Infants, Children, and Adolescents, 9/e

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chapter

9

Cognitive Development in Early Childhood

One rainy morning, as I observed in our laboratory preschool, Leslie, the children's teacher, joined me at the back of the room. "Preschoolers' minds are such a blend of logic, fantasy, and faulty reasoning," Leslie reflected. "Every day, I'm startled by the maturity and originality of what they say and do. Yet at other times, their thinking seems limited and inflexible."

Leslie's comments sum up the puzzling contradictions of early childhood cognition. That day, for example, 3-year-old Sammy looked up, startled, after a loud crash of thunder outside. "A magic man turned on the thunder!" he pronounced. Even when Leslie patiently explained that thunder is caused by lightning, not by a person turning it on, Sammy persisted: "Then a magic lady did it."

In other respects, Sammy's thinking was surprisingly advanced. At snack time, he accurately counted, "One, two, three, four!" and then got four cartons of milk, one for each child at his table. Sammy's keen memory and ability to categorize were also evident. He could recite by heart *The Very Hungry Caterpillar*, a story he had heard many times. And he could name and classify dozens of animals.

But when his snack group included more than four children, Sammy's counting broke down. And some of his notions about quantity seemed as fantastic as his understanding of thunder. After Priti dumped out her raisins, scattering them on the table, Sammy asked, "How come you got lots, and I only got this little bit?" He didn't realize that he had just as many raisins; his were simply all bunched up in a tiny red box.

While Priti was washing her hands after snack, Sammy stuffed her remaining raisins back in the box and placed it in her cubby. When Priti returned and looked for her raisins, Sammy insisted, "You know where they are!" He failed to consider that Priti, who hadn't seen him move the raisins, would expect them to be where she had left them.

In this chapter, we explore early childhood cognition, drawing on three theories with which you are already familiar. To understand Sammy's reasoning, we turn first to Piaget's and Vygotsky's theories along with evidence highlighting the strengths and limitations of each. Then we examine additional research on young children's cognition inspired by the information-processing perspective. Next, we address factors that contribute to individual differences in mental development—the home environment, the quality of preschool and child care, and the many hours young children spend with screen media. Our chapter concludes with the dramatic expansion of language in early childhood. ∎

9.1 Piaget's Theory: The Preoperational Stage

As children move from the sensorimotor to the **preoperational stage,** which spans the years 2 to 7, the most obvious change is an extraordinary increase in representational, or symbolic, activity. Recall that infants and toddlers have an impressive ability to mentally represent their world. In early childhood, this capacity blossoms.

9.1.1 Advances in Mental Representation

Piaget acknowledged that language is our most flexible means of mental representation. By detaching thought from action, rapid gains in language permit far more efficient thinking than was possible during the first two years. When we think in words, we overcome the limits of our momentary experiences. We can deal with

9.1a Describe advances in mental representation, and limitations of thinking, during the preoperational stage.

9.1b Explain the implications of follow-up research on early childhood cognitive development for the accuracy of Piaget's preoperational stage.

9.1c Describe educational principles that can be derived from Piaget's theory.

past, present, and future at once and combine concepts in unique ways, as when we imagine a hungry caterpillar eating bananas or monsters flying through the forest at night.

Despite the power of language, Piaget did not regard it as a primary ingredient in childhood cognitive change. Instead, he believed that sensorimotor activity leads to internal images of experience, which children then label with words (Piaget, 1936/1952). In support of Piaget's view, recall from Chapter 6 that children's first words have a strong sensorimotor basis. Also, infants and toddlers acquire an impressive range of categories long before they use words to label them (see page 215 in Chapter 6). But as we will see, Piaget underestimated the power of language to spur children's cognition.

9.1.2 Make-Believe Play

Make-believe play is another excellent example of the development of representation in early childhood. Piaget believed that through pretending, young children practice and strengthen newly acquired representational schemes. Drawing on his ideas, several investigators have traced changes in make-believe play during the preschool years.

Development of Make-Believe   One day, Sammy's 20-month-old brother, Dwayne, visited the classroom. Dwayne wandered around, picked up a toy telephone receiver, eyed his mother, said, "Hi, Mommy," and then dropped it. Next, he found a cup, pretended to drink, and then toddled off again. Meanwhile, Sammy joined Vance and Priti in the block area for a space shuttle launch.

"That can be our control tower," Sammy suggested, pointing to a corner by a bookshelf. "Countdown!" he announced, speaking into his "walkie-talkie"—a small wooden block. "Five, six, two, four, one, blastoff!" Priti made a doll push a pretend button, and the rocket was off!

Comparing Dwayne's pretend play with Sammy's, we see three important changes that reflect the preschool child's growing symbolic mastery:

- *Play detaches from the real-life conditions associated with it.* In early pretending, toddlers use only realistic objects—a toy telephone to talk into or a cup to drink from. Their earliest pretend acts usually imitate adults' actions and are not yet flexible. Children younger than age 2, for example, will pretend to drink from a cup but refuse to pretend a cup is a hat (Rakoczy, Tomasello, & Striano, 2005). They have trouble using an object (cup) that already has an obvious use as a symbol of another object (hat).

  After age 2, children pretend with less realistic toys—for example, a block for a telephone receiver. Gradually, they can imagine objects and events without any support from the real world, as Sammy's imaginary control tower illustrates. And by age 3, they flexibly understand that an object (a yellow stick) may take on one fictional identity (a toothbrush) in one pretend game and another fictional identity (a carrot) in a different pretend game (Wyman, Rakoczy, & Tomasello, 2009).

- *Play becomes less self-centered.* At first, make-believe is directed toward the self. For example, Dwayne pretends to feed only himself. Soon, children begin to direct pretend actions toward objects, as when a child feeds a doll. Early in the third year, they become detached participants, making a doll feed itself or pushing a button to launch a rocket (McCune, 1993). Increasingly, preschoolers realize that agents and recipients of pretend actions can be independent of themselves.

- *Play includes more complex combinations of schemes.* Dwayne can pretend to drink from a cup, but he does not yet combine drinking with pouring. Later, children combine schemes with those of peers in **sociodramatic play,** the make-believe with others that is under way by the end of the second year and that increases rapidly in complexity during early childhood (Jing & Li, 2015; Kavanaugh, 2006a). Already, Sammy and his classmates can create and coordinate several roles in an elaborate plot. By the end of the preschool years, children have a sophisticated understanding of role relationships and story lines.

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Make-believe play increases in sophistication during the preschool years. Children pretend with less realistic toys and increasingly coordinate make-believe roles, such as school bus driver and passengers.

In sociodramatic, play, children as young as age 2 display awareness that make-believe is a representational activity. They distinguish make-believe from real experiences and grasp that pretending is a deliberate effort to act out imaginary ideas—an understanding that strengthens over early childhood (Rakoczy, Tomasello, & Striano, 2004; Sobel, 2006). Listen closely to a group of preschoolers as they assign roles and negotiate make-believe plans: "*You pretend to be* the astronaut, *I'll act like* I'm operating the control tower!" "Wait, *I gotta set up* the space-ship." In communicating about pretend, children think about their own and others' fanciful representations—evidence that they have begun to reason about people's mental activities, a topic we will return to later in this chapter.

Benefits of Make-Believe   Today, many researchers regard Piaget's view of make-believe as mere practice of representational schemes as too limited. In their view, play not only reflects but also contributes to children's cognitive and social skills. Sociodramatic play has been studied most thoroughly. Compared with social nonpretend activities (such as drawing or putting puzzles together), during sociodramatic play preschoolers' interactions last longer, show more involvement, draw more children into the activity, and are more cooperative (Creasey, Jarvis, & Berk, 1998).

It is not surprising, then, that preschoolers who devote a lot of time to sociodramatic play are rated by observers as more socially competent than their peers a year later (Lindsey & Colwell, 2013). And many studies reveal that make-believe predicts a wide variety of cognitive capacities, including executive function, memory, logical reasoning, language and literacy (including story comprehension and storytelling skills), math computation skills, imagination, creativity, and the ability to reflect on one's own thinking, regulate emotions, and take another's perspective (Berk & Meyers, 2013; Buchsbaum et al., 2012; Carlson & White, 2013; Melzer & Palermo, 2016; Mottweiler & Taylor, 2014; Nicolopoulou & Ilgaz, 2013; Roskos & Christie, 2013; Wallace & Russ, 2015).

Critics, however, point out that the evidence just summarized is largely correlational, with too many studies failing to control all factors that might alternatively explain their findings (Lillard et al., 2013). In response, play investigators note that decades of research are consistent with a positive role for make-believe play in development and that new, carefully conducted research strengthens that conclusion (Berk, 2015; Carlson, White, & Davis-Unger, 2014; Thibodeau et al., 2016). Furthermore, make-believe is difficult to study experimentally, by training children to engage in it. Besides alterations of reality, true make-believe *play* involves spontaneous qualities, including intrinsic motivation (doing it for fun, not to please an adult), positive emotion, and child control of the experience (Bergen, 2013).

Finally, much make-believe takes place when adults are not around to observe it! An estimated 25 to 45 percent of preschoolers and young school-age children spend much time in solitary make-believe, creating imaginary companions—special fantasized friends endowed with humanlike qualities. For example, one preschooler created Nutsy and Nutsy, a pair of boisterous birds who lived outside her bedroom window and often went along on family outings (Gleason, Sebanc, & Hartup, 2000; Taylor et al., 2004). Imaginary companions were once viewed as a sign of maladjustment, but research challenges this assumption. Children with imaginary companions display more complex and imaginative make-believe play; more often describe others in terms of their internal states, including desires, thoughts, and emotions; and are more sociable with peers (Bouldin, 2006; Davis, Meins, & Fernyhough, 2014; Gleason, 2013, 2017). Imaginary companions seem to offer children rich opportunities to enact events and practice social skills that might occur in real relationships.

Applying What We Know on page 310 lists ways to enhance preschoolers' make-believe play. Later we will return to the origins and consequences of make-believe from an alternative perspective—that of Vygotsky.

9.1.3 Symbol–Real-World Relations

To engage in symbolic representation, as in make-believe and drawing—and to understand other forms of symbolic representation, such as photographs, models, and maps—children must realize that symbols correspond to something specific in everyday life. In Chapter 6, we

LOOK and LISTEN

Observe the make-believe play of several 2- to 4-year-olds at a family gathering, a preschool or child-care center, or in another community setting. Describe pretend acts that illustrate important developmental changes.

APPLYING WHAT WE KNOW

Enhancing Make-Believe Play in Early Childhood

STRATEGY	DESCRIPTION
Provide sufficient space and play materials.	Generous space and materials allow for many play options and reduce conflict.
Encourage children's play without controlling it.	Model, guide, and build on young preschoolers' play themes. Provide open-ended suggestions ("I wonder whether the animals want to walk or take a train ride."), and talk with the child about the thoughts, motivations, and emotions of play characters. These forms of adult support lead to more elaborate pretending. Refrain from directing the child's play; excessive adult control destroys the creativity and pleasure of make-believe.
Offer a variety of both realistic materials and materials without clear functions.	Children use realistic materials, such as trucks, dolls, tea sets, dress-up clothes, and toy scenes (house, farm, garage, airport) to act out everyday roles in their culture. Materials without clear functions (such as blocks, cardboard cylinders, paper bags, and sand) inspire fantastic role play, such as "pirate" and "creature from outer space."
Ensure that children have many rich, real-world experiences to inspire positive fantasy play.	Opportunities to participate in real-world activities with adults and to observe adult roles in the community provide children with rich social knowledge to integrate into make-believe. Restricting time devoted to screen media, especially access to programs and video games with violent content, limits the degree to which violent themes and aggressive behavior become part of children's play. (See pages 000–000 in Chapter 10.)
Help children solve social conflicts constructively.	Cooperation is essential for sociodramatic play. Guide children toward positive relationships with peers by helping them resolve disagreements constructively. For example, ask, "What can you do if you want a turn?" If the child cannot think of possibilities, suggest options and assist the child in implementing them.

Sources: Nielsen & Christie, 2008; Weisberg et al., 2013.

saw that by the middle of the second year, children grasp the symbolic function of realistic-looking pictures and, around age 2½, of TV and video. When do children comprehend other challenging symbols—for example, three-dimensional scale models of real-world spaces?

In one study, 2½- and 3-year-olds watched an adult hide a small toy (Little Snoopy) in a scale model of a room and then were asked to retrieve it. Next, they had to find a larger toy (Big Snoopy) hidden in the room that the model represented. Not until age 3 could most children use the model as a guide to finding Big Snoopy in the real room (DeLoache, 1987). The 2½-year-olds did not realize that the model could be both *a toy room* and *a symbol of another room.* They had trouble with **dual representation**— viewing a symbolic object as both an object in its own right and a symbol. In support of this interpretation, when researchers made the model room less prominent as an object, by placing it behind a window and preventing children from touching it, more 2½-year-olds succeeded at the search task (DeLoache, 2002). Recall, also, that in make-believe play, 1½- to 2-year-olds cannot use an object that has an obvious use (cup) to stand for another object (hat).

How do children grasp the dual representation of symbolic objects? When adults point out similarities between models and real-world spaces, 2½-year-olds perform better on the find-Snoopy task (Peralta de Mendoza & Salsa, 2003). And 3-year-olds who can use a model of a room to locate Big Snoopy readily transfer their understanding to a simple map (Marzolf & DeLoache, 1994). Similarly, opportunities to make drawings and label them, and to observe peers and adults doing the same, help children grasp that line drawings can represent real-world objects—an understanding first evident between ages 2½ and 3 (Preissler & Bloom, 2008). By age 4, children flexibly realize that an ambiguous drawing, such as a circular shape,

These 4-year-olds understand dual representation—that the structure they are building is both an object in its own right and a potential model of a real-world structure.

can serve as a symbol for more than one object, such as a balloon or a lollipop (Allen, Nurmsoo, & Freeman, 2016). They are also aware that which object the drawing actually stands for depends on the intention of the artist.

In sum, experiences with diverse symbols—photographs, drawings, make-believe, and maps—strengthen preschoolers' understanding that one object can stand for another. With age, children comprehend a wider range of symbols that have little physical similarity to what they represent. As a result, doors open to vast realms of knowledge.

9.1.4 Limitations of Preoperational Thought

Aside from gains in representation, Piaget described preschoolers in terms of what they *cannot* understand. As the term *pre*operational suggests, he compared them to older, more competent children who have reached the concrete operational stage. According to Piaget, young children are not capable of *operations*—mental representations of actions that obey logical rules. Rather, their thinking is rigid, limited to one aspect of a situation at a time, and strongly influenced by the way things appear at the moment.

Egocentrism   For Piaget, the most fundamental deficiency of preoperational thinking is **egocentrism**—failure to distinguish others' symbolic viewpoints from one's own. He believed that when children first mentally represent the world, they tend to focus on their own viewpoint and simply assume that others perceive, think, and feel the same way they do.

Piaget's most convincing demonstration of egocentrism involves his *three-mountains problem,* described in Figure 9.1. He also regarded egocentrism as responsible for preoperational children's *animistic thinking*—the belief that inanimate objects have lifelike qualities, such as thoughts, wishes, feelings, and intentions (Piaget, 1926/1930). Recall Sammy's insistence that someone must have turned on the thunder. According to Piaget, because young children egocentrically assign human purposes to physical events, magical thinking is common during the preschool years.

Piaget believed that preschoolers' egocentric bias prevents them from *accommodating,* or reflecting on and revising their faulty reasoning in response to their physical and social worlds. To understand this shortcoming, let's consider some additional tasks that Piaget gave to children.

FIGURE 9.1   **Piaget's three-mountains problem.** Each mountain is distinguished by its color and by its summit. One has a red cross, another a small house, and the third a snow-capped peak. Children at the preoperational stage respond egocentrically. They cannot select a picture that shows the mountains from the doll's perspective. Instead, they simply choose the photo that reflects their own vantage point.

Inability to Conserve   Piaget's famous conservation tasks reveal a variety of deficiencies of preoperational thinking. **Conservation** refers to the idea that certain physical characteristics of objects remain the same, even when their outward appearance changes. At snack time, Priti and Sammy had identical boxes of raisins, but when Priti spread her raisins out on the table, Sammy was convinced that she had more.

In another conservation task, involving liquid, the child is shown two identical tall glasses of water and asked if they contain equal amounts. Once the child agrees, an adult pours the water in one glass into a short, wide container, changing its appearance but not its amount. Then the adult asks the child whether the amount of water is the same or has changed. Preoperational children think the quantity has changed. They explain, "There is less now because the water is way down here" (that is, its level is so low) or, "There is more now because it is all spread out." Figure 9.2 on page 312 illustrates other conservation tasks that you can try with children.

The inability to conserve highlights several related aspects of preoperational children's thinking. First, their understanding is *centered,* or characterized by **centration.** They focus on one aspect of a situation, neglecting other important features. In conservation of liquid, the child *centers* on the height of the water, failing to realize that changes in width compensate for the changes in height. Second, children are easily distracted by the *perceptual appearance* of
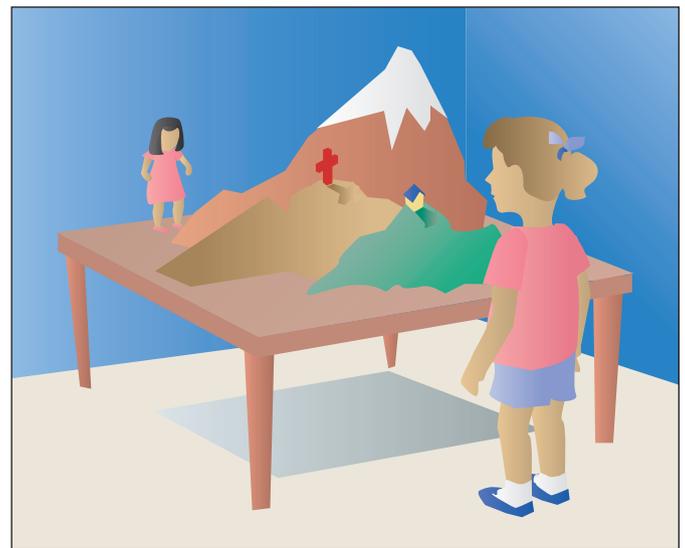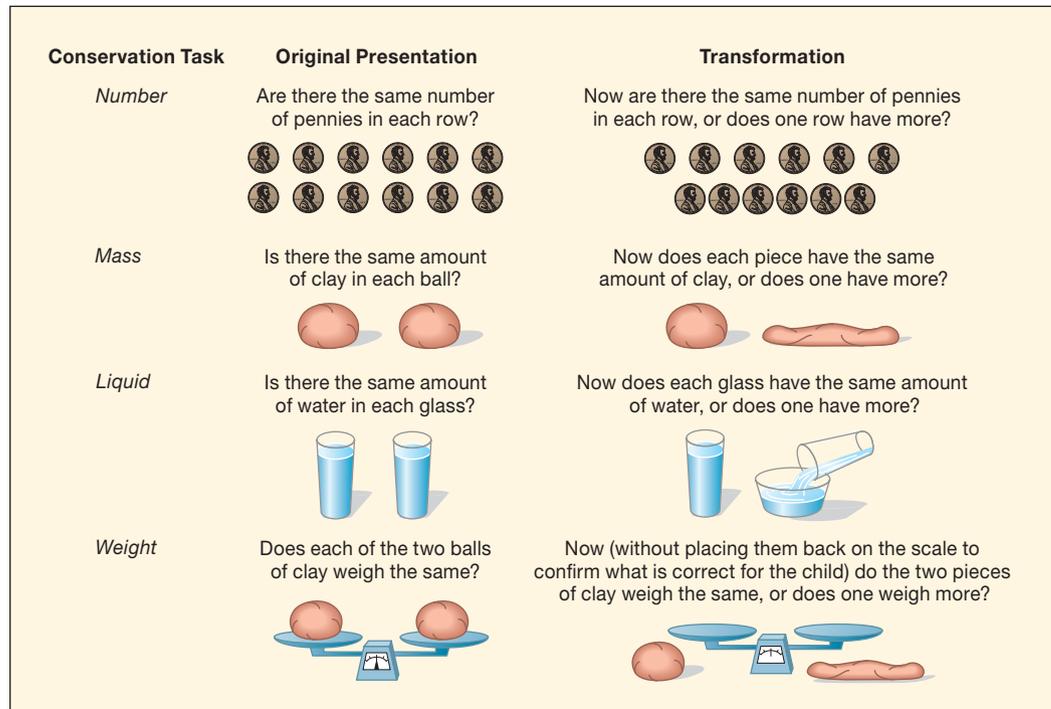
FIGURE 9.2   **Some Piagetian conservation tasks.** Children at the preoperational stage cannot yet conserve. These tasks are mastered gradually over the concrete operational stage. Children in Western nations typically acquire conservation of number, mass, and liquid sometime between 6 and 7 years and conservation of weight between 8 and 10 years.

objects. Third, children treat the initial and final states of the water as unrelated events, ignoring the *dynamic transformation* (pouring of water) between them.

The most important illogical feature of preoperational thought is its **irreversibility**—an inability to mentally go through a series of steps in a problem and then reverse direction, returning to the starting point. *Reversibility* is part of every logical operation. After Priti spills her raisins, Sammy cannot reverse by thinking, "I know Priti doesn't have more raisins than I do. If we put them back in that little box, her raisins and mine would look just the same."

Lack of Hierarchical Classification   Preoperational children have difficulty with **hierarchical classification**—the organization of objects into classes and subclasses on the basis of similarities and differences. Piaget's famous *class inclusion problem,* illustrated in Figure 9.3, demonstrates this limitation. Preoperational children *center* on the overriding feature, red. They do not think reversibly, moving from the whole class (flowers) to the parts (red and blue) and back again.

9.1.5 Follow-Up Research on Preoperational Thought

Over the past several decades, researchers have challenged Piaget's view of preschoolers as cognitively deficient. Because many Piagetian problems contain unfamiliar elements or too many pieces of information for young children to handle at once, preschoolers' responses often do not reflect their true abilities. Piaget also missed many naturally occurring instances of effective reasoning by preschoolers. Let's look at some examples.
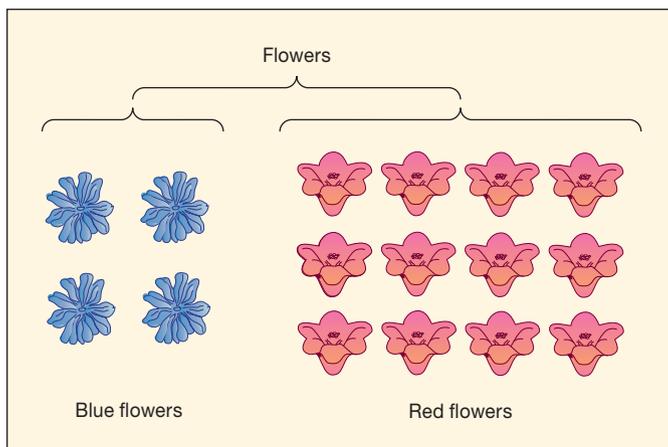

FIGURE 9.3   **A Piagetian class inclusion problem.** Children are shown 16 flowers, 4 of which are blue and 12 of which are red. When asked, "Are there more red flowers or flowers?" the preoperational child responds, "More red flowers," failing to realize that both red and blue flowers are included in the category "flowers."

Egocentric, Animistic, and Magical Thinking   When researchers use simplified tasks with familiar objects, 3-year-olds show clear awareness of others' vantage points, such as recognizing how something appears to another person who is looking at it through a color filter (Moll & Meltzoff, 2011). Even 2-year-olds realize that what they see sometimes differs from what another person sees. When asked to help an adult look for a lost object, 24-month-olds (but not 18-month-olds) handed her a toy resting behind a bucket that was within their line of sight but not the adult's (Moll & Tomasello, 2006).

Nonegocentric responses also appear in young children's everyday interactions. For example, 4-year-olds use shorter, simpler expressions when talking to 2-year-olds than to agemates or adults (Gelman & Shatz, 1978). Furthermore, in describing objects, children do not use such words as "big" and "little" in a rigid, egocentric fashion. Instead, they *adjust* their descriptions to allow for context. By age 3, children judge a 2-inch shoe as little when seen by itself (because it is much smaller than most shoes) but as big for a tiny 5-inch-tall doll (Ebeling & Gelman, 1994). And research described in previous chapters reveals that even toddlers have begun to infer others' intentions and perspectives. In his later writings, Piaget (1945/1951) described preschoolers' egocentrism as a *tendency* rather than an inability. As we revisit the topic of perspective taking, we will see that it develops gradually throughout childhood and adolescence.

Piaget also overestimated preschoolers' animistic beliefs. By age 2½, children give psychological explanations ("he likes to" or "she wants to") for people and occasionally for other animals, but rarely for objects (Hickling & Wellman, 2001). In addition, preschoolers seldom attribute biological properties (like eating and growing) to objects, including robots, indicating that they are well aware that even a self-moving object with lifelike features is not alive. But unlike adults, they often say that robots have perceptual and psychological capacities—for example, seeing, thinking, and remembering (Jipson & Gelman, 2007; Subrahmanyam, Gelman, & Lafosse, 2002). These responses result from incomplete knowledge about certain objects, and they decline with age.

Similarly, preschoolers think that magic accounts for events they otherwise cannot explain—fairies, goblins, and for Sammy, thunder in the opening to this chapter. But their notions of magic are flexible and appropriate. For example, older 3-year-olds and 4-year-olds are more likely to say that a magical process—wishing—caused an event (an object to appear in a box) when a person made the wish before the event occurred, the event was consistent with the wish (the wished-for object rather than another object appeared in the box), and no alternative causes were apparent (Woolley, Browne, & Boerger, 2006). These features of causality are the same ones preschoolers rely on in ordinary situations.

Three- to 5-year-olds distinguish between animate and inanimate and realize, for example, that a robot with lifelike features cannot eat or grow. But because of incomplete knowledge, they often claim that robots have perceptual and psychological capacities, such as seeing, thinking, and remembering.

Between ages 4 and 8, as children gain familiarity with physical events and principles, their magical beliefs decline. They question the reality of Santa Claus and the Tooth Fairy, realize that magicians' feats are due to trickery, and say that characters and events in fantastical stories aren't real (Shtulman & Yoo, 2015; Woolley & Cornelius, 2013; Woolley & Cox, 2007). Still, because children entertain the possibility that something they imagine might materialize, they may react with anxiety to scary stories, TV shows, and nightmares.

Culture and religion play a role in children's fantastic and supernatural ideas. The more live Santas children encounter in their everyday lives and the more they observe their parents vouching for Santa's existence, the less likely they are to question who live Santa really is (Goldstein & Woolley, 2016). This helps explain why Jewish children are more likely than their Christian agemates to express disbelief in Santa Claus, and the Tooth Fairy as well. Having heard at home that Santa is imaginary, Jewish children generalize this attitude to other unseen agents (Woolley, 1997). And cultural myths about wishing—for example, the custom

LOOK and LISTEN

Try the conservation of number and mass tasks in Figure 9.2 with a 3- or 4-year-old. Next, simplify conservation of number by reducing the number of pennies, and relate conservation of mass to the child's experience by pretending the clay is baking dough and transforming it into cupcakes. Did the child perform more competently?

of making a wish before blowing out birthday candles—probably underlie the conviction of most 3- to 6-year-olds that by wishing, you can sometimes make your desires come true (Woolley, 2000).

In actuality, adults as well as children often attribute hard-to-explain events to both super-natural and natural causes. Children, however, prefer natural over supernatural explanations, even in cultures that strongly endorse supernatural beliefs (Woolley, Cornelius, & Lacey, 2011). In one study, researchers asked 5- to 15-year-olds living in South African communities where witchcraft beliefs were widespread to explain why certain people got AIDS. Children of all ages—even 5-year-olds—more often gave biological explanations (contact with a sick person, exposure to germs) than bewitchment explanations (a neighbor cast a spell). Bewitchment accounts increased in middle childhood, as children acquired their culture's belief system, but they did not replace biological explanations (Legare & Gelman, 2008). And children mentioned witchcraft as a cause of serious illness far less often than did adults!

Logical Thought   Many studies show that when preschoolers are given tasks that are simplified and made relevant to their everyday lives, they do not display the illogical characteristics that Piaget saw in the preoperational stage. For example, when a conservation-of-number task is scaled down to include only three items instead of six or seven, 3-year-olds perform well (Gelman, 1972). And when preschoolers are asked carefully worded questions about what happens to substances (such as sugar) after they are dissolved in water, most 3- to 5-year-olds know that the substance is conserved—that it continues to exist, can be tasted, and makes the liquid heavier, even though it is invisible in the water (Au, Sidle, & Rollins, 1993; Rosen & Rozin, 1993).
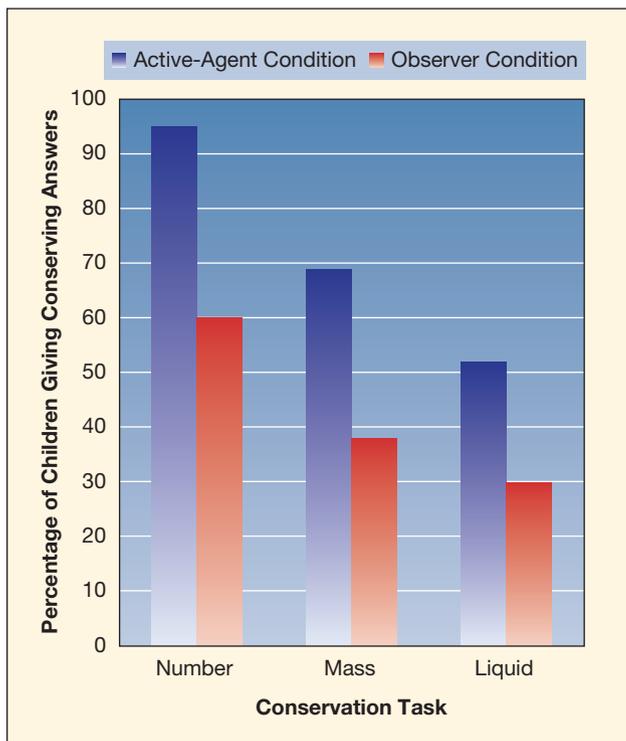
Notice in our description on page 311 that in a typical conservation task, the child observes while an adult demonstrates the transformation. In one study, 6-year-olds were randomly assigned to either an observer condition or an active-agent condition, in which they actively transformed the conservation materials. For example, in a conservation of mass task, the adult asked the child to form two identical balls with the same amount of clay and then roll one ball into a thinner, longer shape. As Figure 9.4 shows, actively manipulating the materials through the transformation process greatly facilitated learning, increasing children's conservation performance across multiple conservation tasks, including number, mass, and liquid (Lozada & Carro, 2016). Furthermore, in this investigation and others, children often used both speech and gesture when explaining their answers. As the Social Issues: Education box on the following page reveals, gesture offers an additional illustration of the vital role of action in advancing children's cognition.

Young children's ability to reason about transformations is evident on problems other than conservation. For example, they can engage in impressive *reasoning by analogy* about physical changes. When presented with the picture-matching problem "Play dough is to cut up play dough as apple is to …," even 3-year-olds choose the correct answer (a cut-up apple) from a set of alternatives, several of which (a bitten apple, a cut-up loaf of bread) share physical features with the right choice (Goswami, 1996). These findings indicate that in familiar contexts, preschoolers can overcome appearances and think logically about cause and effect.

FIGURE 9.4   **Influence of children's active transformation of materials on conservation performance.** Six-year-olds randomly assigned to an active-agent condition, in which they actively transformed the materials in conservation tasks, performed much better than children in an observer condition who experienced typical task procedures in which an adult demonstrated the transformations for them. (From M. Lozada & N. Carro, 2016, "Embodied Action Improves Cognition in Children: Evidence from a Study Based on Piagetian Conservation Tasks," *Frontiers in Psychology*, 7, Art. No. 393. Adapted by permission.)

Categorization   Despite their difficulty with Piagetian class inclusion tasks, preschoolers organize their everyday knowledge into nested categories at an early age. By the beginning of early childhood, children's categories include objects that go together because of their common function, behavior, or natural kind (animate versus inanimate), challenging Piaget's assumption that preschoolers' thinking is wholly governed by perceptual appearances.

Social Issues: Education | Children's Gestures Facilitate Cognitive Change

After agreeing that two identical tall, narrow glasses held the same amount of water, 5-year-old Kerry watched as an adult poured the water from one into a short, wide glass. She then confidently asserted that the amount of water had changed. When asked to explain, she replied, "It's less because this one's lower than that one," gesturing with her hands to highlight the discrepant water levels. With this *speech–gesture match,* Kerry conveyed the same nonconserving information in both speech and gesture.

Kerry's classmate Noelle, also a nonconserver, responded differently, with a *speech–gesture mismatch.* While claiming that the short, wide glass held less water, she expressed contrary information in gesture, designating the differing widths of the two glasses with her hands.

Although Piaget believed that action plays a central role in cognitive development, he overlooked the importance of the gestures children produce as they explain their solutions to problems. If we merely listen to Kerry and Noelle, they appear to reason identically. But if we look at their gestures, we can predict which of the two children is most likely to benefit from teaching. When researchers divided 5- to 8-year-olds into those producing speech–gesture matches and those producing mismatches and gave both groups the same training in conservation, those who produced mismatches before instruction were more likely to gain in understanding (Church & Goldin-Meadow, 1986; Ping & Goldin-Meadow, 2008).

Speech–gesture mismatches are common, occurring spontaneously in children of all ages and in adults as well. They have been studied in preschoolers explaining a game, counting objects, and assigning numbers to small and large sets; school-age children solving math problems and puzzles; and adults engaged in a wide variety of activities. Children who produce speech–gesture mismatches appear to be in cognitive transition or, as Piaget expressed it, a state of disequilibrium (see page 198 in Chapter 6). Their behavior indicates that they are considering two contradictory strategies at once, a sign of readiness to learn. On diverse tasks, children and adults who displayed speech–gesture mismatches were more likely than others to gain in performance as the result of teaching (Goldin-Meadow, 2015).

Gestures seem to provide a window into the thoughts of learners as they move from lesser to greater mastery of a problem. But beyond insight into children's thinking, gesturing can facilitate their reasoning, helping them work out their ideas.

In one study, children who were told to gesture while explaining solutions to math problems generated more new and accurate ideas in their gestures than control-group agemates told not to gesture or given no gesturing instructions (Broaders et al., 2007). When later taught how to solve the problems, the children who had been told to gesture displayed greater gains.

A 4-year-old gestures dramatically as she explains an event in a story—a combination of speech and action that promotes learning.

Furthermore, training children to produce either type of speech–gesture strategy (a match or a mismatch) while acquiring a concept promotes greater learning than asking them to produce only correct speech (Goldin-Meadow, Cook, & Mitchell, 2009; Wakefield & James, 2015).

Why does gesture promote learning? One conjecture is that it brings together two forms of representation, one in action and the other in speech, enabling the former to influence the latter. Consistent with this view, brain-imaging evidence suggests that gesturing during learning establishes sensorimotor representations in the cerebral cortex that learners reactivate during subsequent encounters with the task (Wakefield et al., 2014).

Parents and teachers can use children's gestures to provide teaching at the most opportune moments. And adults who gesture while teaching encourage children to gesture, which enhances learning (Goldin-Meadow, 2015).

Indeed, 2- to 5-year-olds readily draw appropriate inferences about nonobvious, inner features shared by category members. For example, even without detailed biological or mechanical knowledge, they realize that the insides of animals are responsible for causing certain behaviors (such as making oneself move) that are impossible for nonliving things, such as machines (Gelman, 2003). And after being told that a bird has warm blood and that a stegosaurus (dinosaur) has cold blood, preschoolers infer that a pterodactyl (labeled a dinosaur) has cold blood, even though it closely resembles a bird (Gopnik & Nazzi, 2003).

Nevertheless, when most instances of a category have a certain perceptual property (such as long ears), preschoolers readily categorize on the basis of perceptual features. This indicates that they flexibly use both nonobvious and perceptual information to classify, depending on the situation (Rakison & Lawson, 2013). Watching others interact with objects influences how preschoolers' categorize. When 3- and 4-year-olds observed an adult reveal a nonobvious property of a set of small containers (shaking them to see whether or not they made a sound), most preferred to sort the containers by the nonobvious property, even though they could have sorted by color (Yu & Kushnir, 2016). The children also generalized their bias for sorting by the nonobvious property to a new set of objects. This suggests that by watching the adult, they acquired a categorization strategy that they readily applied to new situations.

These preschoolers understand that a category ("dino-saurs") can be based on underlying characteristics ("cold-blooded"), not just on perceptual features such as upright posture and scaly skin.

Children's own past experience also influences how they categorize. A comparison of Native-American 5-year-olds growing up on the Menominee Reservation in northern Wisconsin with European-American 5-year-olds growing up in Boston revealed that the Menominee children often categorized animals according to their relation to the natural world. For example, they grouped together wolves and eagles because of their shared forest habitat (Ross et al., 2003). In contrast, the European-American children mostly categorized animals according to their common features.

During the second and third years, and perhaps earlier, children discriminate many *basic-level categories*—ones at an intermediate level of generality, such as "chairs," "tables," and "beds." By the third year, children easily move back and forth between basic-level categories and *general categories,* such as "furniture." And they break down basic-level categories into *subcategories,* such as "rocking chairs" and "desk chairs."

Preschoolers' rapidly expanding vocabularies and general knowledge support their impressive skill at categorizing, and they benefit greatly from conversations with adults, who frequently label and explain categories to them. When adults use the word *bird* for hummingbirds, turkeys, and swans, they signal to children that something other than physical similarity binds these instances together (Gelman & Kalish, 2006). Children also ask many questions about their world, the majority of which are information-seeking: "What's that?" "What does it do?" (Chouinard, 2007). Usually parents give informative answers that advance children's conceptual understanding. Picture-book reading is an especially rich context for category learning. In conversing about books, parents provide information that guides children's inferences about the structure of categories: "Penguins live at the South Pole, swim, catch fish, and have thick layers of fat and feathers that help them stay warm."

In sum, although preschoolers' category systems are less complex than those of older children and adults, they already have the capacity to classify hierarchically and on the basis of nonobvious properties. And they use logical, causal reasoning to identify the features that form the basis of a category and to classify new members.

9.1.6 Evaluation of the Preoperational Stage

Table 9.1 provides an overview of the cognitive attainments of early childhood just considered. Compare them with Piaget's description of the preoperational child on pages 311–312. The evidence as a whole indicates that Piaget was partly wrong and partly right about young children's cognitive capacities. When given simplified tasks based on familiar experiences, preschoolers show the beginnings of logical thinking. How can we make sense of the contradictions between Piaget's conclusions and the findings of recent research?

That preschoolers display logical understandings that strengthen with age indicates they attain logical operations gradually. Over time, children rely on increasingly effective mental (as opposed to perceptual) approaches to solving problems. For example, children who cannot use counting to compare two sets of items do not conserve number. Rather, they use perceptual cues to compare the amounts in two sets of items (Rouselle, Palmers, & Noël, 2004). Once preschoolers can count, they apply this skill to conservation-of-number tasks involving just a few items. As counting improves, they extend the strategy to problems with more items. Eventually, they realize that number remains the same after a transformation in the length and spacing of a set of items as long as nothing is added or taken away (Halford & Andrews, 2011). Consequently, they no longer need to count to verify their answer.

Evidence that preschool children can be trained to perform well on Piagetian problems also supports the idea that operational thought is not absent at one point in time and present at another (Siegler & Svetina, 2006). Children who possess some understanding would naturally benefit from training, unlike those with no understanding at all. The gradual development of logical operations poses a serious challenge to Piaget's assumption of abrupt change toward logical reasoning around age 6 or 7. Does a preoperational stage really exist? Some researchers no longer think so. Recall from Chapter 6 that according to the information-processing

TABLE 9.1 Some Cognitive Attainments of Early Childhood

APPROXIMATE AGE	COGNITIVE ATTAINMENTS
2–4 years © LAURA DWIGHT PHOTOGRAPHY	Shows a dramatic increase in representational activity, as reflected in the development of language, make-believe play, understanding of dual representation, and categorization
	Takes the perspective of others in simplified, familiar situations and in everyday, face-to-face communication
	Distinguishes animate beings from inanimate objects; prefers natural over supernatural explanations for events
	Grasps conservation, notices transformations, reverses thinking, and understands many cause-and-effect relationships in simplified, familiar situations
	Categorizes objects on the basis of common function, behavior, and natural kind as well as perceptual features, depending on context; uses nonobvious, inner features to categorize objects varying widely in external appearance
	Sorts familiar objects into hierarchically organized categories
4–7 years © RYAN MCVAY/PHOTODISC/GETTY IMAGES	Becomes increasingly aware that make-believe and other thought processes are representational activities
	Replaces beliefs in magical creatures and events with plausible explanations
	Passes Piaget's conservation of number, mass, and liquid problems

perspective, children work out their understanding of each type of task separately, and their thought processes are basically the same at all ages—just present to a greater or lesser extent.

Other experts think the stage concept is still valid, with modifications. For example, some *neo-Piagetian theorists* combine Piaget's stage approach with the information-processing emphasis on task-specific change (Case, 1998; Halford & Andrews, 2011). They believe that Piaget's strict stage definition must be transformed into a less tightly knit concept, one in which a related set of competencies develops over an extended period, depending on brain development and specific experiences. These investigators point to evidence that as long as the complexity of tasks and children's exposure to them are carefully controlled, children approach those tasks in similar, stage-consistent ways (Andrews & Halford, 2002; Case & Okamoto, 1996). For example, in drawing pictures, preschoolers depict objects separately, ignoring their spatial arrangement (return to the drawing in Figure 8.6 on page 299 in Chapter 8. In understanding stories, they grasp a single story line but have trouble with a main plot plus one or more subplots.

This flexible stage notion recognizes the unique qualities of early childhood thinking. At the same time, it provides a better account of why, as Leslie put it, "Preschoolers' minds are such a blend of logic, fantasy, and faulty reasoning."

9.1.7 Piaget and Education

Three educational principles derived from Piaget's theory continue to influence teacher training and classroom practices, especially those for young children:

- *Discovery learning.* In a Piagetian classroom, children are encouraged to discover for themselves through spontaneous interaction with the environment. Instead of presenting ready-made knowledge verbally, teachers provide a rich variety of activities designed to promote exploration and discovery, including art, puzzles, table games, dress-up clothing, building blocks, books, measuring tools, natural science tasks, and musical instruments.

- *Sensitivity to children's readiness to learn.* In a Piagetian classroom, teachers introduce activities that build on children's current thinking, challenging their incorrect ways of viewing the world. But they do not try to speed up development by imposing new skills before children indicate they are interested and ready.
- *Acceptance of individual differences.* Piaget's theory assumes that all children go through the same sequence of development, but at different rates. Therefore, teachers must plan activities for individual children and small groups, not just for the whole class. In addition, teachers evaluate educational progress in relation to each child's previous development, rather than on the basis of normative standards, or average performance of same-age peers.

Like his stages, educational applications of Piaget's theory have met with criticism, especially his insistence that young children learn primarily through acting on the environment (Bjorklund & Causey, 2016). As we have already seen, children also use language-based routes to knowledge—a point emphasized by Vygotsky's sociocultural theory, to which we now turn. Nevertheless, Piaget's influence on education has been powerful. He gave teachers new ways to observe, understand, and enhance young children's development and offered strong theoretical justification for child-oriented approaches to classroom teaching and learning.

ASK YOURSELF

Connect ■ Select two of the following features of preoperational thought: egocentrism, a focus on perceptual appearances, difficulty reasoning about transformations, and lack of hierarchical classification. Present evidence indicating that preschoolers are more capable thinkers than Piaget assumed.

Apply ■ Three-year-old Will understands that his tricycle isn't alive and can't feel or move on its own. But at the beach, while watching the sun dip below the horizon, Will exclaimed, "The sun is tired. It's going to sleep!" What explains this apparent contradiction in Will's reasoning?

Reflect ■ Did you have an imaginary companion as a young child? If so, what was your companion like, and why might you have created it? Were your parents aware of your companion? What was their attitude toward it?

9.2 Vygotsky's Sociocultural Theory

9.2a Describe Vygotsky's perspective on the social origins and developmental significance of children's private speech.

9.2b Describe applications of Vygotsky's theory to education, and evaluate his major ideas.

Piaget's de-emphasis on language as a source of cognitive development brought on yet another challenge, this time from Vygotsky's sociocultural theory, which stresses the social context of cognitive development. In Vygotsky's view, the child and the social environment collaborate to mold cognition in culturally adaptive ways. During early childhood, rapid expansion of language broadens preschoolers' participation in social dialogues with more knowledgeable individuals, who encourage them to master culturally meaningful tasks. Soon children start to communicate with themselves in much the same way they converse with others. This greatly enhances their thinking and ability to control their own behavior. Let's see how this happens.

9.2.1 Private Speech

Watch preschoolers as they play and explore the environment, and you will see that they frequently talk out loud to themselves. For example, as Sammy worked a puzzle, he said, "Where's the red piece? I need the red one. Now, a blue one. No, it doesn't fit. Try it here."

Piaget (1923/1926) called these utterances *egocentric speech,* reflecting his belief that young children have difficulty taking the perspectives of others. Their talk, he said, is often "talk for self" in which they express thoughts in whatever form they happen to occur, regardless

of whether a listener can understand. Piaget believed that cognitive development and certain social experiences eventually bring an end to egocentric speech. Specifically, through disagreements with peers, children see that others hold viewpoints different from their own. As a result, egocentric speech declines in favor of social speech, in which children adapt what they say to their listeners.

Vygotsky (1934/1987) disagreed with Piaget's conclusions. He maintained that language helps children think about their mental activities and behavior and select courses of action, thereby serving as the foundation for all higher cognitive processes, including controlled attention, deliberate memorization and recall, categorization, planning, problem solving, and self-reflection. In Vygotsky's view, children speak to themselves for self-guidance. As they get older and find tasks easier, their self-directed speech is internalized as silent, *inner speech*—the internal verbal dialogues we carry on while thinking and acting in everyday situations.

Because nearly all studies support Vygotsky's perspective, children's self-directed speech is now called **private speech** instead of egocentric speech. Research indicates that children use more of it when tasks are appropriately challenging (neither too easy nor too hard), after they make errors, or when they are confused about how to proceed. For example, Figure 9.5 shows how 5- and 6-year-olds' private speech increased as researchers made a problem-solving task moderately difficult, then decreased as the task became very difficult (Fernyhough & Fradley, 2005).

With age, as Vygotsky predicted, private speech goes underground, changing into whispers and silent lip movements. Furthermore, children who freely use private speech during a challenging activity are more attentive and involved and perform better than their less talkative agemates (Alarcón-Rubio, Sánchez-Medina, & Prieto-Garcia, 2014; Benigno et al., 2011; Lidstone, Meins, & Fernyhough, 2010). Private speech seems to play an important role in diverse activities in which children must manage their thinking and behavior, including regulating emotions, communicating clearly with others, strengthening autobiographical memories, and thinking flexibly, imaginatively, and creatively (Alderson-Day & Fernyhough, 2015).

Compared with their agemates, children with learning and behavior problems engage in more private speech over a longer period of development (Berk, 2001b; Bono & Bizri, 2014; Ostad, 2015; Winsler et al., 2007). They seem to use private speech to help compensate for challenges with attention and cognitive processing that make many tasks more difficult for them.

9.2.2 Social Origins of Early Childhood Cognition

Where does private speech come from? Recall from Chapter 6 that Vygotsky believed that children's learning takes place within the *zone of proximal development*—a range of tasks too difficult for the child to do alone but possible with the help of others. Consider the joint activity of Sammy and his mother, who helps him put together a difficult puzzle:

Sammy: "I can't get this one in." *[Tries to insert a piece in the wrong place.]*
Mother: "Which piece might go down here?" *[Points to the bottom of the puzzle.]*
Sammy: "His shoes." *[Looks for a piece resembling the clown's shoes but tries the wrong one.]*
Mother: "Well, what piece looks like this shape?" *[Pointing again to the bottom of the puzzle.]*
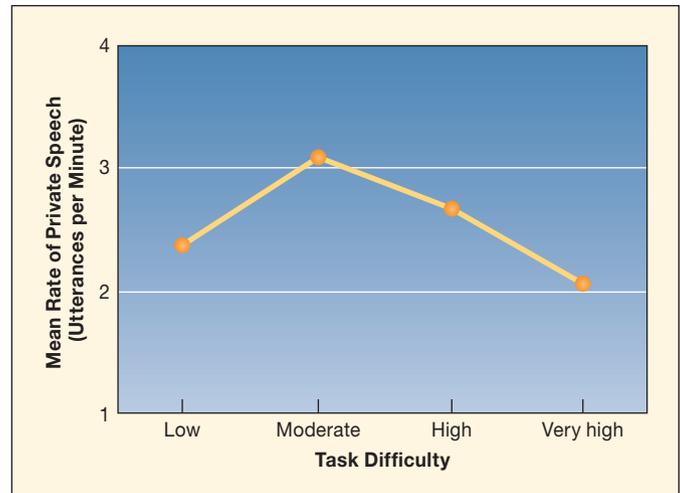
FIGURE 9.5 **Relationship of private speech to task difficulty among 5- and 6-year-olds.** Researchers increased the difficulty of a problem-solving task. Private speech rose as the task became moderately difficult, then declined as it became highly difficult. Children are more likely to use private speech for self-guidance when tasks are within their zone of proximal development, or range of mastery. (Adapted from Fernyhough & Fradley, 2005.)

A 4-year-old talks to herself as she attempts to mount a toy car on a tow truck. Research supports Vygotsky's theory that children use private speech to guide their thinking and behavior during challenging tasks.

Sammy: "The brown one." *[Tries it, and it fits; then attempts another piece and looks at his mother.]*

Mother: "Try turning it just a little." *[Gestures to show him.]*

Sammy: "There!" *[Puts in several more pieces while his mother watches.]*

By questioning, prompting, and suggesting strategies, Sammy's mother keeps the puzzle within his zone of proximal development, at a manageable level of difficulty.

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A father engages in scaffolding as his 4-year-old son uses blocks to lay out the streets of a miniature town. As the child gains in competence, his father will gradually withdraw support, permitting his son to take more responsibility for the task.

LOOK and LISTEN

Ask a preschooler to join you in working a difficult puzzle or mastering another challenging task. How did you scaffold the child's progress? Did the child display any self-guiding private speech?

Effective Social Interaction   To promote cognitive development, social interaction must have two vital features. The first is **intersubjectivity,** the process by which two participants who begin a task with different understandings arrive at a shared understanding (Newson & Newson, 1975). Intersubjectivity creates a common ground for communication, as each partner adjusts to the other's perspective. Adults try to promote it when they translate their own insights in ways that are within the child's grasp. As the child stretches to understand the adult, she is drawn into a more mature approach to the situation.

The capacity for intersubjectivity is present early, in parent–infant mutual gaze, exchange of vocal and emotional signals, imitation, and joint play with objects; and in toddlers' capacity to infer others' intentions (Brugué & Burriel, 2016; Csibra, 2010). Later, language facilitates intersubjectivity. As conversational skills improve, preschoolers increasingly seek others' help and direct that assistance to ensure that it is beneficial. Between ages 3 and 5, children strive for intersubjectivity in dialogues with peers, as when they affirm a playmate's message, add new ideas, and make contributions to ongoing play to sustain it. They can also be heard saying, "I think [this way]. What do you think?"—evidence of a willingness to share viewpoints (Berk, 2001b; Garte, 2015). In these ways, children create zones of proximal development for one another.

A second important feature of social experience is **scaffolding**—adjusting the support offered during a teaching session to fit the child's current level of performance. When the child has little notion of how to proceed, the adult uses direct instruction, breaking the task into manageable units, suggesting strategies, and offering rationales for using them. As the child's competence increases, effective scaffolders—like Sammy's mother—gradually and sensitively withdraw support, turning over responsibility to the child. Then children take the language of these dialogues, make it part of their private speech, and use this speech to organize their independent efforts. Although preschoolers freely use private speech when alone or when others are nearby, they use more in the presence of others (McGonigle-Chalmers, Slater, & Smith, 2014). This suggests that some private speech retains a social purpose, perhaps as an indirect appeal for renewed scaffolding should the child need additional help.

Scaffolding captures the form of teaching interaction that occurs as children work on school or school-like tasks, such as puzzles, model building, conversing about picture books, and (later) academic assignments. It may not apply to other contexts that are equally vital for cognitive development—for example, play or everyday activities, during which adults usually support children's efforts without deliberately teaching.

Research on Social Interaction and Cognitive Development   What evidence supports Vygotsky's ideas on the social origins of cognitive development? In previous chapters, we reviewed evidence indicating that when adults establish intersubjectivity by being stimulating, responsive, and supportive, they foster many competencies—attention, language, complex play, and understanding of others' perspectives. In several studies, children whose parents were effective scaffolders used more private speech, were more likely to succeed when attempting challenging tasks on their own, and were more advanced in executive function and overall intellectual performance than children of less effective scaffolders (Berk & Spuhl, 1995; Conner & Cross, 2003; Fay-Stammbach, Hawes, & Meredith, 2014). Improved scaffolding also helps explain why many home-based interventions aimed at enhancing parenting skills in poverty-stricken families result in cognitive gains in early childhood (Guttentag et al., 2014).

Effective scaffolding, however, can take different forms in different cultures. An investigation of Hmong families who had emigrated from Southeast Asia to the United States found, like other studies, that parental cognitive support was associated with children's advanced reasoning skills. But unlike European-American parents, who emphasize independence by encouraging their children to think of ways to approach a task, Hmong parents—who highly value interdependence and child obedience—frequently tell their children what to do (for example, "put this block piece here, then this piece on top of it") (Stright, Herr, & Neitzel, 2009). Among European-American kindergartners, such directive scaffolding is associated with lack of self-control and behavior problems (Neitzel & Stright, 2003). Among the Hmong kindergartners, it is linked to greater rule following, organization, and task completion.

9.2.3 Vygotsky and Early Childhood Education

Both Piagetian and Vygotskian classrooms emphasize active participation and acceptance of individual differences. But a Vygotskian classroom goes beyond independent discovery to promote *assisted discovery*. Teachers guide children's learning with explanations, demonstrations, and verbal prompts, tailoring their interventions to each child's zone of proximal development. Assisted discovery is aided by *peer collaboration,* as children with varying abilities work in groups, teaching and helping one another.

Vygotsky (1935/1978) saw make-believe play as the ideal social context for fostering cognitive development in early childhood. As children create imaginary situations, they learn to follow internal ideas and social rules rather than their immediate impulses. For example, a child pretending to go to sleep follows the rules of bedtime behavior. A child imagining himself as a father and a doll as a child conforms to the rules of parental behavior (Meyers & Berk, 2014). According to Vygotsky, make-believe play is a unique, broadly influential zone of proximal development in which children try out a wide variety of challenging activities and acquire many new competencies. (Turn back to page 309 to review evidence on the contributions of make-believe play to cognitive and social development.)

Make-believe play is also rich in private speech—a finding that supports its role in helping children bring action under the control of thought (Berk & Meyers, 2013). Preschoolers who spend more time engaged in sociodramatic play are better at inhibiting impulses, thinking flexibly, regulating emotion, and taking personal responsibility for following classroom rules (Elias & Berk, 2002; Kelly & Hammond, 2011; Lemche et al., 2003; Thibodeau et al., 2016). These findings support the role of make-believe in children's increasing self-control.

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In this Vygotsky-inspired classroom, preschoolers benefit from peer collaboration as they jointly create an elaborate block structure.

9.2.4 Evaluation of Vygotsky's Theory

In granting social experience a fundamental role in cognitive development, Vygotsky's theory underscores the vital role of teaching and helps us understand the wide cultural variation in children's cognitive skills. Nevertheless, his ideas have not gone unchallenged. In some cultures, verbal dialogues are not the only—or even the most important—means through which children learn. When Western parents scaffold their young children's mastery of challenging tasks, they assume much responsibility for children's motivation by frequently giving verbal instructions and conversing with the child. Their communication resembles the teaching that occurs in school, where their children will spend years preparing for adult life. In cultures that place less emphasis on schooling and literacy, parents often expect children to take greater responsibility for acquiring new skills through keen observation and participation in community activities (Rogoff, Correa-Chavez, & Silva, 2011). See the Cultural Influences box on page 322 for research illustrating this difference.

Finally, Vygotsky's theory says little about how basic motor, perceptual, attention, memory, and problem-solving skills, discussed in Chapters 5 and 6, contribute to socially transmitted higher cognitive processes. For example, his theory does not address how these elementary capacities spark changes in children's social experiences, from which more advanced

Cultural Influences | Children in Village and Tribal Cultures Observe and Participate in Adult Work

In Western societies, children are largely excluded from participating in adult work, which generally takes place outside the home. The role of equipping children with the skills they need to become competent workers is assigned to school. In early childhood, middle-SES parents' interactions with children emphasize child-focused activities designed to prepare children to succeed academically—especially adult–child conversations and play that enhance language, literacy, and other school-related knowledge. In village and tribal cultures, children receive little or no schooling, spend their days in contact with or participating in adult work, and start to assume mature responsibilities in early childhood (Gaskins, 2014). Consequently, parents have little need to rely on conversation and play to teach children.

A study comparing 2- and 3-year-olds' daily lives in four cultures—two U.S. middle-SES suburbs, the Efe hunters and gatherers of the Republic of Congo, and a Mayan agricultural town in Guatemala—documented these differences (Morelli, Rogoff, & Angelillo, 2003). In the U.S. communities, young children had little access to adult work and spent much time conversing and playing with adults. In contrast, the Efe and Mayan children rarely engaged in these child-focused activities. Instead, they spent their days close to—and frequently observing—adult work, which often took place in or near the Efe campsite or the Mayan family home.

An ethnography of a remote Mayan village in Yucatán, Mexico, shows that when young children are legitimate onlookers and participants in a daily life structured around adult work, their competencies differ from those of Western preschoolers (Gaskins, 1999; Gaskins, Haight, & Lancy, 2007). Yucatec Mayan adults are subsistence farmers. Men tend cornfields, aided by sons age 8 and older. Women prepare meals, wash clothes, and care for the livestock and garden, assisted by daughters and by sons too young to work in the fields. Children join in these activities from the second year on. When not participating, they are expected to be self-sufficient.

Young children make many nonwork decisions for themselves—how much to sleep and eat, what to wear, when to take their daily bath, and even when to start school. As a result, Yucatec Mayan preschoolers are highly competent at self-care. In contrast, their make-believe play is limited; when it occurs, they usually imitate adult work. Otherwise, they watch others—for hours each day.

Yucatec Mayan parents rarely converse or play with preschoolers or scaffold their learning. Rather, when children imitate adult tasks, parents conclude that they are ready for more responsibility. Then they assign chores, selecting tasks the child can do with little help so that adult work is not disturbed. If a child cannot do a task, the adult takes over and the child observes, reengaging when able to contribute.

Expected to be autonomous and helpful, Yucatec Mayan children seldom display attention-getting behaviors or ask others for something interesting to do. From an early age, they can sit quietly for long periods—through a lengthy religious service or a three-hour truck ride. And when an adult interrupts their activity and directs them to do a chore, they respond eagerly to the type of command that Western children frequently avoid or resent. By age 5, Yucatec Mayan children spontaneously take responsibility for tasks beyond those assigned.

In a South African village, a young child intently watches his mother grind grain. Children in village and tribal cultures observe and participate in the work of their community from an early age.

cognition springs (Bjorklund & Causey, 2016; Daniels, 2011). Piaget paid far more attention than Vygotsky to the development of basic cognitive processes. It is intriguing to speculate about the broader theory that might exist today had Piaget and Vygotsky—the two twentieth-century giants of cognitive development—had a chance to meet and weave together their extraordinary accomplishments.

ASK YOURSELF

Connect ■ Explain how Piaget's and Vygotsky's theories complement each other. How would classroom practices inspired by these theories be similar? How would they differ?

Apply ■ Tanisha sees her 5-year-old son Toby talking aloud to himself as he plays. She wonders whether she should discourage this behavior. Use Vygotsky's theory to explain why Toby talks to himself. How would you advise Tanisha?

Reflect ■ When do you use private speech? Does it serve a self-guiding function for you, as it does for children? Explain.

9.3 Information Processing

Return to the model of information processing discussed on pages 210–212 in Chapter 6. Recall that information processing focuses on cognitive operations and mental strategies that children use to transform stimuli flowing into their mental systems. As we have already seen, early childhood is a period of dramatic strides in mental representation. And the various components of *executive function* that enable children to succeed in cognitively challenging situations—inhibiting impulses and distracting stimuli, flexibly shifting attention depending on task demands, coordinating information in working memory, and planning—show impressive gains (Carlson, Zelazo, & Faja, 2013). Preschoolers also become more aware of their own mental life and begin to acquire academically relevant knowledge important for school success.

9.3a Describe changes in executive function and memory during early childhood.

9.3b Describe the young child's theory of mind.

9.3c Summarize children's literacy and mathematical knowledge during early childhood.

9.3.1 Executive Function

As parents and teachers know, preschoolers—compared with school-age children—spend shorter times involved in tasks and are more easily distracted. Control of attention improves substantially during early childhood, as studies of inhibition and flexible shifting reveal. As we will see, expansion of working memory supports these attainments. The components of executive function are closely interrelated in the preschool years, and they contribute vitally to academic and social skills from early childhood on (Nelson et al., 2016; Shaul & Schwartz, 2014).

Inhibition   With age, preschoolers gain steadily in ability to inhibit impulses and keep their mind on a competing goal. Consider a task in which the child must tap once when the adult taps twice and tap twice when the adult taps once or must say "night" to a picture of the sun and "day" to a picture of the moon with stars. As Figure 9.6 shows, 3- and 4-year-olds make many errors. But by age 6 to 7, children find such tasks easy (Diamond, 2004; Montgomery & Koeltzow, 2010). They can resist the "pull" of their attention toward a dominant stimulus—a skill that predicts social maturity as early as age 3 to 5 and reading and math achievement from kindergarten through high school (Allan et al., 2014; Duncan et al., 2007; Rhoades, Greenberg, & Domitrovich, 2009).

Flexible Shifting of Attention   In preschoolers and school-age children, the ability to shift one's focus of attention, depending on what's important at the moment, is often studied through rule-use tasks (Zelazo et al., 2013). In a commonly used procedure, the *Dimensional Change Card Sort,* children are asked to switch the rules they use to sort picture cards in the face of conflicting cues. For example, a child might first be told to sort pictures of boats and flowers using color rules, by placing all the blue boats and flowers in a box marked with a blue boat and all the red boats and flowers in a box marked with a red flower. Then the child is asked to switch to shape rules, placing all the boats (irrespective of color) into the box marked with the blue boat and all the flowers into the box marked with the red flower. Three-year-olds persist in sorting by color, whereas most 5-year-olds switch rules flexibly (Zelazo et al., 2013). But when researchers increase the complexity of the rules—for example, requiring children to shift from color to shape rules only on a subset of picture cards with an added black border—most 6-year-olds have difficulty (Henning, Spinath, & Aschersleben, 2011).

As these findings indicate, flexible shifting improves greatly during the preschool years, with gains continuing in middle childhood. Notice how inhibition contributes to preschoolers' flexible shifting (Kirkham, Cruess, & Diamond, 2003; Zelazo et al., 2013).
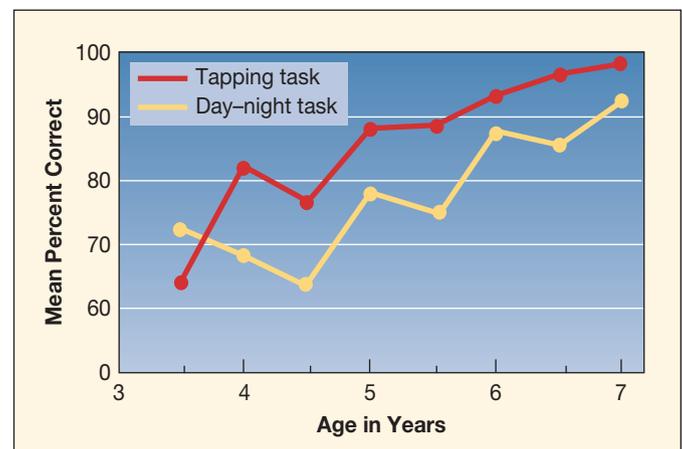
FIGURE 9.6   **Gains between ages 3 and 7 in performance on tasks requiring children to inhibit an impulse and focus on a competing goal.**   In the tapping task, children had to tap once when the adult tapped twice and tap twice when the adult tapped once. In the day–night task, children had to say "night" to a picture of the sun and "day" to a picture of the moon with stars. (From A. Diamond, 2004, "Normal Development of Prefrontal Cortex from Birth to Young Adulthood: Cognitive Functions, Anatomy, and Biochemistry," as appeared in D. T. Stuss & R. T. Knight, [Eds.], *Principles of Frontal Lobe Function,* New York: Oxford University Press, p. 474. Reprinted by permission of Adele Diamond.)

By playing a game of Simon Says, these 3- and 4-year-olds practice inhibition, refraining from acting when their teacher's command omits "Simon Says." Improved inhibition along with gains in working memory contributes to preschoolers' increasing capacity to flexibly shift attention and engage in more complex problem solving.

To switch rules, children must inhibit attending to the previously relevant dimension while focusing on the dimension they had just ignored.

Working Memory   Gains in working memory, enabling preschoolers to hold in mind and manipulate more information at once (see page 211 in Chapter 6), contribute to control of attention. A larger working memory permits preschoolers to generate increasingly complex play and problem-solving goals, which require concentration to attain (Senn, Espy, & Kaufmann, 2004). Greater working-memory capacity also eases effort in keeping several rules in mind, ignoring ones not currently important, and flexibly shifting one's focus to new rules, thereby improving performance.

With age, the ability to hold and combine information in working memory becomes increasingly important in problem solving. In one study, both inhibition and working-memory scores predicted 2½- to 6-year-olds' solutions to a problem-solving task requiring multistep planning. But working memory was a stronger predictor for the 4- to 6-year-olds than for the younger children (Senn, Espy, & Kaufman, 2004). Older preschoolers were able to deploy their larger working memories to solve more challenging problems involving planning.

Planning   As the findings just described suggest, early childhood is a time of marked gains in **planning**—thinking out a sequence of acts ahead of time and performing them accordingly to reach a goal. Because successful planning requires that basic executive processes be integrated with other cognitive operations, it is regarded as a complex executive function activity (Müller & Kerns, 2015). As long as tasks are not too difficult, older preschoolers can follow a plan.

Consider a task, devised to resemble real-world planning, in which 3- to 5-year-olds were shown a doll named Molly, a camera, and a miniature zoo with a path, along which were three animal cages. The first and third cages had storage lockers next to them; the middle cage, with no locker, housed a kangaroo (see Figure 9.7). The children were told that Molly could follow the path only once and that she wanted to take a picture of the kangaroo. Then they were asked, "What locker could you leave the camera in so Molly can get it and take a photo of the

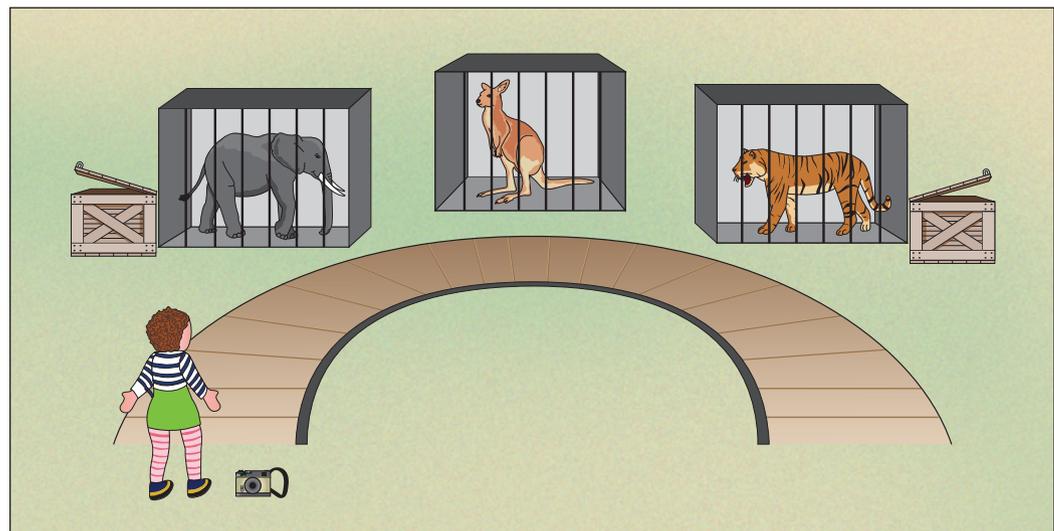**FIGURE 9.7**   **Miniature zoo used to assess children's planning.** After having been told that Molly wanted to take a picture of the kangaroo but could follow the path only once, preschoolers were asked which locker the camera should be left in so Molly could get it and take the photo. Not until age 5 did children plan, more often selecting the first locker. (Based on McColgan & McCormack, 2008.)

kangaroo?" (McColgan & McCormack, 2008). Not until age 5 were children able to plan effectively, selecting the locker at the first cage.

On this and other planning tasks, younger preschoolers have difficulty (McCormack & Atance, 2011). By the end of early childhood, children make strides in postponing action in favor of mapping out a sequence of future moves, evaluating the consequences of each, and adjusting their plan to fit task requirements.

Parenting, Socioeconomic Status, and Development of Executive Function   Parental sensitivity, encouragement, and scaffolding foster preschoolers' executive function skills, as many investigations reveal (Carlson, Zelazo, & Faja, 2013; Devine, Bignardi, & Hughes, 2016). In one study, parental scaffolding of 2- and 3-year-olds while jointly solving a challenging puzzle predicted higher scores on diverse executive function tasks at age 4 (Hammond et al., 2012). Among the 2-year-olds, effective scaffolding led to gains in language, which in turn promoted executive function, perhaps by augmenting children's ability to verbally regulate their behavior through private speech.

With respect to planning, children learn much from cultural tools that support it—directions for playing games, diagrams for construction, recipes for cooking— especially when they collaborate with expert planners who offer scaffolded assistance. In another investigation, mothers were observed jointly using a diagram to construct a structure out of interlocking blocks with their 3-year-olds. Those who pointed out the overall goal of the task, modeled the successive steps needed to reach the goal, and encouraged planning ("Do you want to look at the picture and see what pieces you need first?") had children who scored higher in math achievement when they reached first grade (Lombardi et al., 2017). Parents who take advantage of many opportunities to promote planning in everyday activities, from loading the dishwasher to packing for a vacation, help their children plan more effectively while also enhancing their academic success.

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Children learn much from cultural tools that support planning. This preschooler consults a box-top illustration to decide which pieces he should insert next into a partially completed puzzle.

A wealth of evidence confirms that from early childhood on, children from low-SES families score less well on measures of executive function than their higher-SES counterparts— a difference that contributes to SES variations in achievement throughout middle childhood and adolescence (Hackman et al., 2015; Lawson & Farah, 2017). Conditions more common in low-SES homes—reduced parental scaffolding, negative parent–child interactions, and fewer informal learning opportunities—interfere with the development of preschoolers' executive function, thereby diminishing their literacy and math skills and thus their readiness for formal schooling (Devine, Bignardi, & Hughes, 2016).

Poverty exerts an especially negative impact on executive function, in part through maladaptive parenting practices and chronic stress (Lawson et al., 2016). In a sample diverse in SES and ethnicity, poverty-stricken mothers more often interacted harshly and intrusively with their 7- to 24-month-olds—parenting behaviors associated with children's elevated cortisol levels and with poor executive function scores during a follow-up at age 3 (Blair et al., 2011). As the authors noted, poverty and negative parenting undermined early stress regulation, promoting "reactive and inflexible rather than reflective and flexible forms of behavior and cognition" (p. 1980).

Factors that compromise young children's executive function are prime targets for early intervention. In an investigation conducted in rural Pakistan, where extreme poverty is widespread, mothers were randomly assigned to either a parenting intervention or a control group receiving only food supplements during their child's first two years. During monthly group meetings and home visits, trained health workers taught intervention-group mothers about child development and coached them on how to engage in appropriate play and communication activities with their children (Obradović et al., 2016; Yousafzai et al., 2014). Follow-ups revealed that the parenting intervention led to improved home stimulation and maternal scaffolding, which predicted gains in children's cognitive skills, including executive function, at age 4.

As we will see later, preschool intervention is another route to strengthening executive function (Blair, 2016). These approaches may be among the best ways to protect young children from the adverse effects of poverty on brain development, discussed in Chapter 8.

9.3.2 Memory

The memory changes that infants and toddlers experience during the first two years are largely *implicit,* taking place without conscious awareness. In contrast, preschoolers have the language skills to describe what they remember, and they can follow directions on simple memory tasks. This enables researchers to focus on *explicit,* or conscious, memory, which undergoes the greatest change throughout development.

Recognition and Recall   Show a young child a set of 10 pictures of objects. Then mix them up with some unfamiliar items, and ask the child to point to the ones in the original set. You will find that preschoolers' *recognition* memory—ability to tell whether a stimulus is the same as or similar to one they have seen before—is remarkably good. In fact, 4- and 5-year-olds perform nearly perfectly.

Now keep the items out of view, and ask the child to name the ones she saw. This more demanding task requires *recall*—generating a mental image of an absent stimulus. Young children's recall is much poorer than their recognition. At age 2, they can recall no more than one or two items, and at age 4 only about three or four (Perlmutter, 1984).

Gains in recall in early childhood are strongly associated with language development, which greatly enhances long-lasting representations of both lists of items and past experiences (Melby-Lervag & Hulme, 2010). But even preschoolers with good language skills recall poorly because they are not skilled at using **memory strategies**—deliberate mental activities that improve our chances of remembering. Preschoolers do not yet *rehearse,* or repeat items over and over, to remember. Nor do they *organize,* intentionally grouping items that are alike (all the animals together, all the vehicles together) so they can easily retrieve those items by thinking of their similar characteristics—even after they are trained to do so (Bauer, 2013). Memory strategies tax the limited working memories of preschoolers, who have difficulty holding onto pieces of information and applying a strategy at the same time.

Memory for Everyday Experiences   Think about the difference between your recall of listlike information and your memory for everyday experiences—what researchers call **episodic memory.** In remembering everyday experiences, you recall information in context—linked to a particular time, place, or person. In remembering lists, you recall isolated pieces—information removed from the context in which it was first learned that has become part of your general knowledge base. Researchers call this type of memory **semantic memory.**

Between 3 and 6 years, children improve sharply in memory for relations among stimuli. For example, in a set of photos, they remember not just the animals they saw but also their contexts, such as a bear emerging from a tunnel or a zebra tied to a tree on a city street (Lloyd, Doydum, & Newcombe, 2009). The capacity to *bind together stimuli* supports the development of an increasingly rich episodic memory.

Memory for Routine Events   Like adults, preschoolers remember familiar, everyday events—what you do when you go to child care or have dinner—in terms of **scripts,** general descriptions of what occurs and when it occurs in a particular situation. Young children's scripts begin as a structure of main acts. For example, when asked to tell what happens at a restaurant, a 3-year-old might say, "You go in, get the food, eat, and then pay." Although children's first scripts contain only a few acts, as long as events in a situation take place in logical order, they are almost always recalled in correct sequence (Bauer, 2006, 2013). With age, scripts become more elaborate, as in this 5-year-old's account of going to a restaurant: "You go in. You can sit in a booth or at a table. Then you tell the waitress what you want. You eat. If you want dessert, you can have some. Then you pay and go home" (Hudson, Fivush, & Kuebli, 1992).

Scripts help children (and adults) organize, interpret, and predict routine experiences. Once formed, scripts can be used to predict what will happen on similar

Like adults, preschoolers remember familiar, repeated events, such as brushing teeth, in terms of scripts. Over time, children construct more elaborate scripts: "You squeeze out the toothpaste and brush your teeth. You rinse your mouth and then your toothbrush."

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occasions in the future. Children rely on scripts to assist recall when listening to and telling stories. They also act out scripts in make-believe play as they pretend to put the baby to bed, go on a trip, or play school. And scripts support children's planning by helping them represent sequences of actions that lead to desired goals (Hudson & Mayhew, 2009).

Memory for One-Time Events In addition to memory for routine events, a second type of episodic memory, which we considered in Chapter 6, is *autobiographical memory*—representations of personally meaningful, one-time events. As preschoolers' cognitive and conversational skills improve, their descriptions of special events become better organized in time, more detailed, enriched with a personal perspective, and related to the larger context of their lives. A young preschooler simply reports, "I went camping." Older preschoolers include specifics: where and when the event happened and who was present. And with age, preschoolers increasingly include subjective information—why, for example, an event was exciting, funny, sad, or made them feel proud or embarrassed—that explains the event's personal significance (Bauer, 2013; Pathman et al., 2013). For example, they might say, "I *loved* sleeping all night in the tent!"

Adults use two styles to elicit children's autobiographical narratives. In the *elaborative style,* they follow the child's lead, ask varied questions, add information to the child's statements, and volunteer their own recollections and evaluations of events, assisting the child in weaving together a story. For example, after a field trip to the zoo, Leslie asked, "What was the first thing we did? Why weren't the parrots in their cages? I thought the lion was scary. What did you think?" In this way, she helped the children reestablish and reorganize their memory of the field trip. In contrast, adults who use the *repetitive style* provide little information and keep repeating the same questions, regardless of the child's interest: "Do you remember the zoo? What did we do at the zoo? What did we do there?" Elaborative-style parents *scaffold* the autobiographical memories of their young children, who recall more information about past events and also produce more organized and detailed personal stories when followed up later in childhood and in adolescence (Reese, 2002; Valentino et al., 2014).

As children talk with adults about the past, they not only improve their autobiographical memories but also create a shared history that strengthens close relationships and self-understanding. Parents and preschoolers with secure attachment bonds engage in more elaborative reminiscing (Bost et al., 2006). And 5- and 6-year-old children of elaborative-style parents describe themselves in clearer, more consistent ways (Bird & Reese, 2006).

Girls tend to produce more organized and detailed personal narratives than boys. Compared with East Asian children, Western children produce narratives with more talk about their own thoughts and emotions. These differences fit with variations in parent–child conversations. Parents reminisce in greater detail and talk more about the emotional significance of events with daughters (Fivush & Zaman, 2014). And cultural valuing of an interdependent self leads many East Asian parents to discourage children from talking about themselves (Fivush & Wang, 2005).

Consistent with these early experiences, women report an earlier age of first memory and more vivid early memories than men. And Western adults' autobiographical memories include earlier, more detailed events that focus more on their own roles than do the memories of Asians, who tend to highlight the roles of others (Wang, 2008).

Finally, parents can be trained to use an elaborative style, which increases the richness of their preschoolers' episodic memories (Reese & Newcombe, 2007). And preschoolers with elaborative-style parents also display more strategylike behaviors (naming and pointing) and attain higher scores on listlike memory tasks (recall of a just-viewed set of objects) (Langley, Coffman, & Ornstein, 2017). By providing children with many opportunities to search their memories, elaborative-style parents seem to give them practice in skills needed to succeed on memory tasks they will encounter often in school.

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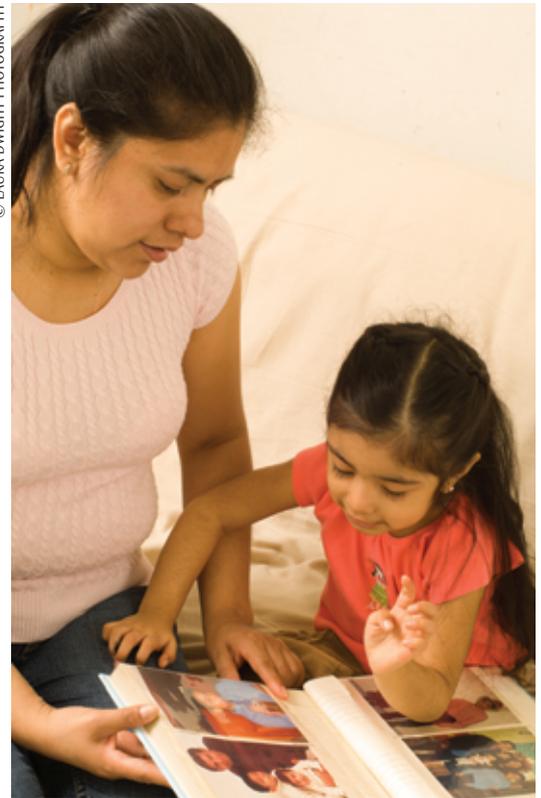
As this 3-year-old talks about past experiences while exploring a family photo album, her mother responds in an elaborative style, asking varied questions and contributing her own recollections and evaluations of events. Elaborative-style conversations enrich young children's autobiographical memories.
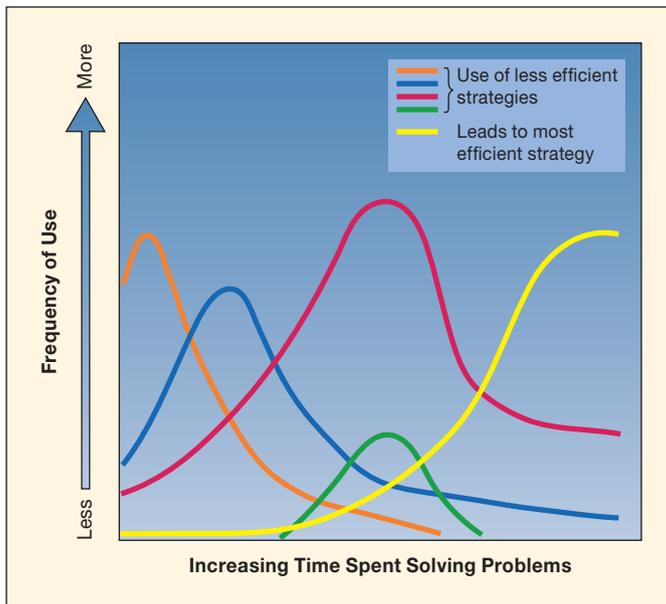
FIGURE 9.8   **Overlapping-waves pattern of strategy use in problem solving.** When given challenging problems, a child generates a variety of strategies, each represented by a wave. The waves overlap because the child tries several different strategies at the same time. Use of each strategy, depicted by the height of the wave, is constantly changing. As the child observes which strategies work best, which work less well, and which are ineffective, the strategy that results in the most rapid, accurate solutions wins out. (From R. S. Siegler, 1996, *Emerging Minds: The Process of Change in Children's Thinking.* Copyright © 1996 by Oxford University Press, Inc. Adapted by permission of Oxford University Press, Inc.)

9.3.3 Problem Solving

How do preschoolers use their cognitive competencies to discover new problem-solving strategies? To find out, let's look in on 5-year-old Darryl as he adds marbles tucked into pairs of small bags that Leslie set out on a table.

As Darryl tries to add each pair, his strategies vary. Sometimes he guesses, without applying any strategy. At other times, he counts from one on his fingers. For example, for bags containing 2 + 4 marbles, his fingers pop up one by one as he exclaims, "One, two, three, four, five, six!" On still other occasions, he starts with the lower digit, 2, and "counts on" ("two, three, four, five, six"). Or he begins with the higher digit, 4, and "counts on" ("four, five, six")— a strategy called *min* because it minimizes the work. Sometimes, he simply retrieves the answer from memory.

To study children's problem solving, Robert Siegler (1996, 2006) used the microgenetic research design (see page 44 in Chapter 1), presenting children with many problems over an extended time. He found that children experiment with diverse strategies on many types of problems—basic math facts, numerical estimation, conservation, memory for lists of items, reading first words, spelling, even tic-tac-toe. And their strategy use follows the overlapping-waves pattern shown in Figure 9.8. According to **overlapping-waves theory,** when given challenging problems, children try out various strategies and observe which work best, which work less well, and which are ineffective. Gradually, they select strategies on the basis of two criteria: *accuracy* and *speed*—for basic addition, the *min* strategy. As children home in on effective strategies for solving the problems at hand, correct solutions become more strongly associated with problems in long-term memory, and children display the most efficient strategy—automatic retrieval of the answer.

How do children move from less to more effective strategies? Often they discover faster, more accurate strategies by using more time-consuming techniques. For example, by repeatedly counting on fingers, Darryl began to recognize the number of fingers he held up. Also, certain problems dramatize the need for a better strategy. When Darryl opened a pair of bags, one containing ten marbles and the other with only two, he realized that *min* would be best. Teaching children to reason logically with concepts relevant to the problems is also helpful (Alibali, Phillips, & Fischer, 2009; Siegler & Svetina, 2006). Once Darryl understood that he got the same result regardless of the order in which he combined two sets (3 + 6 = 9 and 6 + 3 = 9), he more often used *min* and arrived at correct answers. Finally, a large improvement in the accuracy of a newly discovered strategy over previous strategies generally leads to rapid adoption of the new approach (Siegler, 2006).

As children transition to automatic retrieval, functional magnetic resonance imaging (fMRI) reveals reorganized and better integrated activity in networks of brain regions involved in memory-based problem solving (Cho et al., 2011; Qin et al., 2014). These include the prefrontal cortex, the hippocampus, and other areas in the cerebral cortex known to support long-term retention. Augmented brain functioning, in turn, likely enhances future problem solving.

Many factors, including practice, tasks with new challenges, adult scaffolding, and problem-relevant knowledge, contribute to gains in problem solving (Chu et al., 2018). And experimenting with less mature strategies lets children see the limitations of those strategies. In sum, overlapping-waves theory emphasizes that trying many strategies is vital for developing new, more effective solution techniques. The overlapping-waves pattern characterizes problem solving across a wide range of ages. And in the tradition of the information-processing approach, the theory views development as occurring gradually, rather than in discontinuous stages.

9.3.4 The Young Child's Theory of Mind

As mental representation, memory, and problem solving improve, children start to reflect on their own thought processes and construct a *theory of mind,* or coherent set of ideas about mental activities. These understandings are also known as **metacognition,** or "thinking about thought" (the prefix *meta-* means "beyond" or "higher"). As adults, we have a complex appreciation of our inner mental worlds, which we use to interpret our own and others' behavior and to improve our performance on various tasks. How early are children aware of their mental lives, and how complete and accurate is their knowledge?

Awareness of Mental Life   At the end of the first year, babies view people as intentional beings who can share and influence one another's mental states, a milestone that opens the door to new forms of communication—joint attention, social referencing, preverbal gestures, and spoken language. These early milestones serve as the foundation for later mental understandings. In longitudinal research, 8- to 10-month-olds' ability to engage in joint attention and grasp others' intentions predicted theory-of-mind competence at age 4 (Brooks & Meltzoff, 2015; Wellman et al., 2008).

As they approach age 2, children display a clearer grasp of others' emotions and desires, evident in their realization that people often differ from one another and from themselves in likes, dislikes, wants, needs, and wishes ("Mommy like broccoli. Daddy like carrots. I no like carrots."). As 2-year-olds' vocabularies expand, their first verbs include such mental-state words as *want, think, remember,* and *pretend* (Wellman, 2011).

By age 3, children realize that thinking takes place inside their heads and that a person can think about something without seeing, touching, or talking about it (Flavell, Green, & Flavell, 1995). But 2- to 3-year-olds' verbal responses indicate that they think people always behave in ways consistent with their *desires;* they do not understand that less obvious, more interpretive mental states, such as *beliefs,* also affect behavior. Between ages 3 and 4, children use *think* and *know* to refer to their own and others' thoughts and beliefs (Wellman, 2011). And from age 4 on, they realize that both *beliefs* and *desires* determine behavior.

Dramatic evidence for this advance comes from games that test whether preschoolers realize that *false beliefs*—ones that do not represent reality accurately—can guide people's behavior. For example, show a child two small closed boxes—a familiar Band-Aid box and a plain, unmarked box (see Figure 9.9). Then say, "Pick the box you think has the Band-Aids in it." Children usually pick the marked container. Next, open the boxes and show the child that, contrary to her own belief, the marked one is empty, and the unmarked one contains the Band-Aids. Finally, introduce the child to a hand puppet and explain, "Here's Pam. She has a cut, see? Where do you think she'll look for Band-Aids? Why would she look in there? Before you looked inside, did you think that the plain box contained the Band-Aids? Why?" (Bartsch & Wellman, 1995). Only a handful of 3-year-olds can explain Pam's—and their own—false beliefs, but many 4-year-olds can.

Some researchers claim that the procedures just described, which require verbal responses, grossly underestimate younger children's ability to attribute false beliefs to others. Relying on the violation-of-expectation method (which depends on looking behavior), these investigators assert that children comprehend others' false beliefs by age 15 months (Baillargeon, Scott, & He, 2010). But like other violation-of-expectation evidence, this conclusion is controversial (see page 201 in Chapter 6) (Siroiss & Jackson, 2007).

Yet in a study relying on active behavior (helping), most 18-month-olds—after observing an adult reach for a box previously used for blocks that now contains a spoon—based their choice of how to help her on her false belief about the contents of the box: They gave her a block rather than a spoon (Buttelmann et al., 2014). This indicates that toddlers *implicitly* grasp that

(a)   (b)
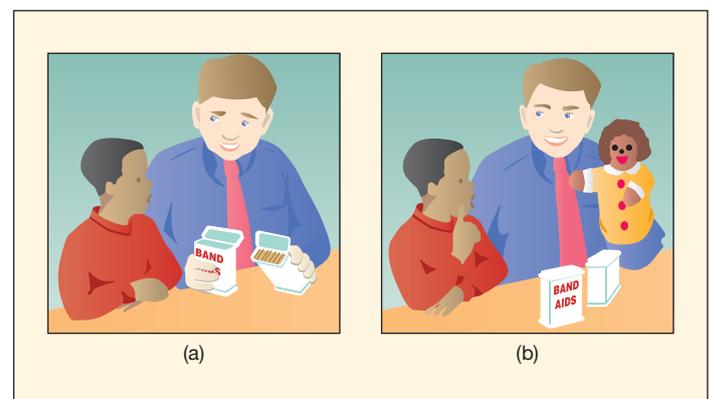
FIGURE 9.9   **Example of a false-belief task.** (a) An adult shows a child the contents of a Band-Aid box and of an unmarked box. The Band-Aids are in the unmarked container. (b) The adult introduces the child to a hand puppet named Pam and asks the child to predict where Pam would look for the Band-Aids and to explain Pam's behavior. The task reveals whether children understand that without having seen that the Band-Aids are in the unmarked container, Pam will hold a false belief.

people's actions can be guided by a false belief—a sensitivity that may be prerequisite for a mature theory of mind. But the striking contrast between toddlers' success on nonverbal tasks and 3-year-olds' consistent failure on verbal assessments suggests that toddlers' appreciation of false beliefs is minimal (Butterfill & Apperly, 2013; Ruffman, 2014).

Among children of diverse cultural and SES backgrounds, *explicit* false-belief understanding, assessed with verbal tasks, strengthens after age 3½, becoming more secure between ages 4 and 6 (Wellman, 2012). During that time, it becomes a powerful tool for reflecting on the thoughts and emotions of oneself and others and a good predictor of social skills (Hughes, Ensor, & Marks, 2010). Understanding the mind contributes to *selective trust*—the realization that some people are more credible sources of information than others. For example, preschoolers' developing grasp of mental states, including false belief, predicts greater willingness to follow the advice of a helpful person as opposed to a trickster, which emerges around age 5 (Vanderbilt, Liu, & Heyman, 2011).

Finally, mastery of false belief is associated with early reading ability, probably because it helps children comprehend story narratives (Astington & Pelletier, 2005). To follow a story line, children generally must link plot actions with characters' motives and beliefs.

Factors Contributing to Preschoolers' Theory of Mind

How do children develop a theory of mind beginning at such a young age? Research indicates that language, executive function, make-believe play, and social experiences all contribute.

Because their language lacks mental state terms, Quechua children of the Peruvian highlands take longer to master false-belief tasks than children in industrialized nations.

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Language and Verbal Reasoning The prefrontal cortex seems to play a crucial role in theory-of-mind development. Brain-wave recordings obtained while 4- to 6-year-olds reasoned about others' beliefs revealed that children who pass false-belief tasks (as opposed to those who fail) display a distinct pattern of activity in the left prefrontal cortex (Liu et al., 2009). This left-prefrontal pattern also appears when adults reason verbally about mental concepts.

Understanding the mind requires the ability to reflect on thoughts, which language makes possible. Many studies indicate that language ability strongly predicts preschoolers' grasp of false belief (Milligan, Astington, & Dack, 2007). Grammatical competence and use of mental-state terms in conversation are associated with passing false-belief tasks, likely because these linguistic features help clarify the differing perspectives people bring to the same event—for example, "Heidi thought that peanut butter was in the jar, but Isra knew it was really tahini" (Brooks & Meltzoff, 2015; de Villiers & de Villiers, 2014; San Juan & Astington, 2012).

Children with language impairments are often delayed in mastery of false belief (Stanzione & Schick, 2014). And native language attributes make a difference, too. The Quechua people of the Peruvian highlands refer to mental states such as "think" and "believe" indirectly because their language lacks mental-state terms. Quechua children have difficulty with false-belief tasks for years after children in industrialized nations have mastered them (Vinden, 1996).

Executive Function Several aspects of preschoolers' executive function—inhibition, flexible shifting of attention, and planning—predict mastery of false belief because they enhance children's ability to reflect on people's experiences and mental states (Benson et al., 2013; Marcovitch et al., 2015; Müller et al., 2012). Inhibition is strongly related to mastery of false belief and other theory of mind tasks, perhaps because each requires suppression of the tendency to assume that others' perspectives are the same as one's own (Carlson, Claxton, & Moses, 2015; Carlson, Moses, & Claxton, 2004).

Make-Believe Play Make-believe offers a rich context for thinking about the mind. As children act out roles, they often express the thoughts and emotions of the characters they portray and then reason about their implications (Saracho, 2014). Preschoolers who engage in extensive fantasy play or who have imaginary companions—and, thus, are deeply absorbed in creating make-believe characters—are advanced in understanding false belief and other aspects of the mind (Astington & Jenkins, 1995; Lalonde & Chandler, 1995). And as theory of mind develops, it may enhance the richness of children's make-believe.

Social Interaction Social experiences promote understanding of the mind. In longitudinal research, the maternal "mind-mindedness" experienced by securely attached babies (frequent commentary on their mental states) was positively associated with later performance on false-belief and other theory-of-mind tasks (Laranjo et al., 2010; Meins et al., 2003; Ruffman et al., 2006). And as we saw earlier, secure attachment is also related to more elaborative parent–child narratives, which often include discussions of mental states that help preschoolers think about their own and others' mental lives (Ontai & Thompson, 2008; Taumoepeau & Ruffman, 2006).

Also, preschoolers with siblings who are children (but not infants)—especially those with older siblings or two or more siblings—tend to be more aware of false beliefs because they are exposed to more family talk about varying thoughts, beliefs, and emotions (Devine & Hughes, 2018; Hughes et al., 2010; McAlister & Peterson, 2013). Similarly, preschool friends who often engage in mental-state talk are advanced in false-belief and other mental-state understandings (de Rosnay & Hughes, 2006). These exchanges offer children extra opportunities to talk about their own and others' inner states.

Children with cultural backgrounds emphasizing interdependence, where talk about one's own opinions and emotions is discouraged, are delayed in passing false-belief tasks in relation to Western children. Preschoolers growing up in China and Iran, for example, attain a grasp of explicit false belief somewhat later than their Australian and American agemates (Shahaeian et al., 2011; Wellman et al., 2006). Both Chinese and Iranian parents teach children to respect their elders' authority and to avoid disagreeing with the viewpoints of parents and other family members.

Core knowledge theorists (see pages 207–209 in Chapter 6) believe that to profit from the social experiences just described, children must be biologically prepared to develop a theory of mind. They claim that children with *autism,* for whom mastery of false belief is either greatly delayed or absent, are deficient in the brain mechanism that enables humans to detect mental states. See the Biology and Environment box on page 332 to find out more about the biological basis of reasoning about the mind.

Interaction with siblings, especially older siblings, contributes to preschoolers' awareness of others' perspectives and, therefore, promotes understanding of false belief.

Limitations of the Young Child's Theory of Mind   Though surprisingly advanced, preschoolers' awareness of mental activities is far from complete. For example, 3- and 4-year-olds are unaware that people continue to think while they wait, look at pictures, listen to stories, or read books—that is, when there are no obvious cues that they are thinking. Preschoolers also do not realize that when two people view the same object, their trains of thought will differ because of variations in their knowledge and other characteristics (Eisbach, 2004; Flavell, Green, & Flavell, 1995, 2000).

A major reason for these findings is that children younger than age 6 pay little attention to the *process* of thinking. When asked about subtle distinctions between mental states, such as *know* and *forget,* they express confusion. And they often insist that they have always known information they just learned (Lyon & Flavell, 1994; Taylor, Esbenson, & Bennett, 1994). Finally, they believe that all events must be directly observed to be known. They do not understand that *mental inferences* can be a source of knowledge (Miller, Hardin, & Montgomery, 2003).

These findings suggest that preschoolers view the mind as a passive container of information. Consequently, they greatly underestimate the amount of mental activity that people engage in and are poor at inferring what people know or are thinking about. As they move into middle childhood, they will increasingly view the mind as an active, constructive agent—a change we will consider in Chapter 12.

9.3.5 Early Literacy and Mathematical Development

Researchers are studying how children's information-processing capacities affect the development of basic reading, writing, and mathematical skills that prepare them for school. The way preschoolers begin to master these complex activities gives us additional information about their cognitive strengths and limitations—knowledge we can use to foster early literacy and mathematical development.

Biology and Environment | Autism and Theory of Mind

Michael stood at the water table in Leslie's classroom, repeatedly filling a plastic cup and dumping out its contents—dip-splash, dip-splash—until Leslie came over and redirected his actions. Without looking at Leslie's face, Michael moved to a new repetitive pursuit: pouring water from one cup into another and back again. As other children entered the play space and conversed, Michael hardly noticed. He rarely spoke, and when he did, he usually used words to get things he wanted, not to exchange ideas.

Michael has *autism,* a term meaning "absorbed in the self." Autism varies in severity along a continuum, called *autism spectrum disorder.* Michael's difficulties are substantial. Like other similarly affected children, by age 3 he displayed deficits in two core areas of functioning. First, he had only limited ability to engage in social interaction—evident in his difficulty with nonverbal communication, such as eye gaze, facial expressions, gestures, imitation, and give-and-take, and in his delayed and stereotyped language: He used words to echo what others said and to get things he wanted, not to exchange ideas. Second, his interests were narrow and overly intense. For example, one day he sat for more than an hour spinning a toy Ferris wheel. And Michael showed another typical feature of autism: He engaged in much less make-believe play than other children (American Psychiatric Association, 2013; Tager-Flusberg, 2014).

Researchers agree that autism stems from abnormal brain functioning, usually due to genetic or prenatal environmental causes. Beginning in the first year, children with the disorder have larger-than-average brains, with the greatest excess in brain-region volume occurring in the prefrontal cortex (Courchesne et al., 2011). This brain overgrowth is believed to result from lack of synaptic pruning, which accompanies typical development of cognitive, language, and communication skills. Furthermore, preschoolers with autism show a deficient left-hemispheric response to speech sounds (Eyler, Pierce, & Courchesne, 2012). Failure of the left hemisphere of the cerebral cortex to lateralize for language may underlie these children's language deficits.

The amygdala, devoted to emotion processing (see page 252 in Chapter 7), also grows abnormally large in childhood, followed by a greater than average reduction in size in adolescence and adulthood. This deviant growth pattern is believed to contribute to deficits in emotion processing and social interaction involved in the disorder (Allely, Gillberg, & Wilson, 2014). fMRI studies reveal that autism is associated with reduced activity in areas of the cerebral cortex involved in emotional and social responsiveness and with weaker connections between the amygdala and the temporal lobes (important for processing facial expressions) (Monk et al., 2010).

Mounting evidence reveals that children with autism are impaired in theory of mind. As early as the first two years, they show deficits in capacities believed to contribute to an understanding of mental life, including interest in observing people's actions, joint attention, and social referencing (Chawarska, Macari, & Shic, 2013; Warreyn, Roeyers, & De Groote, 2005). Long after they reach the intellectual level of an average 4-year-old, they have great difficulty with false belief. Most find it hard to attribute mental states to themselves or others (Hoogenhout & Malcolm-Smith, 2017). They rarely use mental-state words such as *believe, think, know, feel,* and *pretend.*

Do these findings indicate that autism is due to impairment in an innate, core brain function that leaves the child unable to detect others' mental states and therefore deficient in human sociability? Some researchers think so (Baron-Cohen, 2011; Baron-Cohen & Belmonte, 2005). Others point out that individuals with general intellectual disability but not autism also do poorly on tasks assessing mental understanding (Yirmiya et al., 1998). This suggests that cognitive deficits are largely responsible.

One hypothesis with growing research support is that children with autism are impaired in executive function (Kimhi et al., 2014; Kouklari

A teacher works with this child, who has autism, on social skills such as making eye contact. Researchers disagree on whether the deficiencies accompanying autism result from a basic inability to detect others' mental states, an impairment in executive function, or a style of information processing that focuses on parts rather than patterns and coherent wholes.

et al., 2017; Pugliese et al., 2016). This leaves them deficient in skills involved in flexible, goal-oriented thinking, including inhibiting irrelevant responses, shifting attention, and generating plans.

Another possibility is that children with autism display a peculiar style of information processing, preferring to process the parts of stimuli over patterns and coherent wholes (Booth & Happé, 2016). Deficits in thinking flexibly and in holistic processing of stimuli would each interfere with understanding the social world because social interaction requires quick integration of information from various sources and evaluation of alternative possibilities.

It is not clear which of these hypotheses is correct. Perhaps several biologically based deficits underlie the tragic social isolation of children like Michael.

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Literacy   One week, Leslie's students created a make-believe grocery store. They placed empty food boxes on shelves in the classroom, labeled items with prices, made shopping lists, and wrote checks at the cash register. A sign at the entrance announced the daily specials: "APLS BNS 5¢" ("apples bananas 5¢").

As their play reveals, preschoolers understand a great deal about written language long before they learn to read or write in conventional ways. This is not surprising: Children in industrialized nations live in a world filled with written symbols. Each day, they observe and participate in activities involving storybooks, calendars, lists, and signs. Children's active efforts to construct literacy knowledge through informal experiences are called **emergent literacy.**

Young preschoolers search for units of written language as they "read" memorized versions of stories and recognize familiar signs ("PIZZA"). But they do not yet understand the symbolic function of the elements of print (Bialystok & Martin, 2003). Many preschoolers think that a single letter stands for a whole word or that each letter in a person's signature represents a separate name. Initially, as we noted in Chapter 8, preschoolers do not distinguish between drawing and writing but often believe that letters (like pictures) resemble the meanings they represent. For example, one child explained that the word sun begins with the letter O because that letter is shaped like the sun; to demonstrate, he drew an O surrounded with rays to produce a picture of the sun.

Children revise these ideas as their perceptual and cognitive capacities improve, as they encounter writing in many contexts, and as adults help them with written communication. Gradually, preschoolers notice more features of written language and depict writing that varies in function, as in the "story" and "grocery list" in Figure 9.10.

Eventually children figure out that letters are parts of words and are linked to sounds in systematic ways, as 5- to 7-year-olds' invented spellings illustrate. At first, children rely on sounds in the names of letters: "ADE LAFWTS KRMD NTU A LAVATR" ("eighty elephants crammed into a[n] elevator"). Over time, they grasp sound–letter correspondences and learn that some letters have more than one common sound and that context affects their use (*a* is pronounced differently in "cat" than in "table") (McGee & Richgels, 2012).

Literacy development builds on a broad foundation of spoken language and knowledge about the world (Dickinson, Golinkoff, & Hirsh-Pasek, 2010). **Phonological awareness**—the ability to reflect on and manipulate the sound structures of spoken language, as indicated by sensitivity to changes in sounds within words, to rhyming, and to incorrect pronunciation—is a strong predictor of emergent literacy and later reading and spelling achievement (Gillon, 2018). When combined with sound–letter knowledge, it enables children to isolate speech segments and link them with their written symbols. Vocabulary and grammatical knowledge are also influential. And preschoolers' narrative competence, assessed through having them retell stories, fosters diverse language skills essential for literacy progress, including phonological awareness (Gardner-Neblett & Iruka, 2015; Piasta et al., 2018). Coherent storytelling requires attention to large language structures, such as character, setting, problem, and resolution. This seems to support the smaller-scale analysis involved in awareness of sound structures.

The more informal literacy experiences young children have, the better their language and emergent literacy development and their later reading and writing skills (Aram & Levin, 2014; Dickinson & McCabe, 2001). Pointing out letter–sound correspondences and playing language–sound games enhance children's awareness of the sound structures of language and how they are represented in
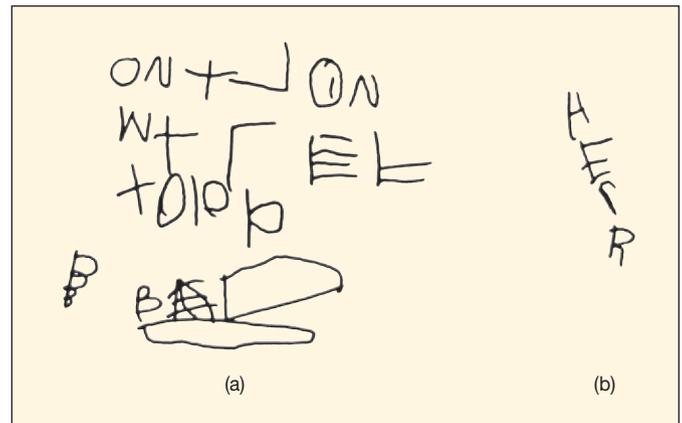
FIGURE 9.10   **A story (a) and a grocery list (b) written by a 4-year-old child.** This child's writing has many features of real print. It also reveals an awareness of different kinds of written expression. (From McGee, Lea M., & Richgels, Donald J., 2004, *Literacy's Beginnings: Supporting Young Readers and Writers,* 4th Ed. Copyright © 2004. Reprinted and electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.)

Preschoolers acquire literacy knowledge informally by participating in everyday activities involving written symbols. These young chefs "write down" orders they need to fill.

print (Ehri & Roberts, 2006; Foy & Mann, 2003). *Interactive reading,* in which adults discuss storybook content with preschoolers, promotes many aspects of language and literacy development. And adult-supported writing activities that focus on narrative, such as preparing a letter or a story, also have wide-ranging benefits (Purcell-Gates, 1996; Wasik & Bond, 2001). In longitudinal research, each of these literacy experiences is linked to improved reading achievement in middle childhood (Hood, Conlon, & Andrews, 2008; Senechal & LeFevre, 2002; Storch & Whitehurst, 2001; Wasik, Hindman, & Snell, 2016).

Preschoolers from low-SES families have fewer home and preschool language and literacy learning opportunities—a gap that translates into large differences in emergent literacy skills at kindergarten entry and into widening disparities in reading achievement during the school years (Cabell et al., 2013; Strang & Piasta, 2016). Age-appropriate books, for example, are scarce in their environments, and parents read to their children far less often than in higher-SES families, in part because many low-SES parents' own language and literacy skills are less well developed (Puglisi et al., 2017). Over time, skilled readers acquire wide-ranging knowledge more efficiently, progressing more rapidly than poor readers in all achievement areas (Neuman, 2006). In this way, literacy deficiencies at the start of school contribute to widening achievement disparities between economically advantaged and disadvantaged children that often persist into high school.

High-quality intervention can reduce the SES gap in early literacy development substantially. Providing low-SES parents with children's books, along with guidance in how to stimulate emergent literacy, greatly enhances literacy activities in the home (Huebner & Payne, 2010). And when teachers are shown how to engage in effective early childhood instruction of diverse literacy skills, low-SES preschoolers gain in emergent literacy components included in their classroom experiences (Hilbert & Eis, 2014; Lonigan et al., 2013). For ways to support early childhood literacy development, refer to Applying What We Know on the following page.

Mathematical Reasoning   Mathematical reasoning, like literacy, builds on informal knowledge. Between 14 and 16 months, toddlers display a beginning grasp of **ordinality,** or order relationships between quantities—for example, that 3 is more than 2, and 2 is more than 1. In the early preschool years, children attach verbal labels (*lots, little, big, small*) to amounts and sizes. Sometime in the third year, they begin to count. By the time children turn 3, most can count rows of about five objects, although they do not yet know what the words mean. For example, when asked for *one,* they give one item, but when asked for *two, three, four,* or *five,* they usually give a larger, but incorrect, amount. Nevertheless, 2½- to 3½-year-olds realize that a number word refers to a unique quantity (Sarnecka & Gelman, 2004). They know that when a number label changes (for example, from *five* to *six*), the number of items should also change. Soon they comprehend the meaning of the first three to four number words.

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A 3½-year-old counts blocks of different colors. Grasping the principle of cardinality—that the last number word in a sequence indicates the quantity of items in a set—spurs development of numerical knowledge and skills.

By age 3½ to 4, most children have mastered the numbers up to *ten,* count correctly, and grasp the vital principle of **cardinality**— that the last number word in a counting sequence indicates the quantity of items in the set, and each additional number word is one more than the preceding number (Sarnecka & Wright, 2013). In the preschool scene described in the opening of this chapter, Sammy showed an understanding of cardinality when he counted four children at his snack table and then retrieved four milk cartons. Grasping cardinality seems to spur development of crucial numerical knowledge and skills. Once preschoolers attain this insight, they show improved understanding of the quantities and relative magnitudes (7 is more than 4, 12 is more than 10) that number words represent, and their counting increases in accuracy and efficiency (Geary & vanMarle, 2018; Knudsen, Fischer, & Aschersleben, 2015).

Around age 4, children use counting to solve simple arithmetic problems. At first, their strategies are tied to the order of numbers presented; to add 2 + 4, they count on from 2 (Bryant & Nunes, 2002). But soon they experiment with other strategies and master

APPLYING WHAT WE KNOW

Supporting Emergent Literacy in Early Childhood

STRATEGY	EXPLANATION
Provide literacy-rich home and preschool environments.	Homes and preschools with abundant reading and writing materials—including a wide variety of children's storybooks, some relevant to children's ethnic backgrounds—open the door to a wealth of language and literacy experiences. Make-believe play in which children have many opportunities to use newly acquired literacy skills in meaningful ways spurs literacy development.
Engage in interactive book reading.	When adults discuss story content, ask open-ended questions about story events, explain the meaning of words, and point out features of print, they promote language development, comprehension of story content, knowledge of story structure, and awareness of units of written language.
Provide outings to libraries, museums, parks, zoos, and other community settings.	Visits to child-oriented community settings enhance children's general knowledge and offer many opportunities to see how written language is used in everyday life. They also provide personally meaningful topics for narrative conversation, which promote many language skills essential for literacy development.
Point out letter–sound correspondences, play rhyming and other language–sound games, and read rhyming poems and stories.	Experiences that help children isolate the sounds in words foster phonological awareness—a powerful predictor of early childhood literacy knowledge and later reading and spelling achievement.
Support children's efforts at writing, especially narrative products.	Assisting children in their efforts to write—especially letters, stories, and other narratives—fosters many language and literacy skills.
Model literacy activities.	When children see adults engaged in reading and writing activities, they better understand the diverse everyday functions of literacy skills and the knowledge and pleasure that literacy brings. As a result, children's motivation to become literate strengthens.

Sources: McGee & Richgels, 2012.

the *min* strategy, a more efficient approach (see page 328)—in this example, beginning with 4, the higher digit. Around this time, children realize that subtraction cancels out addition. Knowing, for example, that $4 + 3 = 7$, they infer without counting that $7 - 3 = 4$ (Rasmussen, Ho, & Bisanz, 2003). Grasping basic arithmetic rules greatly facilitates rapid, accurate computation. With enough practice, children recall answers automatically and gradually extend their knowledge to larger numbers.

Understanding basic arithmetic makes possible beginning estimation—the ability to generate approximate answers, which are useful for evaluating the accuracy of exact answers. After watching several doughnuts being added to or removed from a plate of four to ten doughnuts, 3- and 4-year-olds make sensible predictions about how many are on the plate (Zur & Gelman, 2004). Still, children can estimate only just beyond their calculation competence. For example, preschoolers who can solve addition problems with sums up to 10 can estimate answers with sums up to about 20 (Dowker, 2003). And as with arithmetic operations, children try out diverse estimation strategies, gradually moving to more efficient, accurate techniques.

The arithmetic knowledge just described emerges universally around the world. But when adults provide occasions for counting, comparing quantities, and talking about numbers, children acquire these understandings sooner (Ginsburg, Lee, & Boyd, 2008). In one study, preschoolers' grasp of number concepts was enhanced by just a brief, 5-minute teaching session in which an adult modeled counting and labeling of the number of items in a set beyond which the child could currently count (Posid & Cordes, 2018).

Numerical knowledge at age 4—especially, understanding the cardinal value of number words—is strongly related to math knowledge and skills at school entry, after diverse factors that might otherwise explain the relationship (such as IQ, executive function, and parental education) are controlled (Geary & vanMarle, 2016; Geary et al., 2018). Math proficiency

LOOK and LISTEN

Ask several parents of preschoolers what they routinely do to help their children learn about math. Then ask what they do to support literacy. Do the parents promote math as much as literacy learning?

FIGURE 9.11   A number board game. An adult and child took turns using a spinner with a "1" section and a "2" section, which indicated how far to move a token on each turn. Children were asked to say the number spun and the numbers on the spaces as they moved. For example, a child on 5 who spun 2 would say "6, 7." Compared with agemates who played a color version of the game (it had only colored spaces on the board and a spinner with matching color sections), low-SES 4-year-olds who played the number board game showed large gains in number concepts and counting proficiency from 1 to 10. (From R. S. Siegler, 2009, "Improving Preschoolers' Number Sense Using Information-Processing Theory," in O. A. Barbarin & B. H. Wasik, eds., *Handbook of Child Development and Early Education*. New York: Guilford, p. 438. Reprinted by permission of Guilford Publications, Inc.)

at school entry, in turn, predicts math achievement years later, in elementary and secondary school (Duncan et al., 2007; Romano et al., 2010).

As with emergent literacy, children from low-SES families receive less stimulation and support at home for acquiring numerical concepts and skills and, thus, begin kindergarten with considerably less math knowledge than their economically advantaged agemates (Elliott, 2018). In several studies, just a few sessions devoted to playing number board games with an adult (see Figure 9.11 for an example) led to dramatic improvements in low-SES 4- to 5-year-olds' numerical understanding and proficiency at counting (Siegler, 2009; Siegler & Braithwaite, 2017). And in an early childhood math curriculum called *Building Blocks,* materials that promote math concepts and skills through three types of media—computers, manipulatives, and print—enable teachers to weave math into many preschool daily activities, from block-building to art and stories (Clements et al., 2011). Compared with agemates randomly assigned to other preschool programs, low-SES preschoolers experiencing Building Blocks showed substantially greater year-end gains in math concepts and skills, including counting, sequencing, arithmetic computation, and knowledge of geometric shapes.

ASK YOURSELF

Connect ■ Cite evidence on the development of preschoolers' executive function, memory, theory of mind, and literacy and mathematical understanding that is consistent with Vygotsky's sociocultural theory.

Apply ■ Lena wonders why her 4-year-old son Gregor's teacher provides extensive playtime in learning centers during each preschool day. Explain to Lena how adult-supported play can promote literacy and math skills essential for academic success.

Reflect ■ Describe informal experiences important for literacy and math development that you experienced while growing up.

9.4 Individual Differences in Mental Development

9.4 Describe early childhood intelligence tests and the impact of home, preschool and kindergarten programs, child care, and educational media on mental development.

Psychologists and educators typically measure how well preschoolers are developing mentally by giving them intelligence tests. Scores are computed in the same way as they are for infants and toddlers (return to page 221 in Chapter 6 to review). But tests for preschoolers sample a much wider range of mental abilities. Understanding the link between early childhood experiences and intelligence test performance is essential for identifying ways to intervene in support of children's cognitive development.

9.4.1 Early Childhood Intelligence Tests

Five-year-old Hal sat in a small, unfamiliar testing room while Sarah gave him an intelligence test. Some of Sarah's questions were *verbal*. For example, she showed Hal a picture of a shovel and said, "Tell me what this is"—an item measuring vocabulary. She tested Hal's working memory by asking him to repeat lists of letters and numbers backward. She probed his quantitative knowledge and problem solving by seeing if he could count and solve simple addition and subtraction problems. Finally, to assess Hal's spatial reasoning, Sarah used *nonverbal*

tasks: Hal copied designs with special blocks, figured out the pattern in a series of shapes, and indicated what a piece of paper folded and cut would look like when unfolded (Roid, 2003; Wechsler, 2012).

The questions Sarah asked Hal tap knowledge and skills that not all children have equal opportunity to learn. In Chapter 12, we will take up the hotly debated issue of *cultural bias* in mental testing. For now, keep in mind that intelligence tests do not sample all human abilities, and performance is affected by cultural and situational factors. Nevertheless, test scores remain important: By age 6 to 7, they are good predictors of later IQ and academic achievement, which are related to adult vocational success in industrialized societies. Let's see how the environments in which children spend their days—home, preschool, and child care—affect mental test performance.

9.4.2 Home Environment and Mental Development

A special version of the *Home Observation for Measurement of the Environment (HOME),* covered in Chapter 6, assesses aspects of 3- to 6-year-olds' home lives that foster intellectual growth. Research with the HOME early childhood subscales reveals that preschoolers who develop well intellectually have homes rich in educational toys and books. Their parents are warm and affectionate, stimulate language and academic skills, and arrange interesting outings. They also make reasonable demands for socially mature behavior—for example, that the child perform simple chores and behave courteously toward others. And these parents resolve conflicts with reason instead of physical force and punishment (Bradley & Caldwell, 1982; Espy, Molfese, & DiLalla, 2001; Roberts, Burchinal, & Durham, 1999).

When low-SES parents manage, despite low education and income, to obtain high HOME scores, their preschoolers do substantially better on tests of intelligence, language, and emergent literacy skills (Berger, Paxson, & Waldfogel, 2009; Mistry et al., 2008). In a study of African-American 3- and 4-year-olds from low-income families, HOME cognitive stimulation and emotional support subscales predicted reading achievement four years later (Zaslow et al., 2006). These findings (along with others we will discuss in Chapter 12) highlight the vital contribution of home environmental quality to children's overall intellectual development.
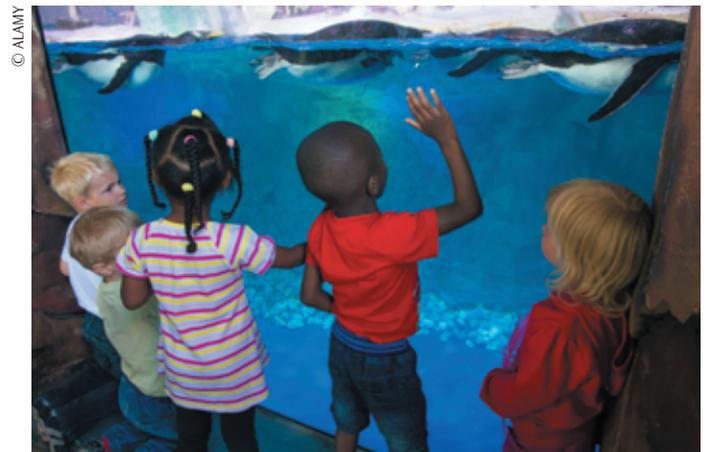
Parents who arrange interesting outings, such as a visit to an aquarium, encourage their children's intellectual development.

9.4.3 Preschool, Kindergarten, and Child Care

Largely because of the rise in maternal employment, over the past several decades the number of young children enrolled in preschool or child care has steadily increased to more than 65 percent in the United States (U.S. Bureau of Labor Statistics, 2018). The line between preschool and child care is fuzzy. Parents often select a preschool as a child-care option. And in response to the needs of employed parents, many U.S. preschools, as well as most public school kindergartens, have increased their hours from half to full days (U.S. Department of Education, 2018).

With age, preschoolers tend to shift from home-based to center-based early childhood programs. In the United States, children of higher-income parents and children of very low-income parents are especially likely to attend preschools or child-care centers (U.S. Department of Education, 2018). Many low-income working parents rely on care by relatives because they are not eligible for public preschool or government-subsidized child-care centers. A few states offer government-funded prekindergarten programs located within public schools to all 4-year-olds. The goal of these universal prekindergartens is to ensure that as many children as possible, from all SES levels, enter kindergarten prepared to succeed.

Types of Preschool and Kindergarten   Preschool and kindergarten programs range along a continuum from child-centered to teacher-directed. In **child-centered programs,** teachers provide activities from which children select, and much learning takes place through

play. In contrast, in **academic programs,** teachers structure children's learning, teaching letters, numbers, colors, shapes, and other academic skills through formal lessons, often using repetition and drill.

Despite evidence that formal academic training undermines young children's motivation and emotional well-being, early childhood teachers have felt increased pressure to take this approach. Preschoolers and kindergartners who spend much time in large-group, teacher-directed academic instruction and completing worksheets—as opposed to being actively engaged in learning centers by warm, responsive teachers—display more stress behaviors (such as wiggling and rocking), have less confidence in their abilities, prefer less challenging tasks, and are less advanced in motor, academic, language, and social skills at the end of the school year (Stipek, 2011; Stipek et al., 1995). Follow-ups reveal lasting effects through elementary school in poorer study habits and lower achievement test scores (Burts et al., 1992; Hart et al., 1998; Stipek, 2004; Stipek et al., 2017). These outcomes are strongest for low-SES children, with whom teachers more often use a directive, academic approach—a disturbing trend in view of its negative impact on motivation and learning.

Although government spending for universal prekindergarten is controversial in the United States, in Western Europe such programs are widespread and child-centered in their daily activities. Enrolled preschoolers of all SES backgrounds show gains in cognitive and social development still evident in elementary and secondary school (Rindermann & Ceci, 2008; Waldfogel & Zhai, 2008). Findings on some U.S. universal prekindergarten programs that meet rigorous state standards of quality—especially, provision of rich teacher–child interactions and stimulating learning activities—reveal up to a one-year advantage in kindergarten and first-grade language, literacy, and math scores relative to those of children not enrolled (Gormley & Phillips, 2009; Weiland & Yoshikawa, 2013). Children from low-SES families benefit most.

A special type of child-centered approach is Montessori education, devised more than a century ago by Italian physician and child development researcher Maria Montessori, who originally applied her method to poverty-stricken children. Features of Montessori schooling include multiage classrooms, long time periods for individual and small-group learning in child-chosen activities, teaching materials specially designed to enable children to move from easier to more complex tasks at their own pace and skill level, and equal emphasis on academic content and social development (Lillard, 2008). In a study that followed children diverse in ethnicity and family income from ages 3 to 6, researchers compared the development of those randomly assigned to either Montessori or other public preschools. From age 4 on, the Montessori children outperformed their other-preschool agemates in language, literacy, and math knowledge; mastery motivation (preference for solving a challenging rather than easy puzzle); and theory of mind, including false belief (Lillard et al., 2017). Especially impressive, the Montessori preschools substantially reduced the gap in academic knowledge typically found between low- and higher-SES children.

Five-year-olds in a Montessori classroom benefit cognitively and socially from specially designed teaching materials that permit them to learn at their own pace and from ample time for both individual and small-group learning.

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Montessori children also reported greater liking of academic tasks, perhaps because of the leeway they have to select their own activities. Children and adults alike tend to be more satisfied when they are given options, which grants them a sense of self-determination (Ryan & Deci, 2017). Another educational approach that combines child autonomy with focused learning is *guided play*. See the Social Issues: Education box on the following page for evidence on its effectiveness.

As for the dramatic rise in U.S. full-day preschools and kindergartens, the longer school day is associated with better academic achievement in elementary school for children of all SES backgrounds, though gains generally diminish over time. And findings for social development are mixed (Ansari, 2018; Brownell et al., 2015; Cooper et al., 2010; Thompson & Sonnenschein, 2015). In some studies, children in full-day as opposed to half-day have more behavior problems, whereas other studies report social benefits or no difference.

Social Issues: Education | Teaching Through Guided Play

"Play is the core of my teaching approach because it's hands-on. It keeps the children engaged, excited about learning, and supports the development of so many important capacities," Leslie explained to the parents of her preschool students during an open house. "But I also need to intervene in that play to make sure my students acquire the knowledge and skills they'll need to succeed in school."

Like Leslie, many early childhood teachers seek a middle ground between child-controlled playful exploration and teacher-directed academic tutoring. **Guided play,** which integrates child autonomy and playful exploration with adult-guided instruction, enables teachers to preserve the voluntary, engaging, and flexible features of play while ensuring that children focus on content relevant to learning goals (Weisberg et al., 2016). Adults can implement guided play in two ways.

In the first, teachers arrange activities by setting out a limited, carefully chosen set of materials that emphasizes a learning goal. Then they permit children to explore those materials relatively freely while keeping the learning goal in mind. For example, when an adult showed 4- to 9-year-olds evidence that conflicted with their belief that only the size of an object affects the size of its shadow, all children (even preschoolers) experimented successfully while playing with a "shadow machine," varying the distance of two equal-size objects from a light source to verify that distance also influences shadow size (van Schijndel et al., 2015). In comparison, only half the children who received evidence confirming their initial belief discovered the importance of distance.

In a second approach to guided play, adults observe child-controlled, playful activities, making comments and suggestions and asking questions that extend children's knowledge and deepen their curiosity. In an investigation that took place in kindergarten classrooms, children were divided into small groups and given miniature toys and letter tiles to be used to promote phonological awareness (word rhyming and sounds of initial letters in words). In groups assigned to a guided play condition, a teacher assisted the children in collaboratively making up a game through which they practiced the skills using the objects. In groups serving as controls, a teacher told the children how to practice the skills. Students experiencing guided play showed greater gains in literacy knowledge that extended well beyond the skills taught. The guided-play condition also offered other benefits, including practice in social skills such as negotiating with peers and (since most games involved fanciful pretend scenarios) in imagination, humor, and creativity (Cavanaugh et al., 2017). Children experiencing guided play so enjoyed the experience that they continued to play the games they had invented during recess and at other times.

Notice how in guided play, adult *scaffolding* promotes progress toward a learning goal while capitalizing on the power of play to spur children's motivation to learn. A growing number of studies report that guided play leads to more favorable outcomes in early childhood than other types of learning. It exceeds direct instruction, resulting in greater transfer of acquired knowledge to new situations while cultivating children's enthusiasm for learning (Alfieri et al., 2011; Fisher et al., 2013). And although free play promotes many skills in early childhood, children often must be pointed toward relevant aspects of a play situation to learn from it. By integrating adult scaffolding with child exploration, guided play offers an optimal means of doing so.

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Guided play combines adult scaffolding of learning with the pleasurable, motivating features of play. As these preschoolers explore pieces of a tree trunk, a teacher makes comments and suggestions that enhance the children's knowledge and curiosity.

Early Educational Intervention for At-Risk Preschoolers   In the 1960s, as part of the "War on Poverty" in the United States, many intervention programs for low-SES preschoolers were initiated in an effort to address learning problems prior to school entry. The most extensive of these federal programs, **Project Head Start,** began in 1965. A typical Head Start center provides children with a year or two of preschool, along with nutritional and health services. Parent involvement is central to the Head Start philosophy. Parents serve on policy councils, contribute to program planning, work directly with children in classrooms, attend special programs on parenting and child development, and receive services directed at their own emotional, social, and vocational needs. Currently, Head Start serves about 1 million children and their families across the nation (Office of Head Start, 2018).

Benefits of Preschool Intervention Several decades of research have established the long-term benefits of preschool intervention. The most extensive study combined data from seven programs implemented by universities or research foundations. Results showed that
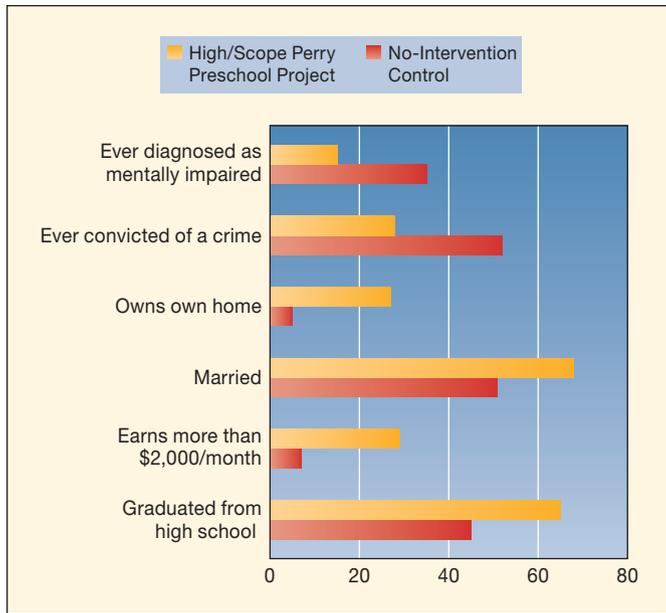
FIGURE 9.12   Some outcomes of the High/Scope Perry Preschool Project on follow-up at age 27. Although two years of a cognitively enriching preschool program did not eradicate the effects of growing up in poverty, children who received intervention were advantaged over no-intervention controls on all measures of life success when they reached adulthood. (Adapted from Schweinhart, 2010; Schweinhart et al., 2005.)

poverty-stricken children who attended programs scored higher in IQ and achievement than no-intervention controls during the first two to three years of elementary school. After that, differences declined (Lazar & Darlington, 1982). But on real-life measures of school adjustment, children and adolescents who had received intervention remained ahead. They were less likely to be placed in special education or retained in grade, and a greater number graduated from high school.

A separate report on one program—the High/Scope Perry Preschool Project—revealed benefits lasting well into adulthood. Two years' exposure to cognitively enriching preschool was associated with increased employment and reduced pregnancy and delinquency rates in adolescence. At age 27, those who had attended preschool were more likely than their no-preschool counterparts to have earned both high school and college degrees, have higher incomes, be married, and own their own home—and less likely to have been involved with the criminal justice system (see Figure 9.12). In the most recent follow-up, at age 40, the intervention group sustained its advantage on all measures of life success, including education, income, family life, and law-abiding behavior (Schweinhart, 2010; Schweinhart et al., 2005).

Do effects on school adjustment of these excellent interventions generalize to Head Start and other community-based preschool interventions? Gains are similar, though not as strong, because the quality of services provided often does not equal that of model university-based programs (Barnett, 2011). But community-based interventions of documented high quality are associated with diverse life-success outcomes, including higher rates of high school graduation and college enrollment and lower rates of school absenteeism, grade retention, and adolescent drug use and delinquency (Yoshikawa et al., 2013).

A consistent finding is that gains in IQ and achievement test scores from attending Head Start and other interventions quickly dissolve. In the Head Start Impact Study, a nationally representative sample of 5,000 Head Start eligible 3- and 4-year-olds was randomly assigned to one year of Head Start or to a control group that could attend other types of preschool programs, though half were cared for by a parent or other relative (Puma et al., 2012; U.S. Department of Health and Human Services, 2010b, 2014). By year's end, Head Start 3-year-olds exceeded controls in vocabulary, emergent literacy, and math skills; Head Start 4-year-olds were ahead in vocabulary, emergent literacy, and color identification. Head Start 3-year-olds also benefited socially, displaying declines in overactivity and withdrawn behavior. But except for language skills, academic test-score advantages were no longer evident by the end of first grade. And Head Start graduates did not differ from controls on any achievement measures at the end of third grade.

What explains these disappointing results? Head Start programs vary considerably in quality, and children who attend typically enter inferior public schools in poverty-stricken neighborhoods, which undermine the benefits of preschool intervention (Ramey, Ramey, & Lanzi, 2006). In one evaluation of a Head Start program of especially high quality, achievement gains in math were still evident in middle school (Phillips, Gormley, & Anderson, 2016).

Furthermore, in the Head Start Impact Study and other research, children from higher-risk families (single-parent, low education, non-English-speaking, deeper poverty, parental psychological problems) benefitted most from Head Start, academically and socially. And children who experienced two years (entering at age 3) rather than just one year displayed greater academic gains at the end of

Project Head Start provides preschoolers from poverty-stricken families with preschool education and nutritional and health services. High-quality early educational intervention is associated with diverse life success outcomes, including reduced need for special education assistance and higher rates of high school graduation and college enrollment.

their Head Start experience (Cooper & Lanza, 2014; Lee, 2011). Recall from Chapter 6 that when high-quality intervention begins in infancy and is sustained through the preschool years, IQ gains are more likely to endure into adulthood (see pages 224–226 in Chapter 6).

The long-term, improved school adjustment that results from attending a one- or two-year high-quality preschool education program is especially impressive. Program effects on parents may contribute: The more involved parents are in Head Start, the better their child-rearing practices and the more stimulating their home learning environments. These factors are positively related to preschoolers' independence, task persistence, and year-end academic, language, and social skills (Bulotsky-Shearer et al., 2012; Marcon, 1999; McLoyd, Aikens, & Burton, 2006).

Strengthening Preschool Intervention A few supplementary programs have responded to the need to intensify preschool intervention to augment its impact. One of the most widely implemented is *Head Start REDI-C* (Research-Based Developmentally Informed classroom program), an enrichment curriculum designed for integration into existing Head Start classrooms. Before preschool begins, Head Start teachers—27 percent of whom do not have a bachelor's degree in early childhood education or a related field—take workshops in which they learn research-based strategies for enhancing language, literacy, and social skills. Throughout the school year, they receive one-to-one mentoring from master teachers, aimed at ensuring effective delivery of REDI-C. An additional parent program, REDI-P, provides home visits before and after the transition to kindergarten, during which parents learn how to engage their children in educational games, interactive storybook reading, and guided play and to use positive child-rearing practices.

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This teacher integrates Head Start REDI-C into her preschool classroom. By delivering extra educational enrichment, Head Start REDI yields greater gains in language, literacy, executive function, and social skills than typical Head Start classrooms.

Relative to typical Head Start classrooms, Head Start plus REDI-C yields higher year-end language, literacy, executive function, and social development scores—advantages still evident in third grade (Bierman et al., 2014; Nix et al., 2017; Sasser et al., 2017). REDI-C's powerful impact on teaching quality is believed to be responsible. Teachers trained in REDI-C converse with preschoolers in more cognitively complex ways and more often use management strategies that prevent disruptive behavior (Domitrovich et al., 2009). Combining REDI-P with REDI-C further strengthens academic and social skills gains in the early elementary school years (Bierman et al., 2017).

Children who experience Head Start are less likely later in life to require special education assistance and be involved with the criminal justice system and more likely to be employed, making the program highly cost-effective. Because of limited funding, however, only 46 percent of 3- and 4-year-olds living in poverty attend preschool, with Head Start serving only about half of these children (Friedman-Krauss et al., 2018).

Child Care   As noted in Chapter 6, however, much child care in the United States is substandard. Preschoolers exposed to it, especially for long hours, tend to score lower in cognitive and social skills and higher in teacher-rated behavior problems (Burchinal et al., 2015; NICHD Early Child Care Research Network, 2003b, 2006). Economically advantaged children in substandard care, for example, are especially likely to display externalizing difficulties (anger and aggression) that endure into the school years (Belsky, Vandell, et al., 2007; Huston, Bobbitt, & Bentley, 2015; Vandell et al., 2010). Children from low-income families, however, more often attend better-quality, publicly subsidized nonprofit child-care centers (see page 224 in Chapter 6), which may offset the negative impact of their stressful home lives.

In contrast to poor-quality care, good child care enhances cognitive, language, and social development, particularly for low-SES children—effects that persist into elementary school and, for academic achievement, into adolescence (Burchinal et al., 2015; Dearing, McCartney, & Taylor, 2009; Vandell et al., 2010). Center-based care is more strongly associated with cognitive gains than are other child-care arrangements (Abner et al., 2013). Child-care centers are more likely than family child-care homes to provide a systematic educational program.

LOOK and LISTEN

Arrange to observe at a child-care center and to talk to its director. Jot down signs of quality, referring to Applying What We Know on page 342. How would you rate the center's overall quality?

APPLYING WHAT WE KNOW

Signs of Developmentally Appropriate Early Childhood Programs

PROGRAM CHARACTERISTIC	SIGNS OF QUALITY
Physical setting	Indoor environment is clean, in good repair, and well-ventilated. Classroom space is divided into richly equipped activity areas, including make-believe play, blocks, science, math, games and puzzles, books, art, and music. Fenced outdoor play space is equipped with swings, climbing equipment, tricycles, and sandbox.
Group size	In preschools and child-care centers, group size is no greater than 18 to 20 children with two teachers.
Teacher–child ratio	In preschools and child-care centers, teacher is responsible for no more than 8 to 10 children. In family child-care homes, caregiver is responsible for no more than 6 children.
Daily activities	Children select many of their own activities and learn through experiences relevant to their own lives, mainly in small groups or individually. Teachers facilitate children's involvement, accept individual differences, and adjust expectations to children's developing capacities.
Interactions between adults and children	Teachers move among groups and individuals, asking questions, offering suggestions, and adding more complex ideas. Teachers use positive guidance techniques, such as modeling and encouraging expected behavior and redirecting children to more acceptable activities.
Teacher qualifications	Teachers have college-level specialized preparation in early childhood development, early childhood education, or a related field.
Relationships with parents	Parents are encouraged to observe and participate. Teachers talk frequently with parents about children's behavior and development.
Licensing and accreditation	Preschool and child-care programs are licensed by the state. Voluntary accreditation by the National Association for the Education of Young Children (*www.naeyc.org/academy*) or the National Association for Family Child Care (*www.nafcc.org*) is evidence of an especially high-quality program.

Sources: Copple & Bredekamp, 2009.

Ingredients of high-quality child care include small group size, generous caregiver-child ratios, richly equipped activity areas, and well-educated caregivers. Child care that meets these criteria enhances development, especially for low-SES preschoolers.

Applying What We Know above summarizes characteristics of high-quality early childhood programs, based on standards for developmentally appropriate practice devised by the U.S. National Association for the Education of Young Children. These standards offer a set of worthy goals as the United States strives to upgrade child-care, preschool, and kindergarten services for young children.

9.4.4 Educational Screen Media

Besides home and preschool, young children spend much time in another learning environment: screen media. In the industrialized world, nearly all homes have at least one television set, and most have two or more. Similarly, the overwhelming majority—again, over 90 percent—have access to a computer and one or more mobile devices, usually smartphones but also tablets, with access to the Internet (Rideout, 2018; U.S. Census Bureau, 2018a).

Educational Television and Videos   Sammy's favorite TV program, *Sesame Street,* uses lively visual and sound effects to convey basic literacy and number concepts and presents engaging puppet and human characters to teach general knowledge, emotional and social understanding, and social skills. Today, *Sesame Street* is broadcast in more than 140 countries, making it the most widely viewed children's program in the world (Sesame Workshop, 2018).

Time devoted to watching children's educational programs, including *Sesame Street,* is associated with gains in early literacy and math skills and with academic progress in elementary school (Fisch, 2015; Mares & Pan, 2013). One study reported a link between pre-school viewing of *Sesame Street* (and similar educational programs) and getting higher grades, reading more books, and placing more value on achievement in high school (Anderson et al., 2001).

Children's programs with slow-paced action and easy-to-follow narratives are associated with improved executive function, greater recall of program content, gains in vocabulary and reading skills, and more elaborate make-believe play than programs presenting quick, disconnected bits of information (Lillard & Peterson, 2011; Linebarger & Piotrowski, 2010). Narratively structured educational TV and video ease processing demands, facilitating sustained attention and freeing up space in working memory for applying program content to real-life situations.

Despite the spread of computers and mobile devices, television remains the dominant form of youth media. On average, U.S. 2- to 8-year-olds watch TV programs and videos 1½ hours a day. In addition, the typical child of this age range devotes about one hour to smartphone and tablet use, mostly to view videos, access apps, or play games (Rideout, 2018). Children's time on mobile devices has tripled since 2013 and may soon overtake time devoted to TV.

As Figure 9.13 shows, children from low-income families devote substantially more time to screen media than their higher-income agemates, a difference that has recently widened. It is largely explained by a rise in low-income children's TV viewing; middle-and high-income children's TV viewing has declined in favor of use of mobile devices. On the positive side, preschoolers from low-income families watch as much educational programming on TV as their economically advantaged agemates (Rideout, 2013, 2018). But parents with limited education are more likely to engage in practices that increase TV viewing of all kinds, including leaving the TV on all day and eating family meals in front of it (Masur, Flynn, & Olson, 2015; Rideout, Foehr, & Roberts, 2010).

Over 40 percent of U.S. parents of children age 8 and younger report that the TV is on in their home "most of the time" or "always" (Rideout, 2018). Background TV impairs young children's sustained attention to play activities, reduces quantity and quality of parent–child interaction, and is associated with delayed motor, cognitive, and language development during toddlerhood and early childhood (Courage & Howe, 2010; Lin et al., 2015; Masur, Flynn, & Olson, 2016).

About 30 percent of U.S. preschoolers and school-age children have a TV set in their bedroom, and 16 percent have a mobile device or laptop in their room on "most" nights or "every night." These children spend an estimated 85 additional minutes per day watching programs, usually with no parental restrictions on what they view (Kabali et al., 2015; Rideout, 2018).

Does extensive screen media viewing take children away from worthwhile activities? The more preschool and school-age children watch prime-time shows and cartoons, the weaker their executive function skills, the less time they spend reading and interacting with others, and the poorer their academic skills (Ennemoser & Schneider, 2007; Munzer et al., 2018; Ribner et al., 2017). Whereas educational media experiences can be beneficial, viewing entertainment media—especially heavy viewing—detracts from children's school success and social experiences.

Learning Through Interactive Digital Media   The majority of 2- to 6-year-olds use interactive digital media (requiring an action on the part of the child), doing so more often on mobile devices than computers. Although nearly all young children from higher-income families have access to a computer with a high-speed Internet connection at home, only about 70 percent of those from low-income families do. The family-income gap is also considerable for access to tablets: 85 percent higher-income versus 60 percent low-income (Rideout, 2018).
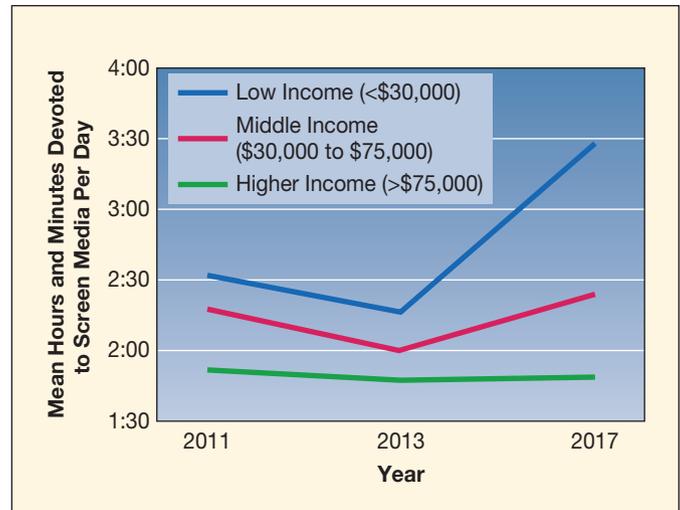

FIGURE 9.13 **Time devoted to screen media per day by children age 8 and younger, by family income.** Surveys of large, representative samples of U.S. parents of children ages 8 and younger in 2011, 2013, and 2017 revealed a recent widening of the family-income difference in screen media use. Compared to children from higher-income families, children from low-income families devoted substantially more time to screen media in 2017—on average, nearly 3½ hours per day. The rise is mostly due to an increase in TV viewing by economically disadvantaged children, who are therefore more susceptible to the detrimental effects of heavy TV use. (From V. Rideout, 2018, *The Common Sense Census: Media Use by Kids Age Zero to Eight,* p. 4. San Francisco: Common Sense Media. Adapted by permission.)

Kindergarten children use a simplified computer language to design a fanciful structure on a tablet. With adult support, programming activities foster many cognitive skills, including reasoning, mathematical and spatial abilities, and creative thinking.

Because interactive media can have rich educational benefits, most early childhood classrooms include learning centers equipped with tablets or computers. As long as adults scaffold children's efforts, well-designed literacy and math apps expand children's general knowledge and enhance diverse language, literacy, and math skills, and their interactivity heightens attention and interest. Tablet-based ebooks are also effective at improving a range of literacy outcomes (Anderson & Subrahmanyam, 2017; Calvert, Strong, & Gallagher, 2005; Neumann & Neumann, 2017; Reich, Yau, & Warschauer, 2016). And kindergartners who use apps to draw or write produce more elaborate pictures and text, make fewer writing errors, and edit their work much as older children do.

Still, in several studies, shared reading of a paper book led to higher-quality parent–child conversation than did shared reading of an ebook. The ebook format resulted in more interaction about the mechanics of using the tablet than about story content, thereby reducing recall of story details (Chiong et al., 2012; Krcmar & Cingel, 2014; Moody, Justice, & Cabell, 2010). Ebooks that are enhanced with too many features, such as animation, music, and hotspots to tap, can also divert children from the text and hinder learning.

Simplified computer languages that can be used to make designs or build structures introduce children as young as kindergarten age to programming skills. With adult support, these activities promote metacognition (awareness of thought processes), reasoning, mathematical and spatial abilities, and creative thinking. To get their programs to work, young programmers must use these skills, which they often transfer to other activities (Scherer, Siddiq, & Viveros, 2019). Furthermore, while programming, children are especially likely to help one another and persist in the face of challenge (Resnick & Silverman, 2005; Tran & Subrahmanyam, 2013).

As with television, children spend much time using interactive digital media for entertainment—especially game playing. Parental reports suggest that about one-third of U.S. preschoolers play electronic games at least occasionally, though typically for just a few minutes per day (Rideout, 2018). As we will see in Chapter 12, playing video games can have cognitive benefits. However, much TV and game media are rife with gender stereotypes and violence, a topic we will consider in the next chapter.

ASK YOURSELF

Connect ■ Explain how guided play is consistent with educational implications of both Piaget's and Vygotsky's theories.

Apply ■ Your senator has heard that IQ and achievement gains resulting from Head Start do not last, so he plans to vote against additional funding. Write a letter explaining why she should support Head Start.

Reflect ■ How much and what kinds of screen media did you engage in as a child? How do you think your home media environment influenced your development?

9.5a Trace the development of vocabulary, grammar, and conversational skills in early childhood.

9.5b Cite factors that support language learning in early childhood.

9.5 Language Development

Language is intimately related to virtually all the cognitive changes discussed in this chapter. Between ages 2 and 6, children make momentous advances in language. Their remarkable achievements, as well as their mistakes along the way, reveal their active, rule-oriented approach to mastering their native tongue.

9.5.1 Vocabulary

At age 2, Sammy had a spoken vocabulary of about 250 words. By age 6, he will comprehend around 10,000 words and produce several thousand (Byrnes & Wasik, 2009). To accomplish this feat, Sammy will learn about five new words each day. How do children build their vocabularies so quickly? Research shows that they can connect new words with their underlying concepts after only a brief encounter, a process called **fast-mapping.** Even toddlers comprehend new labels remarkably quickly, although they need to hear a word used more times than do preschoolers, who process speech-based information faster and are better able to categorize and recall it (Akhtar & Montague, 1999; Brady & Goodman, 2014). Still, fast-mapping does not imply that children immediately acquire adultlike word meanings.

Types of Words   One day, Leslie announced to the children that they would soon take a field trip. That night, Sammy excitedly told his mother, "We're going on a field trip!" When she asked where the class would go, Sammy responded matter-of-factly, "To a field!" Sammy's error suggests that young children fast-map some words more easily than others.

Children in many language communities fast-map labels for objects especially rapidly because these refer to concepts that are easy to perceive (McDonough et al., 2011; Parish-Morris et al., 2010). When adults point to, label, and talk about an object, they help the child figure out and retain the word's meaning. Soon children add verbs *(go, run, broke),* which require understandings of relationships between objects and actions. Preschoolers speaking quite different languages take longer to extend a new verb ("*push* the bike") to other instances of the same action ("*push* the box") than they do to extend a novel noun to other objects in the same category (Imai et al., 2008; Scott & Fisher, 2012). The explanation most often given for this evidence is that learning verbs is more cognitively challenging.

However, children learning Chinese, Japanese, and Korean—languages in which nouns are often omitted from adults' sentences, while verbs are stressed—acquire verbs much sooner (early in the second year) and more readily than their English-speaking agemates (Chan et al., 2011; Tardif, 2006). Besides increased exposure to verbs, Chinese-speaking children hear a greater variety of verbs denoting physical actions, which are visually obvious and therefore easily mastered (Ma et al., 2009). For example, Mandarin Chinese has several verbs for *carry,* each referring to a different way of carrying, such as on one's back, in one's arms, or with one's hands.

These findings suggest that verb meanings might not be inherently harder to learn than noun meanings. In mastering both, young children benefit from multiple examples of the same word used in a consistent manner in different contexts. But in many languages (such as English), nouns are especially frequent in everyday conversation and verbs less so, making verbs seem more difficult to acquire during early vocabulary development (Gogate & Hollich, 2016).

As young children acquire verbs, they also add modifiers *(red, round, sad).* First, they make general distinctions *(big–small),* and then more specific ones *(tall–short, high–low, wide–narrow)* (Stevenson & Pollitt, 1987). During their third year, children of both "noun-friendly" and "verb-friendly" languages become adept learners of a variety of word types.

Strategies for Word Learning   Preschoolers figure out the meanings of words by contrasting them with words they already know and assigning the new label to a gap in their vocabulary. On hearing a new word, 2-year-olds repeat the word or acknowledge it with "yeah" or "uh-huh" in their next verbalization 60 percent of the time (Clark, 2007). This suggests that they assign the word a preliminary meaning and often start to use it right away. Over time, they refine its meaning, striving to match its conventional use in their language community.

When learning a new noun, toddlers and preschoolers acquiring diverse languages tend to assume it refers to an object category at the basic level—an intermediate level of generality (see page 316). This preference helps young children narrow the range of possible meanings. Once they acquire a basic-level name *(dog),* they add names at other hierarchical levels—both more general *(animal)* and more specific *(beagle, greyhound)* (Imai & Haryu, 2004; Waxman & Lidz, 2006).

To engage in effective verbal communication, preschoolers must master and combine principles of word meaning, grammar, and everyday conversation. How they accomplish this feat so rapidly is the focus of intensive research and debate.

How do children discover which concept each word picks out? This process is not yet fully understood. Early in vocabulary growth, children adopt a **mutual exclusivity bias**—the assumption that words refer to entirely separate (nonoverlapping) categories (Markman, 1992). Use of mutual exclusivity to connect new words with objects increases after age 2 (Bion, Borovsky, & Fernald, 2013). Young children are especially likely to use mutual exclusivity when the objects named are perceptually distinct—for example, differ clearly in shape. After hearing the labels for two distinct novel objects (for example, *clip* and *horn*), 2-year-olds assigned each word correctly, to the whole object, not just a part of it (Waxman & Senghas, 1992).

Indeed, children's first several hundred nouns refer mostly to objects well-organized by shape. In a study in which toddlers repeatedly played with and heard names for novel objects of different shapes ("That's a *wif* ") over a nine-week period, they soon formed the generalization that only similar-shaped objects have the same name (Smith et al., 2002; Yoshida & Smith, 2003). Toddlers with this training added more than three times as many object names to their vocabularies outside the laboratory as did untrained controls. Because shape is a perceptual property relevant to most object categories for which they have already learned names, this *shape bias* helps preschoolers master additional names of objects as well as their distinctly shaped features (*blade* of a knife, *branch* of a tree) (Perry, Axelsson, & Horst, 2016; Vlach, 2016). As a result, vocabulary accelerates.

Once the name of a whole object is familiar, on hearing a new name for that object, 2- and 3-year-olds set aside the mutual exclusivity assumption. For example, if the object *(bottle)* has a part that stands out *(spout),* children readily apply the new label to it (Hansen & Markman, 2009). In these instances, mutual exclusivity helps limit the possibilities the child must consider. Still, mutual exclusivity and object shape cannot account for preschoolers' remarkably flexible responses when objects have more than one name.

By age 3, preschoolers' memory, categorization, and language skills have expanded, and they assign multiple labels to many objects. For example, they refer to a sticker of a gray goose as "sticker," "goose," and "gray." To do so, children often call on other aspects of language. According to one proposal, preschoolers discover many word meanings by observing how words are used in syntax, or the structure of sentences—a strategy called **syntactic bootstrapping** (Gleitman et al., 2005; Naigles & Swenson, 2007). Consider an adult who says, "This is a *citron* one," while showing the child a yellow car. Two- and 3-year-olds conclude that a new word used as an adjective for a familiar object (car) refers to a property of that object (Imai & Haryu, 2004). As children hear the word in various sentence structures ("That lemon is bright *citron*"), they use syntactic information to refine the word's meaning.

In addition to information about the meaning of individual words, sentence structure helps children grasp word relationships. For example, on hearing the sentences, "The *cat* drank the *milk*" and "The *dog* drank the *water*," 2½ -year-olds with sufficient grammatical knowledge begin to realize that pairs of words used in the same position—*dog* and *cat, milk* and *water*— have features in common (Wojcik & Saffran, 2015). Preschoolers' capacity to use syntactic cues to discern word meanings predicts vocabulary growth in diverse languages (Abend et al., 2017; McBride-Chang et al., 2008).

Young children also take advantage of rich social information that adults frequently provide, while drawing on their own expanding ability to infer others' intentions, desires, and perspectives. In one study, an adult performed an action on an object and then used a new label while looking back and forth between the child and the object, as if inviting the child to play. Two-year-olds concluded that the label referred to the action, not the object (Tomasello & Akhtar, 1995). Relying on their expanding theory of mind, by age 3 children can even use a speaker's recently expressed desire ("I really want to play with the *riff* ") to figure out a word's meaning (Saylor & Troseth, 2006). And adults often inform children directly about word meanings: "That's not a birdie. It's a seal."

Furthermore, to fill in for words they have not yet learned, children as young as age 3 coin new words using ones they already know—"plant-man" for a gardener, "crayoner" for a child using crayons. Preschoolers also extend language meanings through metaphors based on concrete sensory comparisons: "Clouds are pillows," "Leaves are dancers." Once vocabulary and general knowledge expand, children also appreciate nonsensory comparisons: "Friends are like magnets," "Time flies by" (Özçalişkan, 2005; Pouscoulous, 2014). Metaphors permit young children to communicate in amazingly vivid and memorable ways.

Explaining Vocabulary Development   Children acquire vocabulary so efficiently and accurately that some theorists believe that they are innately biased to induce word meanings using certain principles, such as mutual exclusivity and syntactic bootstrapping (Lidz, Gleitman, & Gleitman, 2004). But critics observe that a small set of built-in, fixed principles cannot account for the varied, flexible manner in which children master vocabulary (Parish-Morris, Golinkoff, & Hirsh-Pasek, 2013). And many word-learning strategies cannot be innate because children acquiring different languages use different approaches to mastering the same meanings.

An alternative view is that vocabulary growth is governed by the same cognitive strategies that children apply to nonlinguistic information. In one account, children draw on a *coalition* of cues—perceptual, social, and linguistic—which shift in importance with age (Golinkoff & Hirsh-Pasek, 2006, 2008). Infants rely solely on perceptual features. Toddlers and young preschoolers, while still sensitive to perceptual features (such as object shape and physical action), increasingly attend to social cues—the speaker's direction of gaze, gestures, and expressions of intention and desire (Hollich, Hirsh-Pasek, & Golinkoff, 2000; Pruden et al., 2006). And as language develops further, linguistic cues—sentence structure and intonation (stress, pitch, and loudness)—play larger roles.

Preschoolers are most successful at figuring out new word meanings when several kinds of information are available (Parish-Morris, Golinkoff, & Hirsh-Pasek, 2013). Researchers have just begun to study the multiple cues that children use for different kinds of words and how their combined strategies change with development.

As this child observes her father creating a sculpture, she attends to a variety of perceptual, social, and linguistic cues to grasp the meanings of unfamiliar words, such as *plaster, statue, base, form, sculpt, mold*, and *studio*.

9.5.2 Grammar

Between ages 2 and 3, English-speaking children use simple sentences that follow a basic subject–verb–object word order. Children learning other languages adopt the word orders of the adult speech to which they are exposed.

Basic Rules   Toddlers' greater looking times at scenes that match sentences they hear reveal that they comprehend the meaning of basic grammatical structures that they cannot yet produce, such as "Big Bird is tickling Cookie Monster" or "What did the ball hit?" (Seidl, Hollich, & Jusczyk, 2003). First use of grammatical rules, however, is piecemeal—limited to just a few verbs. As children listen for familiar verbs in adults' speech, they expand their own utterances containing those verbs, relying on adult speech as their model (Gathercole, Sebastián, & Soto, 1999). Sammy, for example, added the preposition *with* to the verb *open* ("You open with scissors") because he often heard his parents say "open with." But he failed to add *with* to the verb *hit* ("He hit me stick").

To test preschoolers' ability to generate novel sentences that conform to basic English grammar, researchers had them use a new verb in the subject–verb–object form after hearing it in a different construction, such as passive: "Ernie is getting *gorped* by the dog." When children were asked what the dog was doing, the percentage who could respond, "He's *gorping* Ernie," rose steadily with age. But not until age 3½ to 4 could the majority of children apply the fundamental subject–verb–object structure broadly, to newly acquired verbs (Chan et al., 2010; Tomasello, 2003, 2006).

Once children form three-word sentences, they make small additions and changes in words that enable speakers to express meanings flexibly and efficiently. For example, they add -*ing* for ongoing actions *(playing),* add -*s* for plural *(cats),* use prepositions *(in* and *on),* and form various tenses of the verb *to be (is, are, were, has been, will).* English-speaking children master these grammatical markers in a regular sequence, from the simplest meanings and structures *(-ing, in* and *on, -s)* to the most complex (tenses of the verb *to be*) (Brown, 1973). As with basic word order, comprehension of these small units proceeds ahead of production (Soderstrom, 2008; Wood, Kouider, & Carey, 2009). Even 1½- to 2-year-olds can discriminate an adult's correct from incorrect application of the plural -*s* months in advance of using it themselves.

When preschoolers acquire these markers, they sometimes overextend the rules to words that are exceptions, a type of error called **overregularization.** "We each got two *foots*" and "My toy car *breaked*" are expressions that appear between ages 2 and 3 and persist into middle childhood (Maratsos, 2000). Children less often make this error on frequently used irregular verbs, such as the past tense of *go (went)* and *say (said),* which they hear often enough to learn by rote. For rarely used verbs, such as *grow* and *sing,* children alternate for months—or even several years—between overregularized forms *(growed, singed)* and correct forms, until the irregular form eventually wins out. Overregularization provides evidence that children apply grammatical rules creatively.

Complex Structures   Gradually, preschoolers master more complex grammatical structures, although they do make mistakes. Question asking remains variable for several years. An analysis of one child's questions revealed that he inverted the subject and verb when asking certain questions ("What she will do?" "Why he can go?") but not others. The correct expressions were the ones he heard most often in his mother's speech (Rowland & Pine, 2000). And sometimes children produce errors in subject–verb agreement ("Where does the dogs play?") and subject case ("Where can me sit?") (Rowland, 2007).

Similarly, children have trouble with some passive sentences. When told, "The car is pushed by the truck," young preschoolers often make a toy car push a truck. By age 4½, they understand such expressions, whether they contain familiar or novel verbs (Dittmar et al., 2014). But full mastery of the passive form is not complete until the end of middle childhood.

Nevertheless, preschoolers' grasp of language structures is remarkable. By age 4 to 5, they form embedded sentences ("I think *he will come*"), tag questions ("Dad's going to be home soon, *isn't he?*"), and indirect objects ("He showed *his friend* the present") (Zukowski, 2013). As the preschool years draw to a close, children use most of the grammatical constructions of their language competently.

Explaining Grammatical Development   Evidence that grammatical development is an extended process has raised questions about Chomsky's *language acquisition device* (LAD), which assumes that children have innate knowledge of grammatical rules (see page 227 in Chapter 6). Some experts believe that grammar is a product of general cognitive development—children's tendency to search the environment for consistencies and patterns of all sorts (Bloom, 1999; Chang, Dell, & Bock, 2006; Tomasello, 2011). Over time, they group words into grammatical categories and use them appropriately in sentences. Yet among these theorists, debate continues over just how children master grammar.

According to one view, young children rely on *semantics,* or word meanings, to figure out grammatical rules—an approach called **semantic bootstrapping.** For example, children might begin by grouping together words with "agent qualities" (things that cause actions) as subjects and words with "action qualities" as verbs. Then they merge these categories with observations of how words are used in sentences (Bates & MacWhinney, 1987; Braine, 1994).

Others believe that children master grammar through direct observation of the structure of language: These *information-processing theorists* propose that children notice which words appear in the same positions in sentences and are combined in the same way with other words (Howell & Becker, 2013; MacWhinney, 2015; Tomasello, 2011). Over time, they group words into grammatical categories and use them appropriately in sentences (Bannard, Lieven, & Tomasello, 2009; Chang, Dell, & Bock, 2006).

Still other theorists agree with the essence of Chomsky's theory. One idea accepts semantic bootstrapping but proposes that the grammatical categories into which children group word meanings are innate—present at the outset (Pinker, 1999; Tien, 2013). Critics, however, point out that toddlers' two-word utterances do not reflect a flexible grasp of grammar and that preschoolers make many errors in their gradual mastery of grammar. In sum, controversy persists over whether a universal, built-in language-processing device exists or whether children draw on general cognitive-processing procedures, devising unique strategies adapted to the specific language they hear.

9.5.3 Conversation

Besides acquiring vocabulary and grammar, children must learn to engage in effective and appropriate communication—by taking turns, staying on the same topic, stating their messages clearly, and conforming to cultural rules for social interaction. This practical, social side of language is called **pragmatics,** and preschoolers make considerable headway in mastering it.

As early as age 2, children are skilled conversationalists. In face-to-face interaction, they take turns and respond appropriately to their partner's remarks, adding new information. With age, the number of turns over which children can sustain interaction and their ability to respond in a timely fashion, maintain a topic over a sequence of turns, and answer requests for clarification increase (Casillas, 2014; Clark, 2014). By age 3, children can infer a speaker's intention when the speaker expresses it indirectly. For example, most know that an adult who responds to an offer of cereal by saying, "We have no milk," is declining the cereal (Schulze, Grassmann, & Tomasello, 2013). These surprisingly advanced abilities grow out of early interactive experiences with parents and other adults (Callanan & Siegel, 2014; Filipi, 2014).

The presence of a sibling also seems conducive to acquiring the pragmatics of language. Preschoolers closely monitor conversations between their twin or older siblings and parents, and they often try to join in. When they do, these verbal exchanges last longer, with each participant taking more turns (Barton & Strosberg, 1997; Barton & Tomasello, 1991). As they listen to these conversations, young language learners pick up important skills, such as use of personal pronouns (*I* versus *you*), which are more common in the early vocabularies of later-born than of firstborn siblings (Pine, 1995). Furthermore, older siblings' remarks to a younger brother or sister often focus on regulating interaction: "Do you like Kermit?" "OK, your turn" (Oshima-Takane & Robbins, 2003). This emphasis probably contributes to younger siblings' conversational skills.

These preschoolers likely use more assertive language when speaking for a male puppet than they would if speaking for a female puppet. In doing so, they reveal their early grasp of stereotypic features of social roles.

By age 4, children adjust their speech to fit the age, gender, and social status of their listeners. For example, in acting out roles with hand puppets, they show that they understand the stereotypic features of different social positions. They use more commands when playing socially dominant and male roles (teacher, doctor, father) but speak more politely and use more indirect requests when playing less dominant and female roles (student, patient, mother) (Andersen, 2000).

Preschoolers' conversational skills occasionally do break down—for example, when talking on the phone. Here is an excerpt from one 4-year-old's phone conversation with his grandfather:

Grandfather: "How old will you be?"
John: "Dis many." *[Holding up four fingers.]*
Grandfather: "Huh?"
John: "Dis many." *[Again holding up four fingers.]* (Warren & Tate, 1992, pp. 259–260)

Young children's conversations appear less mature in highly demanding situations in which they cannot see their listeners' reactions or rely on typical conversational aids, such as gestures

and objects to talk about. But when asked to tell a listener how to solve a simple puzzle, 3- to 6-year-olds give more specific directions over the phone than in person, indicating that they realize that more verbal description is necessary on the phone (Cameron & Lee, 1997). Between ages 4 and 8, both conversing and giving directions over the phone improve greatly.

9.5.4 Supporting Language Learning in Early Childhood

How can adults foster preschoolers' language development? As in toddlerhood, interaction with more skilled speakers remains vital in early childhood. Conversational give-and-take with adults, either at home or in preschool, is consistently related to language progress (Justice, Jiang, & Strasser, 2018; Weisleder & Fernald, 2013). In one investigation, the more conversational turns with adults 4- to 6-year-olds' experienced during storybook reading at home, the greater the activation of Broca's area in the left frontal cortex (which supports grammatical processing and word production), as measured by fMRI. Increased activation of Broca's area, in turn, predicted more advanced language skills, even after SES and IQ were controlled (Romeo et al., 2018). Enhanced brain functioning appears to play an important role in the association between adult–child conversation and language progress in early childhood.

Sensitive, caring adults use additional techniques that promote language skills. When children use words incorrectly or communicate unclearly, they give helpful, direct feedback: "I can't tell which ball you want. Do you mean a large or small one or a red or green one?" But they do not overcorrect, especially when children make grammatical mistakes. Criticism discourages children from freely using language in ways that lead to new skills.

Instead, adults often provide indirect feedback about grammar by using two strategies, often in combination: **recasts**—restructuring inaccurate speech into correct form, and **expansions**—elaborating on children's speech, increasing its complexity (Bohannon & Stanowicz, 1988; Chouinard & Clark, 2003). For example, if a child says, "I gotted new red shoes," the parent might respond, "Yes, you got a pair of new red shoes." After such corrective input, young children often shift to correct forms (Cleave et al., 2015; Saxton, Backley, & Gallaway, 2005). However, these techniques are not used in all cultures, and in some investigations they had no impact on children's grammar. Rather than eliminating errors, perhaps expansions and recasts model grammatical alternatives and encourage children to experiment with them.

Do the findings just described remind you once again of Vygotsky's theory? In language, as in other aspects of cognitive development, parents and teachers gently prompt young children to take the next developmental step forward. Children strive to master language because they want to connect with other people. Adults, in turn, respond to children's desire to become competent speakers by listening attentively, elaborating on what children say, modeling correct usage, and stimulating children to talk further. In the next chapter, we will see that this combination of warmth and encouragement of mature behavior is at the heart of early childhood emotional and social development as well.

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Adults can support preschoolers' grammatical learning through indirect feedback, including recasts and expansions, which model grammatical alternatives to incorrect constructions.

LOOK and LISTEN

Observe a parent conversing with a 2- or 3-year-old child during play or picture-book reading. List examples of how the parent promotes the child's vocabulary, grammar, and pragmatic skills.

ASK YOURSELF

Connect ■ Explain how children's strategies for word learning support the interactionist perspective on language development, described on page 230 in Chapter 6.

Apply ■ Sammy's mother explained to him that the family would take a vacation in Miami. The next morning, Sammy announced, "I gotted my bags packed. When are we going to Your-ami?" What explains Sammy's errors?

S U M M A R Y

9.1 Piaget's Theory: The Preoperational Stage (p. 307)

9.1a *Describe advances in mental representation, and limitations of thinking, during the preoperational stage.*

- Rapid advances in mental representation, notably language and make-believe play, mark the beginning of Piaget's **preoperational stage.** With age, make-believe becomes increasingly complex and flexibly symbolic, evident in **sociodramatic play** with peers. Although critics question the certainty of the evidence, many studies suggest that make-believe supports diverse aspects of cognitive and social development.

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- **Dual representation** improves rapidly over the third year of life as children realize that models, drawings, and simple maps correspond to circumstances in the real world.
- Aside from representation, Piaget described preschoolers in terms of deficits rather than strengths. Because **egocentrism** prevents them from reflecting on their own thinking and accommodating, it contributes to animistic thinking, **centration,** and **irreversibility.** These difficulties cause preschoolers to fail **conservation** and **hierarchical classification** tasks.

9.1b *Explain the implications of follow-up research on early childhood cognitive development for the accuracy of Piaget's preoperational stage.*

- When young children are given simplified tasks relevant to their experiences, their performance appears more mature than Piaget assumed. Preschoolers recognize differing perspectives, distinguish animate from inanimate objects, have flexible and appropriate notions of magic, and notice and reason about transformations and cause-and-effect relations. They also show impressive skill at flexibly categorizing on the basis of both perceptually apparent and non-observable characteristics.

- These findings indicate that logical operations develop gradually rather than abruptly, suggesting a less strictly defined preoperational stage than Piaget assumed.
- Combining gestures with speech during problem solving facilitates learning.

9.1c *Describe educational principles that can be derived from Piaget's theory.*

- A Piagetian classroom promotes discovery learning, sensitivity to children's readiness to learn, and acceptance of individual differences.

9.2 Vygotsky's Sociocultural Theory (p. 318)

9.2a *Describe Vygotsky's perspective on the social origins and developmental significance of children's private speech.*

- Unlike Piaget, Vygotsky regarded language as the foundation for all higher cognitive processes. **Private speech** emerges out of social communication as adults and more skilled peers help children master challenging tasks within the zone of proximal development. Children use private speech for self-guidance, eventually internalizing it as silent, inner speech.
- **Intersubjectivity** and **scaffolding** are two features of social interaction that promote cognitive development in children.

9.2b *Describe applications of Vygotsky's theory to education, and evaluate his major ideas.*

- A Vygotskian classroom emphasizes assisted discovery, in which both teacher guidance and peer collaboration are vitally important. Make-believe play is a unique, broadly influential zone of proximal development in early childhood.

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- Vygotsky's theory helps us understand the wide cultural variation in cognitive skills. In some cultures, verbal communication is not the only means—or even the most important means—through which children learn.

9.3 Information Processing (p. 323)

9.3a *Describe changes in executive function and memory during early childhood.*

- Children show impressive gains in executive function during the preschool years. They gain steadily in inhibition, flexible shifting of attention, and working-memory capacity, which contribute vitally to cognitive and social skills. Older preschoolers also improve in **planning,** a complex executive function activity.
- Parental sensitivity, encouragement, and scaffolding foster preschoolers' performance on executive function tasks, whereas conditions common in low-SES homes compromise development of executive function. Poverty exerts an especially negative impact through maladaptive parenting and chronic stress.

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- Young children's recognition memory is remarkably accurate. But their recall of listlike information is poor because they use **memory strategies** less effectively than older children.
- **Episodic memory,** or memory for everyday experiences, improves greatly in early childhood, supported by improvements in memory for contextual relations among stimuli. Like adults, preschoolers remember recurring events as **scripts,** which become more elaborate with age.
- As cognitive and conversational skills improve, children's autobiographical memories become more organized, detailed, and related to the larger context of their lives, especially when adults use an elaborative style to talk about the past.

- According to **overlapping-waves theory,** children try out various strategies to solve challenging problems, gradually selecting those that result in rapid, accurate solutions.

9.3b *Describe the young child's theory of mind.*

- Preschoolers begin to construct a theory of mind, indicating that they are capable of **metacognition,** or thinking about thought. Their performance on verbal false belief tasks indicates that from age 4 on, they realize that beliefs as well as desires can influence behavior. False-belief understanding enhances children's capacity to reflect on the thoughts and emotions of themselves and others.

- Language, executive function, make-believe play, and mental-state talk with adults, older siblings, and friends contribute to young children's awareness of false belief and other mental-state understandings.

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- Preschoolers regard the mind as a passive container of information. As a result, they have difficulty inferring what people know or are thinking about.

- Children with autism are impaired in theory of mind, including mastery of false belief.

9.3c *Summarize children's literacy and mathematical knowledge during early childhood.*

- Young children's **emergent literacy** reveals that they revise incorrect ideas about the meaning of written language as their perceptual and cognitive capacities improve, as they encounter writing in many contexts, and as adults help them with written information.

- **Phonological awareness** is a strong predictor of emergent literacy and later reading and spelling achievement. Preschoolers' vocabulary, grammatical knowledge, and narrative competence are also influential. Informal literacy experiences, including adult–child interactive storybook reading, foster literacy development.

- Toddlers' beginning grasp of **ordinality** serves as the basis for early childhood mathematical understandings. By age 3½ to 4, preschoolers grasp the principle of **cardinality,** which spurs the development of crucial numerical knowledge and skills. When adults provide many occasions for counting and comparing quantities, children grasp number concepts sooner.

- High-quality intervention can reduce the gap between preschoolers from low-SES and high-SES families in both early literacy and mathematical development.

9.4 Individual Differences in Mental Development (p. 336)

9.4 *Describe early childhood intelligence tests and the impact of home, preschool and kindergarten programs, child care, and educational media on mental development.*

- Although intelligence test scores are affected by cultural and situational factors, by age 6 to 7 they are nevertheless good predictors of later IQ and academic achievement.

- A warm, stimulating home and parental reasonable demands for mature behavior promote children's intellectual development.

- Preschools and kindergartens range along a continuum from **child-centered programs** to **academic programs.** Emphasizing formal academic training undermines children's motivation and negatively influences later achievement.

- **Guided play** classrooms seek a middle ground between child-centered and academic programs. Montessori education is another approach that combines child autonomy with focused learning through specially designed teaching materials.

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- **Project Head Start** is the most extensive federally funded preschool program for low-income children in the United States. High-quality preschool intervention results in immediate IQ and achievement gains and long-term improvements in school adjustment, educational attainment, and life success. Parental involvement in Head Start, and the implementation of Head Start REDI-C and REDI-P yield higher academic, language, and social skills.

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- Poor-quality child care undermines preschoolers' cognitive and social skills. In contrast, good child care enhances cognitive, language, and social development, especially for low-SES children.

- Children's educational TV programs and videos are associated with improved executive function and academic gains. However, the more preschool and school-age children watch prime-time TV and cartoons, the less time they spend reading and interacting with others and the poorer their academic skills.

- As long as adults scaffold children's efforts, well-designed interactive media, including literacy and math apps, tablet-based ebooks, and simplified computer programming languages, can have rich educational benefits.

9.5 Language Development (p. 344)

9.5a *Trace the development of vocabulary, grammar, and conversational skills in early childhood.*

- Supported by **fast-mapping,** preschoolers' vocabularies increase dramatically. Children learning many languages (including English) fast-map nouns more rapidly than verbs. But in languages in which verbs are stressed (such as Chinese, Japanese, and Korean), children acquire verbs earlier and more readily than their English-speaking counterparts.

■ Early in vocabulary development, children induce word meanings using a **mutual exclusivity bias.** In **syntactic bootstrapping,** they observe how words are used in the structure of sentences to figure out their meanings.

■ Some researchers believe that children are innately biased to use these principles. Another view is that children use the same cognitive strategies to acquire vocabulary that they apply to nonlinguistic information. In one account, preschoolers draw on a coalition of cues— perceptual, social, and linguistic—which shift in importance with age.

■ Between ages 2 and 3, children adopt the basic word order of their language. As they gradually master grammatical rules, they sometimes overextend them in an error called **overregularization.** By the end of the preschool years, children have acquired complex grammatical forms.

■ According to one view, children engage in **semantic bootstrapping,** relying on word meanings to figure out grammatical rules. Alternatively, information-processing theorists propose that children master grammar through direct observation of the structure of language. Still others agree with the essence of Chomsky's theory that children's brains are innately tuned for acquiring grammar.

■ **Pragmatics** refers to the practical, social side of language. In face-to-face interaction with peers, young preschoolers are already skilled conversationalists. By age 4, they adapt their language to social expectations.

9.5b *Cite factors that support language learning in early childhood.*

■ Conversational give-and-take with more skilled speakers activates Broca's area and fosters preschoolers' language progress. Adults provide direct feedback on the clarity of children's utterances. With respect to grammar, they often give indirect feedback through **recasts** and **expansions.**

IMPORTANT TERMS AND CONCEPTS

academic programs (p. 338)
cardinality (p. 334)
centration (p. 311)
child-centered programs (p. 337)
conservation (p. 311)
dual representation (p. 310)
egocentrism (p. 311)
emergent literacy (p. 333)
episodic memory (p. 326)
expansions (p. 350)
fast-mapping (p. 345)
guided play (p. 339)

hierarchical classification (p. 312)
intersubjectivity (p. 320)
irreversibility (p. 312)
memory strategies (p. 326)
metacognition (p. 329)
mutual exclusivity bias (p. 346)
ordinality (p. 334)
overlapping-waves theory (p. 328)
overregularization (p. 348)
phonological awareness (p. 333)
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sociodramatic play (p. 308)
syntactic bootstrapping (p. 346)