate and track objects, and they can perceive a variety of forms, colors, sounds, tastes, and smells. As their brains and nervous systems continue to develop, their perceptual abilities will become even more refined. With rapidly developing nervous systems and enhanced perceptual capabilities, young children are ready to absorb information and learn amazing amounts about their world. In the next section, we will look at one prominent theory that describes how infants and toddlers conceptualize information and learn to think about all of the wonders they encounter.

Does it take a significant amount of trial-and-error learning for infants to connect the voices they hear with the visual images of faces? Evidently not. Using a variety of interesting stimuli, research on intermodal (or intersensory) perception indicates that infants make such connections even when they have had very little experience with the events they are matching.
Chapter 5. Cognitive Development in Infants and Toddlers

Explaining Cognitive Development: Piaget’s Constructivist View

Vast changes in thinking are evident in every aspect of life as children grow from infants into toddlers, ranging from what they will pay attention to to the kinds of questions they ask and the explanations they can understand or offer. These changes in thinking, in which children’s thought gradually becomes more organized and complex, are called cognitive development. The most influential theorist in the study of cognitive development was Jean Piaget (1896–1980). His prolific career in psychology spanned an astonishing seven decades and had an immense impact on the field (Beilin, 1994).

As you study this section, ask yourself these questions:

What influence did Piaget’s background in biology have on his theory and research? What are some specific examples of this biological influence?

What is constructivism, and why is Piaget considered a constructivist?

According to Piaget, what processes guide children’s interaction with the environment? How do these processes affect cognitive development?
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What are the main limitations in cognitive processing at the sensorimotor stage?

What new cognitive structures or other cognitive advances emerge during this stage?

Piaget as a Child Prodigy

Jean Piaget was no ordinary child. From a very early age, he showed tremendous intellectual talent. Born in Neuchâtel, Switzerland, a small university town, Piaget showed an early interest in nature, particularly in observing wildlife in its natural setting. His observations led to the first of his many scientific publications. He was only 10 years old when he published his first article, a one-page report on an albino sparrow he observed in a park. At the Museum of Natural History in Neuchâtel, Piaget began working with a zoologist who specialized in mollusks (clams, oysters, snails, etc.). Piaget “catalogued and studied adaptation” (Bringuier, 1980, p. 8), detailing how mollusks’ shells changed in relation to the movement of the water in which they lived. As you will see, the idea of adaptation came to play a central role in Piaget’s later theory of human cognitive development.

After earning a Ph.D. degree at age 21, Piaget became interested in psychology. He worked for a time at a psychiatric clinic in Zurich, where he learned about Freudian psychoanalysis and how to conduct a clinical interview. Later, he moved to Paris to work with Theophile Simon in the Binet Laboratory. Theophile Simon and Alfred Binet were known for their work on intelligence testing, and Piaget’s job in the laboratory was to help develop a standardized French version of some reasoning tasks. These years were important in several ways for Piaget and the development of his theory and methods. First, he realized that children were active in their thinking, not passive. He found that even very young children made admirable attempts to understand and answer questions, although their reasoning was far from what an adult would see as logical. Drawing on his biological background, Piaget interpreted these attempts as children’s efforts to adapt cognitively to the situations they were in, to understand and succeed in their situations. Second, Piaget began to see that children’s thinking showed a striking regularity and consistency, even though the thinking was often incorrect. Piaget noticed that children of the same age tended to give the same wrong answers, whereas children of a different age tended to give different wrong answers. There seemed to be age-related patterns in the children’s thinking. These might not seem to be groundbreaking insights today, but at that time, most experts believed that children were passive recipients of information (simply memorizing information without interpreting or modifying it) and did not have coherent or regular ways of thinking. Piaget challenged these well-established views. Finally, Piaget realized that a clinical method, in which children are asked to explain the reasons for their answers rather than simply to give an answer, could be an invaluable tool in his efforts to understand children’s thinking.

Constructivism and Interaction with the Environment

Piaget combined his background in biology with his interest in understanding how logic and knowledge develop and spent the rest of his career observing children and articulating his theory of cognitive development. He applied several concepts from biology and used them to explain how knowledge develops.

Piaget’s theory is often described as a constructivist view. According to constructivists, people interpret their environments and experiences in light of the knowledge
and experiences they already have. People do not simply take in an external reality and develop an unchanged, exact mental copy of objects or events. Instead, they build (or “construct”) their own individual understandings and knowledge. For Piaget, the essential building block for cognition is the scheme. A scheme is an organized pattern of action or thought. It is a broad concept and can refer to organized patterns of physical action (such as an infant reaching to grasp an object) or mental action (such as a high school student thinking about how to solve an algebra problem).

As children interact with the environment, individual schemes become modified, combined, and reorganized to form more complex cognitive structures. Think of cognitive structures as the organizing framework of all a child’s knowledge and cognitive skills. According to Piaget, structures are essential for understanding new knowledge, but structures are also changed by the new knowledge. As children mature, these structures allow more complex and sophisticated ways of thinking. These, in turn, allow children to interact in qualitatively different ways with their environment. For example, a little girl develops a scheme for noticing similarities between objects (we’ll call this a “compare” scheme) and a separate one for noticing differences (a “contrast” scheme). Gradually, she coordinates and combines the two into a single cognitive structure that allows her to compare and contrast objects at the same time. When she encounters a new object, she uses this coordinated cognitive structure to develop a fuller understanding of the object. The first time she encounters an avocado, for example, she can compare and contrast it to other foods. This process will help her to determine what kind of food it is and will increase her understanding of the overall category (similar in size to an orange but different in shape, similar in color to a lime, different in texture from an apple).

Cognitive structures not only organize existing knowledge, but also serve as filters for all new experiences. That is, people interpret new experiences in light of their already existing cognitive structures. Because no two people ever have exactly the same experiences, no two cognitive structures ever are exactly the same, and no two people ever interpret events in exactly the same way. The way you interpret and understand the information you’re learning about Piaget is different, at least slightly, from the way your classmates understand it, because each of you filters and interprets the information through a different cognitive structure.

Piaget believed that extensive interaction with the environment is absolutely essential for each person’s cognitive development. Though Piaget acknowledged that biological maturation sets the general limits within which cognitive development occurs, he placed much more emphasis on the role of the environment. Children who have severely limited interactions with their environments simply will not have the opportunities to develop and reorganize their cognitive structures so as to achieve mature ways of thinking. The way people interact with the environment is not random, however. Three common processes guide their interactions: organization, adaptation, and reflective abstraction. If you have studied biology, you will recognize the influence of Piaget’s biology background in the first two of these processes. Both concepts originate in the physical sciences, and Piaget used them in his theory of psychological development.

**Organization** is the tendency of all species to integrate separate elements into increasingly complex higher-order structures. For example, consider the human body. Cells themselves are organized systems of subcellular material. And cells organize into tissues, tissues into organs, organs into organ systems, and organ systems into the body. Piaget believed that the tendency to organize also occurs on the...
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Psychological level—that people try to organize their knowledge into coherent systems. In fact, Piaget believed that the tendency to organize is so basic that people cannot keep from trying to organize their knowledge. This explains why you might find yourself thinking about something that didn’t make sense to you when you encountered it, even when you don’t intend or want to spend time thinking about it. The advantage of this organizational tendency is that it gives people a way to understand and interpret events and objects they encounter; in short, it helps us to function more successfully in our psychological environments. The disadvantage is, of course, that the particular way in which you organize your knowledge might be completely wrong. If enough mistakes and misinterpretations occur, however, you might reexamine your cognitive organization and perhaps make adjustments. Piaget called this later process adaptation.

In biology, the term adaptation refers to every species’ tendency to make modifications in order to survive and succeed in the environment. (Remember how the mollusks’ shells adapted to the water currents?) Applied to cognitive development, adaptation means changing one’s cognitive structure or one’s environment (or both to some degree) in order to better understand the environment. Figure 5.6 diagrams the steps involved in adaptation: A child moves from assimilation through cognitive disequilibrium, accommodation, and cognitive equilibrium, then back to a new assimilation.

Let’s explore this process using the example of Lily, a 2-year-old who is learning to name animals (see Figure 5.6). Lily has a dog at home, and according to her “dog scheme,” “doggies” are animals that have four feet and fur and that bark and fetch balls. One day, riding in the car with her mother, Lily points to a field with several cows and exclaims, “Look, Mommy, doggies!” She is excited to see so many “doggies,” especially ones that are so large! Lily is trying to understand these new animals by thinking about them as something she already understands: “doggies.” This is an example of assimilation, the process of bringing new objects or information into a scheme that already exists.

Thinking of these new animals as “doggies,” Lily fully expects that they will also bark and fetch balls. Such misunderstandings are common when a person tries to force new objects into an ill-fitting scheme. Lily’s mother, however, comments, “No,

Your perspective

Can you think of a time when you found yourself wondering about an event, a fact, or a concept that you did not quite understand, even though you did not intend to think about it? As you continued to think about it, did it finally “fall into place” as you were able to integrate it into your cognitive structures?

Adaptation
In cognitive development, the process of changing a cognitive structure or the environment (or both) in order to understand the environment.

Assimilation
The process of bringing new objects or information into a scheme that already exists.

Figure 5.6 • Adaptation and Equilibration
In the cycle of adaptation and equilibration, a new experience is first assimilated into an existing scheme. If it does not fit properly, cognitive disequilibrium results. Accommodating (adjusting) the scheme brings the child to cognitive equilibrium until a new assimilation challenges the scheme again.
things to learn. Rather a state of ‘moving equilibrium’” (Beilin, 1994, p. 263). There are always new things to learn. Piaget believed that “the normal state of mind is one of disequilibrium—or cognitive disequilibrium. To resolve the disequilibrium, people accommodate, or adjust, their schemes to provide a better fit for the new experience. If this process is successful, they achieve cognitive equilibrium. Equilibration therefore is the dynamic process of moving between states of cognitive disequilibrium and equilibrium as new experiences are assimilated and schemes are accommodated. Because of the process of organization, human beings are never satisfied with equilibrium. They stretch and extend their cognitive structures by assimilating new and challenging information. According to Piaget, the tendency to seek equilibrium is always present—people are constantly seeking to understand—but equilibration is a dynamic process and is never fully achieved. In other words, although there are certainly periods when a person understands and deals effectively with the environment, no one ever attains perfect, complete, and permanent understanding of everything. Piaget believed that “the normal state of mind is one of disequilibrium—or rather a state of ‘moving equilibrium’” (Beilin, 1994, p. 263). There are always new things to learn.

A final process that guides thinking is reflective abstraction. In reflective abstraction, a person notices something in the environment (e.g., some specific property of an object or action), then reflects on it (Ginsburg & Opper, 1988; Piaget, 1971). That is, the person tries to relate it to his or her current cognitive structures. As a result of reflection, people modify their current cognitive structures. For example, a boy playing on the beach might notice that the number of rocks he has is the same regardless of how they are arranged. Reflective abstraction in this case involves the child’s noticing that he has the same number of rocks, then thinking about the implication of this fact—that number is not affected by how they are arranged. According to Piaget, people must engage in reflective abstraction to learn from their interactions with the environment. The process enables them to isolate and think about specific properties, compare and contrast them, and think about how they understand them. In this way, reflective abstraction leads to the accommodation of cognitive structures. A child can notice something in the environment, but if he does not think about its meaning or its relation to what he already knows, no cognitive reorganization will occur. In our earlier example, Lily would not have accommodated her understanding of “doggies” if she had not (1) noticed that the cows were much larger than dogs (and had udders) and (2) reflected or thought about what this meant.

The processes of organization, adaptation, and reflective abstraction play important roles in children’s development. First, children are naturally curious. They are constantly probing and exploring their environments, looking for ways to challenge their existing schemes, and reflecting on whether the things they encounter make sense to them. But without opportunities for exploration...
and stimulating experiences, there would be nothing new to assimilate. Second, cognitive disequilibrium is a precursor to learning. When children are confused and perplexed, they are ready to make adjustments—they are ready to make accommodations in their schemes. Although it might be tempting to think of confusion as a sign of failure or as something to avoid, in Piaget’s system it is a necessary step toward success. Finally, the concept of constructivism is embedded in the cycle. Faced with disequilibrium, children will accommodate their own schemes, engage in reflective abstraction, and improve and reorganize their cognitive structures. In short, children do not passively absorb structures from the adults and other people around them. They actively create their own accommodations and so construct their own understandings.

**Piaget’s Stage 1: Sensorimotor Thought (Birth to 2 Years)**

We have seen that children adapt individual schemes (such as “doggie” and “cow”) through equilibration. According to Piaget, our continual organization and adaptation lead to periodic major reorganizations of cognitive structures, which result in four broad stages of cognitive development. After a major reorganization, new and more powerful ways of thinking become possible. Each stage has certain skills and limitations, as summarized in Table 5.1. In this chapter, we will focus on stage 1, sensorimotor thought, which involves developments in infants and toddlers. We will discuss Stages 2, 3, and 4 in later chapters.

According to Piaget, infants can engage only in **sensorimotor thought**. That is, they know the world only in terms of their own sensory input (what they can see, smell, taste, touch, and hear) and their physical or motor actions on it (e.g., sucking, reaching, and grasping). They do not have internal mental representations of the objects and events that exist outside their own body. For example, consider what

<table>
<thead>
<tr>
<th>COGNITIVE STAGE</th>
<th>LIMITATIONS</th>
<th>ACHIEVEMENTS</th>
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<tbody>
<tr>
<td>Sensorimotor Thought: Birth to 2 years</td>
<td>• No representational thought; infants cannot form internal symbols early in this stage.</td>
<td>• Representational, symbolic thought gradually emerges as the stage progresses.</td>
</tr>
<tr>
<td></td>
<td>• Object permanence is lacking early in this stage.</td>
<td>• Object permanence develops as the stage progresses.</td>
</tr>
<tr>
<td>Preoperational Thought: 2–7 years</td>
<td>• Intuitive logic leads to egocentrism, animism, artificialism, and an inability to use more objective forms of logic.</td>
<td>• Flourishing mental representations and symbols are seen in language, art, and play.</td>
</tr>
<tr>
<td></td>
<td>• Schemes are not reversible, not operational.</td>
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<tr>
<td></td>
<td>• Children fail conservation tasks because of centration, focus on static endpoints, and lack of reversibility.</td>
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<tr>
<td>Concrete Operational Thought: 7–12 years</td>
<td>• Logic is limited to concrete, tangible materials and experiences.</td>
<td>• Logical thought is more objective, allows skills such as class inclusion and transitivity.</td>
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<tr>
<td></td>
<td></td>
<td>• Schemes can be reversible, operational.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Children pass conservation problems due to decentration, focus on dynamic transformations, reversibility.</td>
</tr>
<tr>
<td>Formal Operational Thought: 12 years and up</td>
<td>• Adolescent egocentrism is seen in the imaginary audience and personal fable.</td>
<td>• Hypothetico-deductive reasoning emerges.</td>
</tr>
</tbody>
</table>
Chapter 5. Cognitive Development in Infants and Toddlers

What does this infant understand about her rattle? If she drops the rattle out of sight, will she know that it still exists?

happens when you give 3-month-old Hyeree a plastic rattle. Hyeree grasps the rattle tightly in her hand, shakes it back and forth, and rubs it against her cheek. Then she brings the rattle to her mouth to explore it in detail by sucking and biting on it. Finally, she flings the rattle to the floor and stares brightly back at you. Now, what does Hyeree “know” about the rattle?

According to Piaget, Hyeree doesn’t know anything about the rattle unless she is having direct sensory or motor contact with it. At the time when she is grasping and shaking the rattle, she knows how it feels in her hand and how it moves and sounds when she shakes it. She can feel its smooth surface against her cheek. She knows more about the detailed bumps, curves, and textures when she has it in her mouth. After she flings it to the floor, however, she has no way of maintaining an internalized mental representation of the rattle. She therefore can’t “think” about the rattle, and she doesn’t know or remember anything about it.

Most adults take mental representation for granted. When adults study an object, they form a mental code or image that represents what they know, and they can access this image later when the object is no longer physically available. They are capable of symbolic (representational) thought—the ability to form symbols in their minds that represent (or stand for) objects or events in the world. Piaget claimed that young infants cannot form symbols and are therefore stuck in the here-and-now world of their immediate sensory and motor actions. He believed that representational thought gradually emerges as babies develop the ability to form mental symbols. This represents an important achievement, because the emergence of representational thought frees children from the here and now. With representational thought, children can think about past events and anticipate future interactions. Mental representation also allows children to communicate with others, using language. By definition, language of any type requires that arbitrary symbols (words) represent actual things. Without mental representation, it is impossible to learn words and understand what they stand for.

Piaget proposed six substages of sensorimotor thought that describe how representational thought emerges during infancy. These substages are summarized in Table 5.2. If you look carefully across the substages, you will notice a general trend in babies’ thinking. Infants begin in the early stages as simply reflexive—that is, reacting to environmental stimuli via inborn reflexes. They have no voluntary control over objects or events in their environment but can only react to whatever takes place. Gradually, however, infants begin to take more control. These first attempts occur because infants accidentally notice the effects of certain random actions. They
begin trying to understand events by using *trial and error*, taking actions and simply observing what happens, then slightly modifying the actions, observing, and so on. Initially, these trial-and-error interactions are observations of effects with no anticipation of what the outcomes might be. Eventually, however, babies show evidence of *intentionality*. That is, they begin to take actions that they expect to have specific outcomes. Intentionality represents an effort to exert control over the environment because it involves taking actions that are intended to produce specific results.

### TABLE 5.2 Piaget's Six Substages of Sensorimotor Thought

<table>
<thead>
<tr>
<th>SENSORIMOTOR SUBSTAGE</th>
<th>AGE</th>
<th>CHARACTERISTIC</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Basic Reflexes</td>
<td>Birth to 1 month</td>
<td>The first schemes are inborn reflexes.</td>
<td>Rooting, sucking, grasping reflexes.</td>
</tr>
<tr>
<td>2. Primary Circular Reactions</td>
<td>1–4 months</td>
<td>Infants discover actions involving their own bodies by accident, then learn by trial and error to repeat the actions until they become habits (schemes).</td>
<td>At first thumb comes to mouth by accident. Through trial and error, infants learn to reproduce the event until a thumb-sucking scheme becomes established.</td>
</tr>
<tr>
<td>3. Secondary Circular Reactions</td>
<td>4–10 months</td>
<td>Infants discover actions involving objects in the environment by accident, then learn by trial and error to repeat them until they become habits (schemes).</td>
<td>Holding a rattle, an infant might accidentally shake the rattle and enjoy the noise. Through trial and error, the infant learns to reproduce the event until a shaking scheme becomes established.</td>
</tr>
<tr>
<td>4. Coordination of Secondary Schemes</td>
<td>10–12 months</td>
<td>Infants intentionally put two schemes together to solve a problem or reach a goal. Intentionality is a new feature—these new behaviors are no longer discovered by accident.</td>
<td>An infant sees a toy behind a box, pushes the box aside, then reaches for the toy. The infant intentionally combined pushing and reaching schemes to reach the goal (the toy).</td>
</tr>
<tr>
<td>5. Tertiary Circular Reactions</td>
<td>12–18 months</td>
<td>Babies are curious about objects in the world and explore them in a trial-and-error fashion, trying to produce novel reactions.</td>
<td>A baby drops a ball from shoulder height and watches what happens. The baby then explores the dropping scheme by dropping the ball from hip height, then head height, then knee height, observing each new result.</td>
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<tr>
<td>6. Transition to Symbolic Thought</td>
<td>18–24 months</td>
<td>Toddlers begin to form symbolic representations of events, showing the beginnings of mental thought. Representations still tend to be physical (rather than purely mental), as when toddlers use their own body movements to represent movements of objects in the world.</td>
<td>A 1½-year-old girl would like to open the lid of a box; to think about this, she opens and closes her hand repeatedly. Rather than working directly on the box, she first uses her hand motion as a way to “think” about how to open it. She is thinking about the box using a symbolic representation (her hand).</td>
</tr>
</tbody>
</table>
How can parents tell when an infant has achieved representational thought? One line of evidence is the use of language, starting at about 1 year of age—because to use language, the child must have mental representations to attach labels to. A second indicator is deferred imitation, when a young child observes a behavior and imitates it later, after a period of several hours or days. If the child did not have a mental representation of the behavior, there would be no memory of the event, and imitation would not be possible. Finally, a third line of evidence for representational thought can be seen in babies’ grasp of the concept Piaget called object permanence.

Piaget made the provocative claim that young infants do not understand object permanence—the fact that objects, events, or even people continue to exist when they are not in the infant’s direct line of sensory or motor action. Recall Hyeree and her rattle. Once Hyeree flung the rattle to the floor, Piaget would say that she had no way to think or know about the rattle. Because she couldn’t form a mental representation of it, she couldn’t consider its continued existence. She couldn’t want it or wonder about it. For Hyeree, “out of sight” was literally “out of mind.”

Piaget traced understanding of object permanence through the substages of sensorimotor thought, from nonexistence at birth to its full achievement at about age 2 years (Ginsburg & Opper, 1988; Piaget, 1952a, 1954). In the earliest substages, infants simply do not look for an object once it is out of their immediate experience. They make no attempt to get the object back, though they might continue looking at the place where they last saw the object. Later, they might actively try to retrieve an object, but only if part of it is still visible (e.g., reaching for a toy that is partially hidden under a blanket). By about 1 year, babies will attempt to retrieve an object that is completely hidden. Interestingly, however, if babies watch the object being hidden in one location, then watch as a researcher moves the object to a different location (this is called a visible displacement problem), they will look in the first location rather than the second even though they witnessed the whole sequence. By about 18 months, babies are able to solve these visible displacement problems, but they still cannot find the object when the displacements are invisible. That is, they watch as the object is hidden in one location but when the researcher secretly moves the object to a different location, the babies look only in the first spot. They don’t check other possible places nearby. Finally, by 2 years of age, the child is able to solve invisible displacement problems. Piaget described this ability as evidence of full mental representation. The Personal Perspective Box entitled “Where Did It Go?” describes three families as their infants solve a visible displacement problem.

In summary, there are two major developmental trends as an infant moves through the sensorimotor stage. First, the infant progresses from interacting reflexively with the environment through a trial-and-error phase to deliberate and intentional actions on the environment. Second, the child develops the ability to mentally represent objects, events, and people. Infants’ early thought processes involve reflexes and immediate sensations and motor actions, but toddlers leave the sensorimotor stage with the ability to internalize their thought processes into a purely “mental” form. Internal and intentional thought provides the building blocks for the next stage of cognitive development.

Of course, not everyone agrees with Piaget’s explanation of infant cognition. In particular, researchers from the information-processing approach (which you read about in Chapter 1 and will learn more about in Chapter 8) have found that Piaget underestimated the cognitive skills of infants and toddlers in many areas (Cohen & Cashon, 2006). We will discuss criticisms of Piaget’s theory and alternative approaches in later chapters.
Each of these parents was asked to play a game with their child, similar to the game that researchers sometimes use when studying object permanence. The parents showed their child a toy; then, making sure the child watched, they hid the toy under a blanket (Trial 1). They did the same thing a second time, except that they made sure the baby watched as they moved the toy and hid it in a different place (Trial 2). This is the visible displacement task that Piaget used. Here's how these children responded and what their parents' thought.

**Hanah Shapiro, mother of Asher, 6 months old (Hollywood, Florida)**

**Trial 1:**
Asher grasped for the rattle when I showed it to him. He watched me hide it but cried when he couldn't see it anymore—he didn't even try to look!

**Trial 2:**
Again, Asher cried when he could not see the rattle.

**Parent's thoughts:**
I was surprised Asher didn't even try to look for the rattle. He is normally very inquisitive, looking around a room and reaching for things. As Asher has grown, he explores objects more thoroughly—everything goes into his mouth! He particularly likes toys that play music and respond to him. Asher recently taught himself how to turn on the aquarium in his crib. He is, however, content to play with whatever is given to him rather than seeking out a favorite toy.

**Paul Lewis, father of Paul David, 11 months old (Riverside, California)**

**Trial 1:**
Paul David found the toy very quickly—after about ten seconds.

**Trial 2:**
He went looking for the toy under the first location. He searched there for about 15 seconds before losing interest. He never looked under the final destination of the toy!

**Parent's thoughts:**
Paul David is very interactive and inquisitive. On Trial 1, he went after the ball immediately and was eager to find it. We were very surprised that he did not find the ball the second time. He understood the game and found the ball in Trial 1 but had a hard time making a connection to the ball and its new location. Paul David is very hands-on; he likes most of his toys in his mouth. At this age, it's easy to distract him. If we hide "off-limits" items, he will immediately look for them, but he gives up and loses interest if we move them to a new location.

**Nola Akala, mother of Akindele, 25 months old (Deerfield, Illinois)**

**Trial 1:**
Akindele went directly to retrieve the train underneath the sofa cushion.

**Trial 2:**
He followed me to both locations and retrieved the toys. He looked for the toy in the new location within seconds. I was not surprised. My son is a determined little fellow!

**Parent's thoughts:**
Akindele knows where to go to get what he wants. This makes my life easier because I can say "Where is ABCD?" (his dog that sings the alphabet song) or "Where is Thomas the train?," and he goes to find them with no problems. When he was younger, Akindele played more by exploring with his mouth; he is more physical with his toys now, turning things over and around. Now he likes toys with a "cause and effect," ones that make a sound when you open a door or that speak when you press a button or slide a bar on the toy.

Were you surprised at the 6- and 11-month-olds’ reactions? What reaction do you think these three children would have to an invisible displacement problem? Try these games with some babies you know (with a parent’s permission). What do their responses indicate about their cognitive development?
Learning to Communicate

Language has long been a fascinating subject for psychologists. As you have just learned, it is seen as an indicator of mental representation, and it also seems to be one skill that sets humans apart from other species. Other species have many different ways to communicate with one another, that is, to send and receive information or messages. In this section, we will discuss what sets human language apart. Then we will describe theories of language development and how language develops in infants and toddlers.

As you study this section, ask yourself these questions:

- What are the defining characteristics of language?
- Is language learned or genetically programmed in humans? What role does the language acquisition device (LAD) play?
- How do social interactions and general cognitive level affect language development?
- What is the evidence for and against each of the three views of language development?
- How do infants’ prelinguistic skills help to prepare them for language?
- What are the major developments in vocalizations, semantics, and grammar during infancy?
What Is Language?

Three key features distinguish human language (Brown, 1973; Gleason, 1997). First, language has *semanticity*, which means that it represents thoughts, objects, and events through specific and abstract symbols. For example, the word *baby* does not look or sound like a real baby. This word is an abstract symbol. Second, language is *productive*, which means that there is no limit to the number or types of utterances that humans can create. And as long as people follow the rules that their particular language has for how to put sounds together, their novel communications are completely understandable by others. Third, language has the quality of *displacement*, which means that people can communicate about things that are distant in time or space or even about things that are physically or logically impossible or nonexistent. Displacement allows humans to communicate about a vast range of things instead of being limited to the immediate circumstances.

So *language* is an arbitrary system of symbols (words) that is rule-governed and allows communication about things that are distant in time or space. In studying language, it is important to keep in mind the distinction between language *comprehension* and language *production*. Often, young children are able to understand and respond appropriately to spoken language well before they can produce grammatical speech. One point that most researchers agree on is that humans seem to have a very strong instinctive drive to acquire language. Although an impoverished language environment (i.e., one that provides and encourages less language) will affect a child's rate of language acquisition and the quality of the language the child achieves, it is quite difficult to keep humans from developing any language (Flavell, 1985; Hulit & Howard, 1997).

How do children grasp the complex rules of language? More intriguing, how are they able to master these rules so quickly? Three basic theories attempt to explain language development. The *learning theory* emphasizes the role of the environment, whereas *nativist* theory emphasizes the role of biology. *Interactionist* perspectives, as you might expect, focus on how various aspects of the environment interact with biological characteristics.

**Learning Theory: Language as a Learned Skill**

The *learning theory* of language development is based on behaviorist theories of learning, particularly B. F. Skinner's principles of operant conditioning and Albert Bandura's concept of learning through imitation (Bandura & Walters, 1963; Skinner, 1957). Sometimes referred to as the *environmental view*, this approach views language as a behavior that people learn just like any other skill (Watson, 1924). Learning theorists believe that specific language training governs language development and that biological predispositions do not play an important role.

According to the learning theory, *operant conditioning* principles, particularly the procedure of *shaping* (selectively reinforcing certain behaviors while ignoring or punishing others), explain how children come to produce speech. For example, as a child begins to make sounds, the people around the child tend to reinforce the ones that resemble real words (e.g., “dada”) but ignore those that do not (e.g., “gaga”). As a result, the child tends to repeat the reinforced wordlike sounds, and the nonwordlike sounds gradually die out. Caregivers also reinforce simple phrases such as “Me want juice” when they give the child what was requested. The more clearly the child says the phrase, the more likely an adult is to understand and comply with the request. As the child progresses, parents shift from shaping individual words to shaping longer phrases and sentences (Skinner, 1957).
Imitation and modeling are also important. At the same time that parents and others are selectively reinforcing closer approximations to real words and phrases, they also provide models of more advanced language. One way in which they do this is by repeating the word they think the child means to say. For example, if a young child says “Mmmm” while looking at his mother, the mother might respond by saying “Mommy, that’s right, I’m your mommy.” When the child tries to imitate the mmmmaaa sound in the word “mommy,” the mother reinforces the attempt. Adults also extend words or phrases, elaborating a bit on what the child said. For example, if the child says “Go” as she walks out the door, her father might say, “That’s right, we’re going bye-bye.” Such interactions reinforce the child’s language attempts, and they also provide a model of how to produce more mature words and phrases (Moerk, 1992, 2000).

Word meanings can be learned through these conditioning processes. For example, therapists have successfully used shaping techniques to improve the language skills of children with mental retardation or autistic disorder. Simply providing models of language and grammar does not appear to affect these children’s language skills, but if the children are actively encouraged to imitate the model, their language often improves (Bohannon & Bonvillian, 1997).

However, there are several criticisms of the learning theory of language development. First, it is not clear how consistent parents are in shaping their children’s language. Some studies show that shaping is inconsistent and that parents tend to reinforce or punish the accuracy of the content of children’s utterances rather than the grammatical correctness. Also, parents do not appear to explicitly teach their children language rules. In fact, most adults have a great deal of difficulty identifying and describing these complex rules for themselves, much less explicitly teaching them to children. Second, critics argue that much of the language children hear in their everyday lives is incomplete, ill formed, and full of errors—far from being a good model from which to learn. Third, learning principles can’t really account for the degree of novelty of children’s language utterances, or what linguists call productivity. From an early age, children regularly say things that they have never heard before, such as I goed to the store. They also express things they have heard in new and innovative ways. Critics argue that it would be impossible for all of children’s utterances to result from imitation and shaping. Fourth, critics say that children learn language at a very fast pace—too fast to be explained by reinforcement, shaping, and imitation. Finally, critics question the learning theorists’ idea that language is “simply another behavior.” Research evidence that we will discuss in the next section suggests that humans are biologically predisposed to detect language and process it differently from other types of information (Brown & Hanlon, 1970; Eisenberg, 1976; Morgan, Bonamo, & Travis, 1995; Pinker, 1994).

Nativist Theory: Born to Talk

The famed linguist Noam Chomsky was one of the first to argue that learning theories could not adequately explain how children are able to master so quickly the complex systems of language. Chomsky proposed a nativist theory, the idea that language is an innate human capability. He suggested that humans are born with a language acquisition device (LAD), a brain mechanism that is specialized for detecting and learning the rules of language (Chomsky, 1957, 1981; Lenneberg, 1967). Just as humans are born with specialized organs—a heart and lungs—to carry out the complex tasks of circulation and respiration, they are born with a specialized “language organ” in the brain.

nativist theory
Theory that sees language as an innate human capability that develops when language input triggers a language acquisition device in the brain.

language acquisition device (LAD)
A brain mechanism in humans that is specialized for acquiring and processing language.
to carry out the complex task of acquiring language (Siegler, 1998, p. 140). Children must hear some amount of language to activate the LAD, but extensive language input is not necessary. Nor is it essential that the language that is heard be completely grammatically correct. Because the LAD is innate, language acquisition does not require great cognitive skill or cognitive effort. This explains why young children, as well as children with mental retardation and other cognitive delays, all develop at least some language ability quickly and easily. Another strength of the nativist view is that it explains both language acquisition patterns that are similar across different languages and patterns that differ. The LAD is innate but does not preprogram a child to learn a specific language.

Chomsky proposed that the LAD contains an innate knowledge of universal grammar, or the aspects of language rule systems that are common across all languages. When a child hears language, the LAD analyzes the language to determine its general type of grammatical construction system. Once the basic grammar of the language is recognized, the child can easily abstract important linguistic information and quickly acquire language. Other nativist theories suggest that the LAD contains more general operating principles—assumptions and biases that cause children to treat the language environment in special ways (Slobin, 1982, 1985b). In other words, children are predisposed to pay special attention to certain aspects of the language they hear, such as the ends of words, word order, and differences in intonation. Because of innate operating principles, children notice the subtle patterns their language uses to express things like plurality, possession, or relationships. Children become progressively more sensitive to the features that are most useful in their language (and less sensitive to less useful features). For example, a child learning Russian will gradually focus more closely on word endings to determine relationships between words. In contrast, a child learning English will focus more on the order of words. Regardless of the particular kinds of information contained in the LAD, all nativist theorists agree that a physiologically based LAD exists and that the role of the environment is to trigger its maturation. The environment does not shape or train verbal behavior (Bohannon & Bonvillian, 1997; Saffran et al., 2006).

Is Language Innate? If language acquisition is biologically programmed, then it should show developmental patterns similar to those of other biologically based systems, such as physical maturation. All humans should develop language, and they should develop it in a fairly consistent way. Language should be easy for humans to develop and hard to prevent, but nonhumans should not develop language. Also, there should be physical structures that specialize in language processing. Finally, language development should show sensitive periods (times during which a child is particularly sensitive to some aspect of the environment), as happens with many aspects of physical development. Language development shows several of these characteristics.

Do All Humans Develop Language? There is strong evidence from cross-cultural comparisons that all physically intact humans develop language easily and quickly and that the order and pace of achieving linguistic milestones are remarkably consistent across different languages (Caselli et al., 1995; Slobin, 1982, 1985a). Only extremely impoverished linguistic environments seem to keep children from developing some kind of language skill. Presumably, these environments simply don’t provide enough language experience to trigger the LAD. Even children with significant cognitive delays develop near-average levels of language usage and syntactic knowledge (Bellugi & St. George, 2001; Fowler, 1998; Tager-Flusberg et al., 1999).

Can Nonhumans Develop Language? Whether nonhumans develop language has been an issue of some debate. Through sign language, by manipulating colored plastic tokens, or even by using specially designed computer keyboards, apes can learn to use words to describe things in their environment, ask and answer questions, and make requests. Recent studies with a bonobo chimpanzee named Kanzi shows that he became very good at understanding the meaning and grammar of verbal instructions.
(Goodall, 1986; Savage-Rumbaugh, Shanker, & Taylor, 1998). However, apes do not show knowledge of grammar, rarely include new information in their utterances, and show little understanding of language pragmatics such as taking turns in a conversation (Gleason, 1997; Terrace et al., 1980). And although Kanzi’s performance was impressive, nativists argue that it is unclear whether he could produce grammatically correct phrases, and they point out that it took eight years of intensive training to teach Kanzi his skills. Human children, by contrast, quickly and easily master the rules of grammar, meaning, and the social use of language. What explains the difference? Nativists argue that other species lack the specialized brain mechanism common to all humans: the LAD.

Are There Physical Structures That Are Specialized for Language? Although you might not have thought of them this way, the structures of the human mouth and throat are specially suited for producing the complex sounds of spoken language. Other species are not able to produce these sounds (Lenneberg, 1967). In addition, specific areas within the human brain specialize in processing linguistic information.

Figure 5.7 shows some of these areas. In most people, the left hemisphere of the brain is chiefly responsible for processing language information. Wernicke’s area, located in the left temporal lobe for most people, enables human beings to understand spoken words and produce coherent written and spoken language. Broca’s area, located in the left frontal lobe, directs the patterns of muscle movements necessary for producing speech. Other brain areas that are specialized for language include the arcuate fasciculus, a band of fibers that connects Wernicke’s area to Broca’s area, and the angular gyrus, which is involved in processing written language (Gleason, 1997; Maratsos & Matheney, 1994).

So there is evidence of physical structures that are specialized for language processing. However, there does not appear to be a single area that is the LAD proposed.

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Can primates develop true language?

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![Diagram of brain structures involved in language processing](image)

Figure 5.7 • Brain Structures Involved in Language Processing

Wernicke’s area is important in comprehending spoken words and producing coherent written and spoken language. Nerves connect Wernicke’s area to the primary auditory cortex. Broca’s area directs the patterns of muscle movements necessary to produce speech sounds. The arcuate fasciculus connects Wernicke’s area to Broca’s area. The angular gyrus processes written language.

(Based on Fabes & Martin, 2003.)
by Chomsky. Instead, the LAD may be more correctly thought of as several interconnected brain areas (Cornell et al., 1993; Krishner, 1995). As of now, there is still no agreement as to what kinds of innately hardwired information might exist within those structures.

Are There Sensitive Periods for Language Development? According to Lenneberg (1967), human beings acquire language almost exclusively during childhood, before the brain’s organization becomes specialized and fixed. Areas of the brain are predisposed to respond to linguistic input, but children must experience language to activate these mechanisms. If a child does not receive enough linguistic input, the period of heightened sensitivity goes by. The key brain areas become specialized for other types of processing, and the opportunity for quick and easy language acquisition is lost. If Lenneberg is correct about sensitive periods, then several things should follow:

- Children who have been deprived of language should show poorer language skills, since the brain areas will not be activated.
- Older children and adults should have greater difficulty learning new languages than young children do.
- Older children and adults should recover less fully from damage to language areas of the brain, because the brain is already specialized.

There is evidence to support each of these predictions (Locke, 1993). First, case reports indicate that people who were deprived of linguistic input during childhood do not develop average linguistic skills; they have particular problems with grammar (Curtiss, 1977). Second, learning a new language seems to be more difficult for older children and adults than for younger children. For example, Johnson and Newport (1989) examined the English language skills of Chinese and Korean immigrants, focusing on the ages at which immigrants arrived in the United States. Figure 5.8 shows that English proficiency clearly relates to the immigrants’ age on arrival. Proficiency was not related to the number of years the immigrants had spoken English or to the amount of formal English instruction they had received (Johnson & Newport, 1989). Other research found the same result for deaf children learning American Sign Language: Proficiency in ASL reflected the age at which children first encountered ASL but not how long they had used ASL (Newport, 1990). Finally, recovery of language functions after damage to the left hemisphere of the brain is much faster and more complete for younger children (Stiles & Thal, 1993; Witelson, 1987). In fact, if the left hemisphere is damaged...
before the age of one year, the language functions can shift into the right hemisphere and “crowd out” the perceptual-spatial skills that usually localize there. The result is that language survives but perceptual-spatial skills suffer. So it seems that language development is biologically very important (Maratsos & Matheny, 1994; Siegler, 1998).

**Criticisms of Nativist Theory.** One of the major criticisms of nativist theory concerns the kind and amount of linguistic input and feedback that children actually receive. Pinker (1994), a nativist, suggested that language acquisition according to the learning model could occur only if children received explicit corrections of their language errors. Nativists claim that adults do not give this kind of feedback, so language must be innately driven (Morgan et al., 1995; Pinker, 1994). However, some studies show that adults do provide a great deal of corrective feedback (Bohannon & Bonvillian, 1997; Bohannon & Padgett, 1996; Farrar, 1992; Saxton, 1997). In addition, nativist theory predicts that any kind of exposure to language should activate the LAD and lead to average levels of language, regardless of the level of complexity, abstraction, or grammatical correctness of the linguistic input. But research has found that if language exposure comes only from television, children do not develop typical language skills (Sachs et al., 1981). Other critics point out that nativists have not identified a single universal grammar that applies to all known languages—a critical element in any theory that proposes a biologically programmed universal grammar (Tomasello, 1995). Finally, there is ongoing disagreement about whether other species can develop language.

**Interaction Theories: Cognitive and Social Interactionist Approaches**

Although both Skinner and Chomsky were right about some aspects of language development, many researchers came to believe that these two opposing theorists were too extreme. Dissatisfaction with both purely learning and purely nativist views led researchers to consider how multiple factors might interact to produce language development. Some interaction approaches emphasize the role of cognitive factors; others emphasize how social interactions contribute to language acquisition.

**Cognitive Approach: Language Depends on Cognition.** Not surprisingly, Jean Piaget, the famous cognitive development theorist you read about earlier in this chapter, stressed the role of the general cognitive abilities of the child in language acquisition. Piaget’s cognitive developmental theory views language as only one of several different abilities that depend on overall cognitive maturation. Proper cognitive development is a necessary prerequisite for normal language development (Piaget, 1954). For example, you might remember that one of the major cognitive achievements by the end of Piaget’s first stage of cognitive development—the sensorimotor stage—is object permanence, or the understanding that objects and people continue to exist even when the infant cannot directly experience them. If words are symbols that represent objects, then babies in the sensorimotor stage do not need them. Either babies directly experience objects (and so need no symbols) or objects are out of babies’ immediate experience and no longer exist (requiring no symbols). Only when children develop cognitively to the point at which they need symbols to represent things do they have a reason to use words and develop language. Cognitive skills then interact with environmental demands and language experience to produce increasingly mature language skills.

Some correlational evidence is consistent with Piaget’s cognitive developmental view. For example, children first begin using words that indicate something disappeared (e.g., “all gone”) at about the same time they develop object permanence. Words that indicate evaluation of effort (e.g., “uh-oh,” or “got it”) appear at around the same time children start using intentional, goal-directed problem-solving strategies (Gopnik, 1984; Gopnik & Meltzoff, 1984). Some research indicates that children do not use grammatical markers for things like past tense or possession in their spontaneous speech until they have some understanding that there is such a thing as the past and that objects...
can be owned (Slobin, 1982). However, these correlations do not prove that the
cognitive skills caused the language skills to develop. Interestingly, many children
with significant cognitive deficits still show normal language development; this
should not occur if Piaget’s theory is correct. Other work suggests that some specific
aspects of language might result from general cognitive development, but others
might not (Bellugi & St. George, 2001; Curtiss, 1981; Fowler, 1998; Levy et al.,
2000). (We will describe another cognitive view of language development, which is
based on current information-processing theory, in Chapter 11.)

Social Interactionist Theory. Social interactionist theory says that language
development is the result of a complex interaction between the child’s biological predispositions and
social interactions. Most social interactionists agree with nativists that humans are bio-
logically prepared to develop language, but they believe that simply hearing language is
not enough. Instead, interacting with others is critical: To develop language, children
must have conversations with other people. This theory also assumes that children
have a strong drive to communicate effectively with others. Because humans are social
by nature, children themselves play a significant role by seeking social interactions and trying to communicate with
those around them (Akhtar & Tomasello, 2000).

What role do social interactions play for language
development? As we noted earlier, it seems that parents
provide much more feedback about language performance
than some theorists used to think (Hart & Risley, 1995).
Children often initiate language interaction by attempting
some kind of sound, word, or phrase. If the utterance is
grammatically correct, parents might imitate it—repeat or
echo it—exactly. But parents also provide implicit feed-
back. For example, recasts are restatements of what the
child said but with corrected grammar. If a child says, “I
saw two deers in the yard,” her mother might recast this
and reply, “You saw two deer; that’s great!” Parents also
use expansions, repeating but also correcting and elaborat-
ing the child’s utterance. For example, a mother might
expand the statement about deers by saying, “You saw two
deer? Remember when we saw the deer at the forest preserve? Did those deer look like
the ones in the yard?” Children respond to feedback by correcting their errors (Bohan-

Caregivers also present language to children quite carefully and in a structured
fashion through social interactions (Bruner, 1983). Examples are joint activities such
as songs that have specific gestures, games such as peekaboo, and common daily
activities such as baths and meals. These interactions have predictable structures,
and all are very common across cultures (Fernald & O’Neill, 1993).

Adults and older children also change their linguistic style when they talk to
young children—they use child-directed speech, sometimes called motherese (Sachs &
Devine, 1976; Snow, 1972). As we described in Chapter 4, child-directed speech is
slower and higher pitched, has more frequent and more extreme ups and downs in
pitch, and includes more questions than does speech directed to adults. Child-
directed speech also exaggerates key words and phrases for emphasis and often
repeats such words several times. The sentences are short and simple, and they often
focus on objects and activities to which the child is actively attending. Child-
directed speech occurs in many different cultures and languages (Fernald,
1992; Kuhl et al., 1997). Even deaf mothers use child-directed sign language
with their infants, signing more slowly, employing more repetition, and making
exaggerated gestures (Masataka, 1996). Infants pay more attention to
child-directed speech, and they are more successful in discriminating words
both from nonwords and from other words with subtle differences in sound
when they hear the words in child-directed speech (Cooper & Aslin, 1994; Masataka, 1998; Moore et al., 1997; Thiessen et al., 2005). However, the phenomenon of child-directed speech is not yet fully understood. Although it seems quite useful, it does not have the same features in all cultures. It is not yet known which particular features are most important or whether the central features are different for younger and older children (Bohannon & Bonvillian, 1997; Fee & Shaw, 1998).

Early Communication: How Language Starts

We have explored some of the theories that explain how language develops, but what kinds of changes take place and when do they occur? During the first year of life, important changes relevant to language take place in three areas. First, perceptual skills improve, enabling infants to perceive and discriminate different speech sounds. Second, infants and their caregivers establish a social environment; this encourages babies to turn random sounds into words that communicate specific meanings. Third, having begun life with sounds that are reflexive and unintentional, by 1 year of age, babies begin to use real words.

Perceptual Skills. It does not take babies long to start recognizing differences between speech sounds. One classic study used a variation of the habituation procedure you learned about earlier in this chapter (Eimas et al., 1971). The researchers gave infants as young as 1 month of age a pacifier that activated a predetermined sound (e.g., “ba”). Babies gradually habituated to the sound, slowing their rate and intensity of sucking. When the sound was changed (e.g., to “pa”), the babies increased their rate of sucking. As you might recall, this pattern indicates that the babies remembered the first sound and could tell that the second was different. Other studies have shown the same result with a variety of different speech sounds (Aslin et al., 1998; Saffran et al., 2006). By 6 months, infants are able to discriminate among different sequences of sounds—an important skill, because words are made up of sometimes subtly different sound sequences (Goodsitt et al., 1984). Interestingly, it does not matter whether or not the speech sounds come from the infant’s “native” language for 6- to 8-month-olds, but older babies have increasing difficulty with sounds from nonnative languages (Trehub, 1976; Werker & Tees, 1984). It seems that experience with language increases the ability to discriminate among speech sounds in one’s own language, but people gradually lose the ability to make discriminations that are not required on a regular basis. Perception of the basic sounds of one’s language is a good predictor of later language performance, including important skills such as word comprehension and production (Kuhl et al., 2005; Tsao et al., 2004).

Social Interactions. During the first year, babies are also beginning to understand that they can use sounds to communicate their needs and even to control other people’s behavior. Successful communication requires a joint focus of attention; that is, it requires that both people focus their attention on the same object or event at the same time. You can imagine what odd “conversations” would take place if each conversational partner were talking about different objects, events, or topics! Joint focus of attention develops gradually over the first year of life (Carpenter et al., 1998; Hulit & Howard, 1997). Social interactions during infancy are also essential for developing an understanding of the social rules for language. For example, the games and routines you read about earlier (e.g., peekaboo) help to emphasize when and how the infant is expected to contribute to the conversation or interaction. These interactions help infants to learn when it is their turn to talk and what kinds of contributions they should make (Bruner, 1983).

From Crying to Words: Speech Production in Infancy. Table 5.3 summarizes the developmental progression in speech production during the first year. Examine this progression, and you will notice that the sounds become

Think About Diana . . .
Would you expect Jamie to understand anything about taking turns in conversations yet? How can Diana help her to learn this skill?
increasingly differentiated, which means that specific sounds are produced under specific conditions. The sounds also become increasingly intentional, which means that the baby produces them for a specific goal, such as showing a caregiver a toy or getting a caregiver to provide something. Both differentiation and intentionality help to lay the groundwork for the first real words around the age of one year.

An infant’s first sounds are reflexive, nonintentional sounds such as crying, burping, sneezing, and coughing. Sometimes called vegetative sounds, these natural sounds come from many living creatures but are passive and do not convey an intentional meaning (Hulit & Howard, 1997). Also, a baby’s first cries are undifferentiated; the cry that is produced because the baby is hungry sounds just like the one that is produced because the baby is wet, tired, angry, or in pain. By 2 months, the baby’s cries show much more variation; and by 4 months, the baby is producing distinctive cries to signal such things as discomfort and request. Cooing, the production of vowellike sounds such as “o-o-o-u-u-u,” is present by 2 months. Cooing communicates an infant’s pleasure and comfort; infants often coo during social interactions, such as when their caregivers talk to or smile at them. By 4 months, babies both coo and laugh.

At about 6 months infants show true babbling, or repeated consonant–vowel syllables such as “mamama.” True babbling occurs most often when infants are exploring their surroundings and when an infant is alone (Stark et al., 1993). It includes many different sounds, even sounds that are not part of the infant’s native language. Gradually, the babbling comes to resemble more closely the speech sounds of the family’s language. This means that all infants have the potential to develop any language. It is the language they experience during the first year or so of life that determines which speech sounds they will continue to produce and which will fade away. True babbling depends heavily on infants’ being able to hear themselves clearly. As a result, it is at this point in development that babies with hearing impairments start to show delays, falling behind infants with normal hearing in the amount and variety of speech produced (Oller & Eilers, 1988; Stoel-Gammon & Otomo, 1986).

Between 8 and 12 months, infants start to show echolalia, the immediate imitation of others’ sounds or words. Echolalia can be very accurate and might lead adults to believe that an infant has learned words, but infants do not understand the sounds they are producing. From 9 to 18 months, infants start to show variegated babbling, which

### TABLE 5.3 The Development of Speech Sounds in Infancy

<table>
<thead>
<tr>
<th>AGE</th>
<th>TYPE OF SPEECH SOUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>• Vegetative and undifferentiated sounds: Reflexive, nonintentional sounds such as crying, burps, sneezing, coughing</td>
</tr>
<tr>
<td>2 months</td>
<td>• Greater variation in cries</td>
</tr>
<tr>
<td></td>
<td>• Cooing to indicate comfort and pleasure</td>
</tr>
<tr>
<td>4 months</td>
<td>• Distinctive cries to signal specific states</td>
</tr>
<tr>
<td></td>
<td>• Cooing and laughing</td>
</tr>
<tr>
<td>5 months</td>
<td>• Transitional babbling: Single syllables with one consonant and one vowel sound (“ma”)</td>
</tr>
<tr>
<td>6 months</td>
<td>• True babbling: Repeated vowel-consonant pair (“mamama”)</td>
</tr>
<tr>
<td>8 to 12 months</td>
<td>• Echolalia: Immediate imitation of words</td>
</tr>
<tr>
<td>9 to 18 months</td>
<td>• Variegated babbling: Multiple, differing syllables (“bapadaga”)</td>
</tr>
<tr>
<td></td>
<td>• Jargon babbling: Babbling that includes native language intonation patterns, rhythms, and stresses</td>
</tr>
<tr>
<td></td>
<td>• Protowords: Consistent sound patterns used to refer to specific objects and events</td>
</tr>
<tr>
<td>One year</td>
<td>• First true words, usually accompanied by gestures, babbling, and/or protowords</td>
</tr>
</tbody>
</table>

(Adapted from Hulit & Howard, 1997)
includes syllables that differ from one another (e.g., “badagapa”), and jargon babbling, which includes the rhythms and stress patterns of the native language. Jargon babbling sounds just like a conversation but without using real words. It indicates that babies are attending to and beginning to master the rhythmic and intonation characteristics of the language they are hearing but haven’t put these aspects together with real words yet.

Finally, around 9 to 10 months, infants begin to use protowords (also called vocables): consistent patterns of sounds that refer to specific people, objects, or events. For example, one of our sons used the protoword “nee-nee” to refer to his brother Andy, and many children use the protoword “baba” to refer to a baby bottle. Protowords mark an important transition from the random and nonmeaningful vocalizations of babbling to vocalizations that are intentional, consistent, and have specific meaning. Once a child begins using protowords, it is usually not long until the child begins using true words.

Semantics: Words and Their Meanings. Around the age of 1 year, children say their first true adult word. The transition from protowords to real words is gradual, and children continue to use gestures, babbling, and protowords along with real words for several months (Goldin-Meadow; 2006; Vihman & Miller, 1988). The average child can produce about 50 words by 18 months of age. Table 5.4 shows the kinds of words typically produced first. As you can see, children’s earliest words are usually nouns. They are usually labels for familiar and important objects or people in the environment, such as family members, favorite toys, pets, or favorite foods (Childers & Tomasello, 2002; Nelson et al., 1993; Waxman & Lidz, 2006).

How Are Early Words Acquired? Toddlers learn the meanings of new words at an astonishing pace. One way is through their parents’ modeling and labeling of objects and events. It is not surprising that the first words children acquire are the ones that are used most often by their parents. In addition, the more parents talk to their children, the faster the children’s vocabulary grows. But children also use a process called fast mapping, in which they acquire at least a partial understanding of a word after only a single exposure (Carey, 1977; Woodward et al., 1994). Toddlers as young as 18 months show fast mapping if both the child and his or her conversational partner are attending to the object that is being labeled (Baldwin et al., 1996). Despite these impressive abilities, however, children’s early words often include errors. Children frequently show overextensions, in which they expand a word’s meaning to include more objects than it should (Naigles & Gelman, 1995). For example, a young child who is learning the word parrot might overextend this label and use it to refer to any feathered creature that flies with wings (what adults would call birds) rather than only to a certain type

<table>
<thead>
<tr>
<th>TYPE OF WORD</th>
<th>EXAMPLES</th>
<th>PERCENTAGE OF VOCABULARY WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Names for general examples of a category</td>
<td>Mother, father, grandparent, doggy, kitty, toy</td>
<td>51</td>
</tr>
<tr>
<td>Names for specific members of a category</td>
<td>Mommy, Daddy, Grandma, Spot, Fluffy, Teddy</td>
<td>14</td>
</tr>
<tr>
<td>Words for actions</td>
<td>Go, up, swing, bounce, run, throw, cry</td>
<td>13</td>
</tr>
<tr>
<td>Words that describe objects or events</td>
<td>Big, little, mine, yummy, cold</td>
<td>9</td>
</tr>
<tr>
<td>Words that express feelings or relationships</td>
<td>No, sad, please</td>
<td>8</td>
</tr>
<tr>
<td>Words that serve grammatical functions</td>
<td>What, where, for, is</td>
<td>4</td>
</tr>
</tbody>
</table>

(Adapted from Nelson, 1973.)
of bird. Children also show underextensions, in which they use a word too narrowly. For example, a child might learn that the family’s pet is a parrot and believe that this word applies only to this particular parrot, not to parrots in a zoo, on television, or in other places.

**What Is the Function of Early Words?** As you have read, young children’s early words are often labels for familiar objects or people. Their early attempts at communication consist of single words, but these words often convey an entire idea or sentence. Words used in this way are called holophrases. For example, a toddler might say the word *hot* when he sees his father opening the oven door. Depending on the context and accompanying nonverbal cues, this single word might stand for several different and more complex ideas. The child could be saying, “Watch out, Dad! The oven is hot!” or “I need to stay away from that hot oven because it can burn me” or even “Is the oven hot?” Holophrases cannot communicate the wide range of meanings that children will be able to express once they starts combining words, but holophrases do serve several communication functions, including demands, requests, desires, and questions. To understand holophrases, the listener needs to pay attention to intonational cues (i.e., which parts of a word or phrase are emphasized), gestures, and the specific context (Tomasello, 2006).

**Toddler Grammar: Rules for Putting Words Together.** Between 18 and 24 months of age, toddlers start to produce two- and three-word sentences. Many children’s earliest sentences are of the form “familiar word + ________,” though the particular familiar word differs from child to child (Bloom et al., 1975; Maratsos, 1983). For example, a child’s early sentences might all consist of the phrase “No + ____,” to produce “No milk,” “No Mommy,” “No nap,” “No kitty,” and so forth. The specific functions served by early sentences (e.g., to make demands, ask questions, or claim possession) are very similar across several different languages (Slobin, 1979).

As toddlers expand their language production to sentences, they often use telegraphic speech. Like telegrams, telegraphic speech includes words that are essential to get the meaning across but leaves out nonessential words. Instead of saying, “I’m going to watch my brother Will play baseball,” a 2-year-old is likely to say, “I watch Will.” Interestingly, even such limited utterances follow certain grammatical rules. Young children do not randomly combine words; they choose certain combinations of words and word orders (de Villiers & de Villiers, 1999; Mandel et al., 1996). For example, toddlers usually place nouns before verbs, as in “Daddy play” rather than “play Daddy”; and they place possessives before nouns, as in “my kitty” instead of “kitty my.” Such combinations indicate a beginning understanding that the ordering of words, not just the words themselves, conveys important information.

The infant and toddler period is one of amazing change in language abilities. It is also a time when many parents might begin to notice the vast individual differences between their child and others in the pace of language development and to worry if their child is not saying words or putting together sentences as quickly as other children of the same age. When should parents worry about their child’s pace of language development? What are some common language delays, and what kinds of therapy are available? The field of speech-language pathology helps to provide answers to these kinds of questions. To find out more about this field, read the Professional Perspective box entitled “Career Focus: Meet a Speech-Language Pathologist.”
Chapter 5. Cognitive Development in Infants and Toddlers

What are the early signs of problems in language development?

Parents are often the first to suspect that a child might be delayed in acquiring language. They might notice that their infant does not do much babbling (“abbababa”) or stops producing these playful sounds. The child might not interact or make eye contact when parents try to talk and play with the child. Some young children will have problems learning to produce the sounds of speech. They will be difficult to understand, even beyond the preschool years. Others might be slow to learn new words, word endings (such as “-ing” or “-ed”), or small functional words (such as “is,” “am,” “was”) or to string words together to make sentences.

Some might struggle with how to use language to communicate, not knowing how to ask for objects or actions they want. If parents notice these types of problems, they should seek help. Speech-language pathologists will conduct a speech-language evaluation and work with other professionals to help determine whether a language delay exists, the possible cause(s) for a delay, the skills the child has and/or needs to learn, and intervention strategies that would help the child. It is important that a child receive speech-language therapy as soon as he or she is diagnosed as having a language delay, no matter the cause. The earlier a child receives services, the greater are his or her chances for success.

What are other common problems that you see in your practice?

Some parents get concerned when they hear their 3-year-old say things like “I, I, I, I want the red car,” but this is very common. Three- to three-and-a-half-year-olds often repeat not only whole words (“my, my, my, crayon”) but also phrases (“Mommy, I want, Mommy I want, Mommy I want a drink,”) or even parts of words (“play, play, playschool”). However, if a child repeats the sounds of a word (“p, p, p, pot”), shows signs of struggle behaviors (such as tics, facial tension, or grimaces), or frequently produces a repetition or prolongation (“sssssssit,” in more than one out of ten words), then this could indicate a stuttering condition.

Children who have language problems in the first five years of life are at risk for reading and writing problems later. When learning to read and write, children must actively think about all the components of the language system, and this can be difficult for children who have had a difficult time learning the oral language system. Parents should monitor and encourage their child’s literacy skills and work with their child’s teachers to provide any special help the child might need.

What causes problems in language development?

Often, the reason is not known. Some children have conditions that lead to language problems, such as hearing loss, mental retardation, autism, or attention deficit hyperactivity disorder. For some children, there is a genetic component. Researchers now believe that the “wiring” in the child’s brain that is used to learn language is not operating at its optimum capacity, but they don’t know why some individuals’ “wiring” is less efficient than that of others.

What training is needed to work as a speech-language pathologist?

One needs a master’s degree in speech-language pathology or communication disorders. Different states have different requirements, but some kind of certification and/or licensing is needed.

Do any speech or language problems run in your family? On the basis of what you have learned about language development from this chapter, what techniques do you think might help people with speech and/or language problems?
In this chapter, we have discussed some of the surprising capabilities of young infants and toddlers and have described how they integrate their perceptual experiences to support their cognitive and language development. Clearly, infants and toddlers need many more years and support from those around them to become sophisticated thinkers and conversationalists, but they are far from helpless even during infancy.

Let’s Review . . .

1. The LAD refers to:
   a. a specific structure in the brain’s left hemisphere that governs language development.
   b. the process of learning language.
   c. the specific structured parent–child interactions that help to teach language rules.
   d. several brain areas that together enable humans to detect and learn language rules.

2. The term operating principles refers to:
   a. an innate knowledge of universal grammar.
   b. innate predispositions to notice certain elements of language.
   c. the strategies that parents use to shape their children’s use of grammar.
   d. rules that govern how connections between units change in response to external feedback.

3. Child-directed speech fosters language development in all of the following ways except by:
   a. providing feedback about grammar.
   b. drawing an infant’s attention to the topic of conversation.
   c. explaining the operating principles for the native language.
   d. emphasizing important features of speech.

4. Which of the following provides the best support for the hypothesis that there are sensitive periods in language development?
   a. The existence of physical organs that are specialized for language processing.
   b. The fact that adults and children are both able to learn second languages.
   c. The fact that children are especially sensitive to child-directed speech.
   d. The greater degree of language recovery shown by children than by adults after damage to the brain’s left hemisphere.

5. True or False: Human newborns are able to discriminate between speech sounds of their native language but not between sounds of other languages.

6. True or False: The use of protowords marks the first use of adult language.

Answers: 1. d, 2. b, 3. c, 4. d, 5. F, 6. F
Now that you have studied this chapter, you should be able to explain how Diana can use concepts about perceptual, cognitive, and language development to understand and support her baby's development. You should be able to list at least a dozen specific concepts and explain how each would relate to Diana and Jamie.

Like most parents of infants, Diana is interested in what her baby understands and how she can help to support her baby's learning. She might be interested to know about the perceptual skills that Jamie is developing, including the kinds of visual and auditory preferences she might show.

Diana might be especially interested in the fact that newborns really do prefer to look at human faces. This preference and the supportive behavior it elicits from adults might help to keep Diana and Jamie looking and “talking” to one another for extended periods, which helps to support Jamie's developing cognitive and language skills. It would be useful to tell Diana about infants' abilities to integrate their sensory experiences through intermodal perception. This skill also helps to support Jamie's cognitive development. According to Piaget, a critical part of cognitive development is combining and coordinating experiences to construct understanding. Piaget would encourage Diana to provide Jamie with as much sensory and motor experience as she can, since infant thought is based on these experiences and they lay the foundation for later stages. As Jamie encounters new things in her environment, her natural tendencies to adapt will lead her to construct new understandings of her world. Finally, Diana might be interested to know that even though human infants seem biologically prepared to develop language, the social and language interactions she helps to provide for Jamie are essential to support this important human skill.

Thinking Back to Diana ...

How is the preferential-looking technique used to test infant perception?
Infants are shown two or more stimuli, and the amount of time spent looking at each one is recorded. When infants spend more time fixating on some stimuli than on others, it can be inferred that the infants are visually processing and discriminating the stimuli (i.e., they can see the differences among the stimuli). Using this technique, Robert Fantz and other researchers have demonstrated that young infants prefer to look at moving stimuli, outer contours and edges, areas of high contrast, detailed or complex patterns, symmetrical patterns, curves, and human face patterns.

How is the habituation–dishabituation technique used to test infant perception or avenues of sensation?
Infants are presented with the same stimulus repeatedly until they habituate (show decreased response). When a new stimulus is presented, dishabituation (renewed interest and response) indicates that the infant has processed the difference between the old and new stimuli.

Can infants coordinate information across different sensory modalities or avenues of sensation?
Yes. Research on intermodal perception indicates that young infants can match what they see with what they hear or feel. For example, one-month-olds look longer at...
the shape of pacifier they previously held in their mouths, and older infants can match the sounds of objects with their filmed movements.

**How is Piaget's background in biology reflected in his theory of cognitive development?**

Piaget was a young scholar in biology, producing his first scientific publication at the age of 10. As a teen, he studied how sea mollusks adapt their shells to changes in water currents, and this image of adaptation formed the core of his theory of cognitive development. Piaget theorized that children create and adapt their own cognitive structures in response to their changing experiences with the world.

**Why is Piaget's theory considered a constructivist view?**

Piaget's theory is considered a constructivist view because he emphasized that children learn primarily by interpreting their own environment and experiences in light of the knowledge and experiences they already have, thus constructing their own schemes and cognitive structures. Schemes are the cognitive structures that are constructed by the child, and they are modified through adaptation. New experiences are assimilated into existing schemes, and if the experiences do not fit adequately, cognitive disequilibrium results. Children can accommodate, or modify, their schemes to provide a better fit with the environment, returning the child to cognitive equilibrium. Organization is the tendency to integrate cognitive structures into larger coherent systems, and reflective abstraction is used to notice patterns and connections among related schemes.

**What is Piaget's first stage of cognitive development, and what are the basic changes that occur as children progress through this stage?**

In the stage of sensorimotor thought (birth to 2 years), infants begin by understanding the world through inborn reflexes and through their own direct sensory and motor actions. The ability to represent knowledge internally, in symbolic, mental form, develops gradually during this stage.

**What are the defining characteristics of language?**

Human language has *semanticity* and displacement and is productive. It is made up of arbitrary and abstract symbols and is governed by specific rules for how to communicate.

**How do learning theorists explain language development?**

Learning theorists say that language is learned through shaping of behavior, imitation, and modeling. Research indicates that language can be affected by differential reinforcement.

**What evidence supports the idea that language is innate?**

Nativist theory proposes that humans are endowed with an innate language acquisition device that contains either knowledge of universal grammar or operating principles that guide the processing of language information. Across many languages, children develop language quickly and easily, with marked consistency in the achievement of language milestones. There is disagreement as to whether nonhumans develop language, but the pace of animal language achievements is slower and the effort required is much greater than for humans. There are brain structures that are specialized for language processing, though there does not seem to be a single LAD brain organ. There is some evidence for the existence of sensitive periods in language development.

**Describe the interaction theories of language development.**

Cognitive approaches view language as dependent on other, more general cognitive skills. For Piaget, the broader ability to represent objects leads to the need for language. Social interaction theory emphasizes the importance of social interactions for acquiring language.

**What abilities do infants have or develop that prepare them for language?**

Infants have at birth or rapidly develop abilities to discriminate speech sounds and sequences of sounds, localize sound direction, and recognize a voice. Their recognition of speech sounds from their native language rapidly improves, but they lose the ability to discriminate sounds of other languages. Social interaction during the first year of life helps infants to learn that sounds can be used to communicate and fosters early pragmatic skills such as turn-taking. Child-directed speech and a developing joint focus of attention between infants and caregivers foster prelinguistic skills. Infants begin life making nonspeech sounds with no consistent meaning, then progress through cooing, babbling, echolalia, and protowords during the first year of life. Toddlers expand their vocabularies and learn grammatical rules for combining words into phrases and sentences.
Key Terms

accommodation (165)  nativist theory (173)
adaptation (164)  object permanence (169)
assimilation (164)  organization (163)
constructivist view (162)  perception (154)
dishabituation (157)  Piaget’s cognitive developmental theory (177)
equilibration (165)  preferential-looking technique (155)
habituation (157)  reflective abstraction (165)
habituation–dishabituation technique (157)  scheme (163)
holophrases (182)  sensorimotor thought (166)
intermodal perception (158)  social interactionist theory (178)
language (172)  symbolic (representational) thought (167)
language acquisition device (LAD) (173)  telegraphic speech (182)
learning theory (172)  

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Perceptual Development
Explaining Cognitive Development: Piaget’s Constructivist View

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